Technician License Class

1

Technician Class

Chapter 8

Operating Regulations

2

Control Operators

Control Operator

- The individual designated as responsible for the proper operation of the station is called the *control operator*.
- The control operator is designated by the station licensee.
- The control operator is assumed to be the station licensee unless the station records indicate otherwise.

3

Control Operators

Control Operator

- The control operator must hold an amateur radio license issued by the FCC or be an alien with reciprocal operating authority.
- **ALL** transmissions must be made under the control of a control operator.

4

Control Operators

Control Point.

- The location where the control operator function is performed is called the *control point*.
  - The control point does not have to be where the transmitter is located.
  - The control operator does not have to be at the control point.

5

T1E01 -- When may an amateur station transmit without a control operator?

A. When using automatic control, such as in the case of a repeater
B. When the station licensee is away and another licensed amateur is using the station
C. When the transmitting station is an auxiliary station
D. Never

6

T1E03 -- Who must designate the station control operator?

A. The station licensee
B. The FCC
C. The frequency coordinator
D. Any licensed operator

7

T1E05 -- What is an amateur station's control point?

A. The location of the station's transmitting antenna
B. The location of the station transmitting apparatus
C. The location at which the control operator function is performed
D. The mailing address of the station licensee

8

Control Operators

Privileges and Guest Operating.

- You may allow any amateur radio operator to operate your station, whether you are present or not.
  - Both the station owner and the control operator are responsible for the proper operation of the station.

9

Control Operators

Privileges and Guest Operating.

- A station can only be operated within the privileges available to the class of license held by the control operator regardless of the license class of the station licensee.

10

Identification

Miscellaneous Identification Rules.

- Guest operating.
  - If the control operator's privileges exceed those of the station licensee, special identification rules apply.
    - e.g. -- If K9DUR (Amateur Extra) is operating K9JMA's (General) station in a portion of the band restricted to Amateur Extra class or Advanced class licensees, he must identify as:
      - K9JMA/K9DUR.

11

Control Operators

Privileges and Guest Operating.

- An unlicensed individual may operate an amateur radio station, **PROVIDED** a properly licensed control operator is present and supervising the operation.

12

T1E04 -- What determines the transmitting frequency privileges of an amateur station?

A. The frequency authorized by the frequency coordinator
B. The frequencies printed on the license grant
C. The highest class of operator license held by anyone on the premises
D. The class of operator license held by the control operator

13

T1E06 -- When, under normal circumstances, may a Technician class licensee be the control operator of a station operating in an Amateur Extra Class band segment?

A. At no time
B. When designated as the control operator by an Amateur Extra Class licensee
C. As part of a multi-operator contest team
D. When using a club station whose trustee holds an Amateur Extra Class license

14

T1E07 -- When the control operator is not the station licensee, who is responsible for the proper operation of the station?

A. All licensed amateurs who are present at the operation
B. Only the station licensee
C. Only the control operator
D. The control operator and the station licensee are equally responsible

15

T1E11 -- Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records?

A. The station custodian
B. The third party participant
C. The person operating the station equipment
D. The station licensee

16

Identification

Normal Identification.

- With only two exceptions, **ALL** amateur radio transmissions must be identified with the station call sign.
  - Space stations.
    - Satellites.
  - Telecommand stations.
    - Stations controlling a model craft.

17

Identification

Normal Identification.

- You must transmit your call sign at the end of every contact.
- You must transmit your call sign every 10 minutes during contacts lasting more than 10 minutes.

18

Identification

Normal Identification.

- It is not required to say your call sign at the beginning of a contact.
  - But most people do.
- It is not required to say the other station's call sign.
  - But most people do.
  - **EXCEPTION:** You must transmit the other station's call sign when passing international third-party traffic.

19

Identification

Miscellaneous Identification Rules.

- The two exceptions to the identification requirement are:
  - Space stations.
    - Amateur radio satellites.
    - International Space Station.
      - NA1SS.
  - Telecommand (remote control) of model craft.
    - Must affix label to transmitter.
      - Station call sign.
      - Station licensee's name & address.

20

Identification

Normal Identification.

- Spoken identification must be in the English language.
- When identifying by voice, the use of a standard phonetic alphabet is encouraged.
  - International Radiotelephony Spelling Alphabet.
    - a.k.a – ITU phonetic alphabet, ICAO phonetic alphabet, NATO phonetic alphabet, & military phonetic alphabet.
- Identification may be made in any mode authorized on the frequency being used.

21

T1A03 -- What do the FCC rules state regarding the use of a phonetic alphabet for station identification in the Amateur Radio Service?

A. It is required when transmitting emergency messages
B. It is encouraged
C. It is required when in contact with foreign stations
D. All these choices are correct

22

T1D11 -- When may an amateur station transmit without identifying on the air?

A. When the transmissions are of a brief nature to make station adjustments
B. When the transmissions are unmodulated
C. When the transmitted power level is below 1 watt
D. When transmitting signals to control model craft

23

T1F03 -- When are you required to transmit your assigned call sign?

A. At the beginning of each contact, and every 10 minutes thereafter
B. At least once during each transmission
C. At least every 15 minutes during and at the end of a communication
D. At least every 10 minutes during and at the end of a communication

24

T1F04 -- What language may you use for identification when operating in a phone sub-band?

A. Any language recognized by the United Nations
B. Any language recognized by the ITU
C. English
D. English, French, or Spanish

25

T1F05 -- What method of call sign identification is required for a station transmitting phone signals?

A. Send the call sign followed by the indicator RPT
B. Send the call sign using a CW or phone emission
C. Send the call sign followed by the indicator R
D. Send the call sign using only a phone emission

26

Identification

Normal Identification.

- Tactical calls.
  - Tactical call signs are sometimes used to help identify where a station is or what function they are performing during a public service operation or exercise.
    - e.g. – Shelter 1, Command Post, etc.
    - Tactical call signs are helpful when operators change at assigned locations.
  - Tactical calls **DO NOT** replace normal identification.
    - You still must transmit the FCC-assigned call sign every 10 minutes and at the end of every conversation.

27

T1F02 -- How often must you identify with your FCC-assigned call sign when using tactical call signs such as "Race Headquarters"?

A. Never, the tactical call is sufficient
B. Once during every hour
C. At the end of each communication and every ten minutes during a communication
D. At the end of every transmission

28

Identification

Normal Identification.

- Self-assigned indicators.
  - An amateur operator may add a self-assigned indicator before or after their call sign.
  - The self-assigned indicator must be separated from the call sign by the slant bar (“/”) or any suitable word denoting the slant bar.
    - e.g. – K9DUR/QRP.

29

Identification

Normal Identification.

- Self-assigned indicators.
  - The self-assigned indicator must **NOT** be a prefix assigned to another country.
    - e.g. – Cannot use K9DUR/M or K9DUR/VE.
  - Must **NOT** be an indicator otherwise specified in the FCC rules.
    - e.g. – Cannot use /KT, /AG, or /AE.

30

Identification

Normal Identification.

- Upgrade indicators.
  - When you upgrade your license, you may begin using your new privileges immediately.
  - When using your new privileges before the FCC database shows the upgrade, you must add an indicator after your call to signify the upgrade.
    - /KT for upgrade to Technician.
    - /AG for upgrade to General.
    - /AE for upgrade to Amateur Extra.

31

T1F06 -- Which of the following self-assigned indicators are acceptable when using a phone transmission?

A. KL7CC stroke W3
B. KL7CC slant W3
C. KL7CC slash W3
D. All these choices are correct

32

Identification

Normal Identification.

- Test transmissions.
  - Must be identified just like any other transmission.
  - Should be brief to avoid unnecessary interference.
    - Voice: "Testing this is K9DUR".
    - CW: "VVV VVV VVV DE K9DUR".
    - RTTY: "RYRYRYRYRYRYRYRYRYRY DE K9DUR".

33

T2A06 -- Which of the following is required when making on-the-air test transmissions?

A. Identify the transmitting station
B. Conduct tests only between 10 p.m. and 6 a.m. local time
C. Notify the FCC of the transmissions
D. All these choices are correct

34

Identification

Miscellaneous Identification Rules.

- Automatic Identification.
  - Stations operating under automatic control must also identify every 10 minutes.
    - Voice.
    - CW (not to exceed 20 wpm).
    - Image (if retransmitting video).

35

Identification

Miscellaneous Identification Rules.

- Special event stations.
  - The special event call sign is used for each contact.
  - The call sign of the individual or club who arranged for the special event call sign must be transmitted at least once every hour.

36

Inteference

Types of Interference.

- Radio signals can be interfered with by:
  - Noise (QRN).
    - Natural interference (thunderstorms).
    - Man-made noise (appliances and power lines).
  - Signals (QRM).
    - Interference from nearby stations.
    - Other hams or other users of the frequencies.
      - Operators should avoid interfering with other users of the frequencies.

37

Inteference

Avoiding Interference.

- Use common sense and courtesy.
  - Not all interference is intentional.
- Keep equipment in proper operating order.
- No one owns a frequency; be a good neighbor and share.
  - Move to another frequency to avoid interfering with other communications in progress.

38

Inteference

Avoiding Interference.

- Yield to special operations and special circumstances.
- Radionavigation Service is **ALWAYS** protected from interference from amateur radio stations.

39

Inteference

Harmful and Willful Interference.

- Harmful interference.
  - Interference that is disruptive to other communications.
  - Deal with it as best you can and help others to avoid harmful interference.
- Willful interference
  - Intentionally causing interference to other communications.
  - This is a legal and enforcement issue.

40

T1A11 -- When is willful interference to other amateur radio stations permitted?

A. To stop another amateur station that is breaking the FCC rules
B. At no time
C. When making short test transmissions
D. At any time, stations in the Amateur Radio Service are not protected from willful interference

41

T2B08 -- Which of the following applies when two stations transmitting on the same frequency interfere with each other?

A. The stations should negotiate continued use of the frequency
B. Both stations should choose another frequency to avoid conflict
C. Interference is inevitable, so no action is required
D. Use subaudible tones so both stations can share the frequency

42

Third-Party Communications

Definitions and Rules.

- Third-party communications are messages sent between two amateur radio stations to be delivered to a third person.
  - If the person receiving the message is a licensed amateur radio operator and is authorized to be the control operator of either station, it is **NOT** third-party communications.
- The third party need not be present at either station.

43

Third-Party Communications

Definitions and Rules.

- The message need not be written. It may be verbal, data, or images.
- The third party may participate in sending or receiving the message.
  - e.g. - An unlicensed person speaking into the microphone of an amateur radio station.
- The third party may be an organization.
  - e.g. – Church, school, club, Red Cross, EMA, etc.

44

Third-Party Communications

Definitions and Rules.

- Within the US, third-party communications are only restricted to the extent that they must be non-commercial and of a personal nature.
- International third-party communications are more restricted.
  - Restricted to countries that specifically allow third-party communications with the US.

45

Third-Party Communications

Definitions and Rules.

- In Summary:
  - A message to or from a licensed amateur radio operator is **NOT** third-party communications.
  - Allowing a non-licensed individual to speak on the microphone of your station **IS** third-party communications.
  - If a DX station asks you to pass a message to a family member in your state, there **MUST** be a third-party agreement with his country.

46

T1F07 -- Which of the following restrictions apply when a non-licensed person is allowed to speak to a foreign station using a station under the control of a licensed amateur operator?

A. The person must be a U.S. citizen
B. The foreign station must be in a country with which the U.S. has a third party agreement
C. The licensed control operator must do the station identification
D. All these choices are correct

47

T1F08 -- What is the definition of third party communications?

A. A message from a control operator to another amateur station control operator on behalf of another person
B. Amateur radio communications where three stations are in communications with one another
C. Operation when the transmitting equipment is licensed to a person other than the control operator
D. Temporary authorization for an unlicensed person to transmit on the amateur bands for technical experiments

48

Remote and Automatic Operation

Definitions.

- An amateur radio station may be operated with 3 different types of control:
  - Local Control.
  - Remote Control.
  - Automatic Control.

49

Remote and Automatic Operation

Definitions.

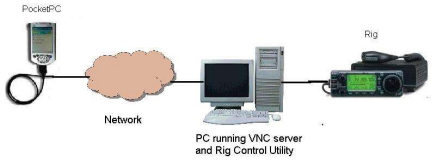
- Local control.
  - The control operator is physically at the station.
  - The operator is directly manipulating the controls.
  - The most common type of operation.

50

Remote and Automatic Operation

Definitions.

- Remote operation.
  - The control operator is physically at the control point.
  - The control point is not at the station location.
  - The control operator is indirectly manipulating the controls via a control link.
    - Radio.
    - Wire.
    - Ethernet (LAN).
    - Internet (WAN).

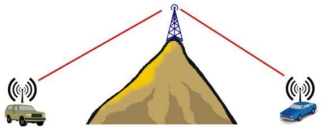


51

Remote and Automatic Operation

Definitions.

- Automatic operation.
  - The control operator is not physically at a control point.
  - The station is completely under the control of devices which assure compliance with FCC rules.

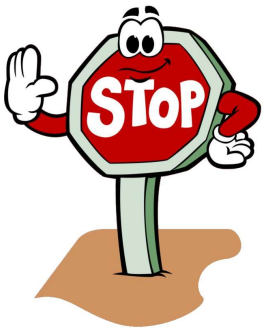


52

Remote and Automatic Operation

Definitions.

- If a station is being operated using either **remote control** or **automatic control**, the station **MUST** include a provision to limit the length of a transmission to no more than 3 minutes in case the control link fails.



53

T1E08 -- Which of the following is an example of automatic control?

A. Repeater operation
B. Controlling the station over the internet
C. Using a computer or other device to send CW automatically
D. Using a computer or other device to identify automatically

54

T1E09 -- Which of the following are required for remote control operation?

A. The control operator must be at the control point
B. A control operator is required at all times
C. The control operator must indirectly manipulate the controls
D. All these choices are correct

55

T1E10 -- Which of the following is an example of remote control as defined in Part 97?

A. Repeater operation
B. Operating the station over the internet
C. Controlling a model aircraft, boat, or car by amateur radio
D. All of these choices are correct

56

Remote and Automatic Operation

Responsibilities.

- Regardless of type of control, station must be operated in accordance with FCC rules.
  - Repeaters under automatic control must have devices and procedures in place to ensure compliance.
    - If a violation occurs, the repeater may be required to use remote control with a control operator on duty at a control point.

57

Remote and Automatic Operation

Responsibilities.

- Stations operating under automatic control may not transmit third-party traffic.
  - Exception: Digital message forwarding systems.

58

Remote and Automatic Operation

Responsibilities.

- If a repeater inadvertently retransmits communications that violate FCC rules,
  - The control operator of the originating station is responsible.
  - If repeated, the repeater owner/trustee may also be liable for not taking steps to prevent recurrence.

59

T1F10 -- Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?

A. The control operator of the originating station
B. The control operator of the repeater
C. The owner of the repeater
D. Both the originating station and the repeater owner

60

Prohibited Transmissions

The following types of transmissions are prohibited:

- Unidentified transmissions.
- False or deceptive signals.
- False distress or emergency signals.
- Obscene or indecent speech.
- Music.
  - Except when incidental to retransmitting signals from a manned spacecraft or space station.

61

T1D06 -- What, if any, are the restrictions concerning transmission of language that may be considered indecent or obscene?

A. The FCC maintains a list of words that are not permitted to be used on amateur frequencies
B. Any such language is prohibited
C. The ITU maintains a list of words that are not permitted to be used on amateur frequencies
D. There is no such prohibition

62

Prohibited Transmissions

Business Communications.

- "Amateur" means you cannot use amateur radio for business purposes.
  - You cannot use amateur radio on behalf of your employer or profession.
    - **Exception:** Teachers using amateur radio in the classroom incidental to their teaching duties.
    - **Exception:** Certain club station managers.
  - You cannot use amateur radio to sell stuff.
    - **Exception:** You can sell amateur radio related equipment if it is not done on a regular basis.

63

Prohibited Transmissions

Business Communications.

- You can:
  - Use a repeater autopatch to make or change a doctor's appointment.
  - Use a repeater autopatch to order a pizza.
  - Advertise a radio on a swap-and-shop net.
  - Describe your business as part of normal conversation.

64

Prohibited Transmissions

Business Communications.

- You cannot:
  - Use a repeater autopatch to make or change a business appointment.
  - Advertise a lawn mower on a swap-and-shop net.
  - Advertise a radio on a swap-and-shop net if you are an amateur radio equipment dealer.
  - Advertise your business over the air.

65

Prohibited Transmissions

Business Communications.

- An amateur radio operator may not be compensated for using amateur radio.
  - You cannot use amateur radio while “on the clock”.
    - Your employer can pay you to set up a station for emergency purposes, but cannot pay you to operate it.
  - Emergency response personnel cannot use amateur radio while performing their duties.
    - **Exception:** During a disaster preparedness drill or actual emergency.

66

T1D05 -- When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade?

A. Never
B. When the equipment is not the personal property of either the station licensee, or the control operator, or their close relatives
C. When no profit is made on the sale
D. When selling amateur radio equipment and not on a regular basis

67

T1D08 -- In which of the following circumstances may the control operator of an amateur station receive compensation for operating that station?

A. When the communication is related to the sale of amateur equipment by the control operator's employer
B. When the communication is incidental to classroom instruction at an educational institution
C. When the communication is made to obtain emergency information for a local broadcast station
D. All of these choices are correct

68

Prohibited Transmissions

Encrypted Transmissions.

- The use of codes or ciphers to hide the meaning of a transmission is prohibited.
  - **Exceptions:**
    - Telecommand of a space station.
    - Telecommand (remote control) of a model craft.
- Encoding a message for transmission using a digital mode is permitted as long as the encoding method has been made public.

69

T1D03 -- When is it permissible to transmit messages encoded to obscure their meaning?

A. Only during contests
B. Only when transmitting certain approved digital codes
C. Only when transmitting control commands to space stations or radio control craft
D. Never

70

Prohibited Transmissions

Broadcasting and Retransmission.

- Broadcasting is defined as one-way transmissions intended for reception by the general public.
- In most cases, the use of an amateur radio station for one-way transmissions is prohibited.
  - **Exceptions:** Code practice, amateur radio related bulletins, beacon stations, telemetry, telecommand, or tests.

71

Prohibited Transmissions

Broadcasting and Retransmission.

- The use of an amateur radio station for newsgathering for the media is prohibited.
  - **Exception:** In emergency situations when necessary to save a life or for the public safety when no other means of communication is available.

72

Prohibited Transmissions

Broadcasting and Retransmission.

- Amateur radio stations may not retransmit radio transmissions from another radio service.
  - **Exception:** Government propagation and weather station broadcasts intended for the general public.

73

Prohibited Transmissions

Broadcasting and Retransmission.

- Manually retransmitting the signals of another amateur radio station is permitted.
- Only the following type of amateur radio stations may automatically retransmit the signals of another amateur radio station:
  - Repeater stations.
  - Auxiliary stations.
  - Space stations.

74

T1D02 -- Under which of the following circumstances are one-way transmissions by an amateur station prohibited?

A. In all circumstances
B. Broadcasting
C. International Morse Code Practice
D. Telecommand or transmissions of telemetry

75

T1D04 -- Under what conditions is an amateur station authorized to transmit music using a phone emission?

A. When incidental to an authorized retransmission of manned spacecraft communications
B. When the music produces no spurious emissions
C. When transmissions are limited to less than three minutes per hour
D. When the music is transmitted above 1280 MHz

76

T1D07 -- What types of amateur stations can automatically retransmit the signals of other amateur stations?

A. Auxiliary, beacon, or Earth stations
B. Earth, repeater, or space stations
C. Beacon, repeater, or space stations
D. Repeater, auxiliary, or space stations

77

T1D09 -- When may amateur stations transmit information in support of broadcasting, program production, or news gathering, assuming no other means is available?

A. When such communications are directly related to the immediate safety of human life or protection of property
B. When broadcasting communications to or from the space shuttle
C. Where noncommercial programming is gathered and supplied exclusively to the National Public Radio network
D. Never

78

T1D10 -- How does the FCC define broadcasting for the Amateur Radio Service?

A. Two-way transmissions by amateur stations
B. Any transmission made by the licensed station
C. Transmission of messages directed only to amateur operators
D. Transmissions intended for reception by the general public

79

Special Circumstances

Operation from boats or aircraft.

- You must get permission from the captain or pilot.
- The radio installation must be separate from the boat or aircraft radio equipment.
- Your radio operations must not cause interference to the boat or aircraft radio systems, including navigation systems.

80

Special Circumstances

Communicating with stations in other radio services.

- Generally prohibited.
- RACES stations may communicate with governmental stations during emergencies.
- Armed Forces Day.
  - Amateurs may contact military stations.

81

Questions?

82

Break

83

Technician Class

Chapter 9
Safety

84

Electrical Safety

Electrical Injuries.

- An electrical current flowing through the human body can cause injuries in the following ways:
  - Heating of body tissue (burns).
  - Interference with the electrical function of cells (shock).
    - Involuntary muscle contractions.
      - Heart fibrillation.
    - Loss of muscle control.
      - Can't let go!

85

Electrical Safety

Electrical Injuries.

- Even small currents can cause problems.
- Voltages over about 30V are considered potentially dangerous.

86

Electrical Safety

Electrical Injuries.

Current	Reaction
<1 mA	Not perceptible.
1 mA	Faint tingle.
5 mA	Slight shock. Not painful, but unpleasant.
6-30 mA	Painful shock, loss of muscle control (can't let go). Ventricular fibrillation.
50-150 mA	Extreme pain, respiratory arrest, severe muscular contractions. Death possible.
1.0-4.3 A	Heart stops, muscular contraction, nerve damage. Death likely.
10 A	Cardiac arrest, severe burns. Death probable.

87

T0A02 -- 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 of these choices are correct

88

Electrical Safety

Avoiding Electrical Hazards.

- **Never assume power is off!**
  - Check with a voltmeter first.
- **Never bypass safety interlocks!**
- Discharge capacitors.
- If you **MUST** work on live circuit:
  - Have a safety observer.
  - Remove watch and jewelry.
  - Keep one hand in pocket.

89

Electrical Safety

Avoiding Electrical Hazards.

- Avoid shorting batteries.
  - Can cause:
    - Burns.
    - Fire.
    - Explosions.

90

Electrical Safety

Response to electrical injury.

- Remove power.
  - Install a clearly labeled master ON/OFF switch & make certain all family members know where it is.
- CPR.
  - All family members should be trained in CPR.

91

T0A01 -- Which of the following is a safety hazard of a 12-volt storage battery?

A. Touching both terminals with the hands can cause electrical shock

B. Shorting the terminals can cause burns, fire, or an explosion

C. RF emissions from a nearby transmitter can cause the electrolyte to emit poison gas

D. All these choices are correct

92

T0A11 -- What hazard exists in a power supply immediately after turning it off?

A. Circulating currents in the dc filter
B. Leakage flux in the power transformer
C. Voltage transients from kickback diodes
D. Charge stored in filter capacitors

93

Electrical Safety

AC Safety Grounding.

- Normally, no special wiring is required.
  - Some high-power amplifiers require 220 VAC.
- Always use 3-wire power cords.
- Use ground fault current interrupter (GFCI) circuit breakers.

94

Electrical Safety

AC Safety Grounding.

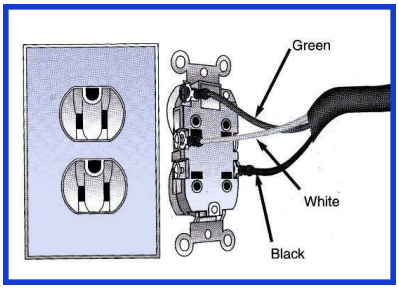
- When building equipment:
  - Always include a circuit breaker or fuse in the hot lead of the AC power cable.
    - If operated from 220V, include a circuit breaker or fuse in **BOTH** hot leads.
  - Include mechanical interlocks to remove power when covers are removed or opened in areas where high voltages are present.

95

Electrical Safety

AC Safety Grounding.

- Make certain that all outlets are wired correctly.
  - Connect black wire to brass terminal.
    - Hot.
  - Connect white wire to silver terminal.
    - Neutral.
  - Connect green or bare wire to green terminal.
    - Safety Ground.



96

T0A03 -- In the United States, what circuit does black wire insulation indicate in a three-wire 120 V cable?

A. Neutral
B. Hot
C. Equipment ground
D. Black insulation is never used

97

T0A06 -- What is a good way to guard against electrical shock at your station?

A. Use three-wire cords and plugs for all AC powered equipment
B. Connect all AC powered station equipment to a common safety ground
C. Use a circuit protected by a ground-fault interrupter
D. All of these choices are correct

98

T0A08 -- Where should a fuse or circuit breaker be installed in a 120V AC power circuit?

A. In series with the hot conductor only
B. In series with the hot and neutral conductors
C. In parallel with the hot conductor only
D. In parallel with the hot and neutral conductors

99

Electrical Safety

Lightning Protection.

- Antennas are not struck any more frequently than trees or tall structures.

100

Electrical Safety

Lightning Protection.

- Ground all antennas & towers.
  - Comply with local electrical codes.
  - Use short, direct connections.
  - There should be no sharp turns.
  - Bond all ground rods and connections together with heavy wire or conductive metal strap.

101

Electrical Safety

Lightning Protection.

- Use lightning arrestors in transmission lines.
  - Mount arrestors on a grounded metal plate located near where the cables enter the building.
  - Connect the plate to an external ground rod.

102

Electrical Safety

Lightning Protection.

- During storms:
  - Disconnect antenna cables and power cords from your equipment.
  - Disconnect telephone lines from computer modems.
  - Disconnect wired internet connections from your computer.

103

T0A07 -- Where should a lightning arrester be installed in a coaxial feed line?

A. At the output connector of a transceiver
B. At the antenna feed point
C. At the ac power service panel
D. On a grounded panel near where feed lines enter the building

104

T0A09 -- What should be done to all external ground rods or earth connections?

A. Waterproof them with silicone caulk or electrical tape
B. Keep them as far apart as possible
C. Bond them together with heavy wire or conductive strap
D. Tune them for resonance on the lowest frequency of operation

105

T0B01 -- Which of the following is good practice when installing ground wires on a tower for lightning protection?

A. Put a drip loop in the ground connection to prevent water damage to the ground system
B. Make sure all ground wire bends are right angles
C. Ensure that connections are short and direct
D. All these choices are correct

106

T0B10 -- Which of the following is true when installing grounding conductors used for lightning protection?

A. Only non-insulated wire must be used
B. Wires must be carefully routed with precise right-angle bends
C. Sharp bends must be avoided
D. Common grounds must be avoided

107

T0B11 -- Which of the following establishes grounding requirements for an amateur radio tower or antenna?

A. FCC Part 97 Rules
B. Local electrical codes
C. FAA tower lighting regulations
D. UL recommended practices

108

Managing RF in Your Station

RF Feedback.

- Your station is usually close to your transmitting antennas.
- All of your station wiring, including the feed lines, can act as receiving antennas and pick up your transmitted signal.
  - The resulting current is called *common-mode* current.
- If this common-mode current is coupled back into your transmitted signal, the result is called *RF feedback*.

109

Managing RF in Your Station

RF Feedback.

- RF feedback results in:
  - Distorted transmit audio.
  - Erratic behavior of computers and other digital equipment.
  - RF burns.

110

Managing RF in Your Station

RF Feedback.

- The cure for RF feedback is to ensure that all equipment is at the same RF potential.
  - Bond all equipment together by connecting to a common ground.
    - Each piece of equipment should have its own separate ground wire to the common ground.
      - Do not “daisy chain” equipment together.
    - Use short, direct connections using low-impedance conductors.
      - Braid.
      - Wide, flat copper strap.

111

T4A08 -- Which of the following conductors is preferred for bonding at RF?

A. Copper braid removed from coaxial cable
B. Steel wire
C. Twisted-pair cable
D. Flat copper strap

112

T7B11 -- What is a symptom of RF feedback in a transmitter or transceiver?

A. Excessive SWR at the antenna connection
B. The transmitter will not stay on the desired frequency
C. Reports of garbled, distorted, or unintelligible voice transmissions
D. Frequent blowing of power supply fuses

113

RF Interference (RFI)

Filters.

- In preventing RFI, filters have two main applications:
  - Prevent unintended signals from being transmitted.
  - Prevent intended signals from entering other equipment.

114

RF Interference (RFI)

Filters.

- The strong RF signals from a properly operating transmitter can interfere with the operation of other nearby equipment.
  - Televisions & radios,
  - Land-line telephones,
  - Electronic door bells,
  - Touch lamps,
  - etc.

115

RF Interference (RFI)

Filters.

- The goal of filtering & bypassing is to prevent RF signals from entering nearby equipment.

116

RF Interference (RFI)

Filters.

- Common-mode signals are often carried into equipment through any wires or cables attached to the equipment.
  - Install ferrite chokes on wires & cables.

117

RF Interference (RFI)

Filters.

- Capacitors can also be connected across the input terminals of a device to prevent RF signals from entering.

118

T7B04 -- Which of the following could you use to cure distorted audio caused by RF current on the shield of a microphone cable?

A. Band-pass filter
B. Low-pass filter
C. Preamplifier
D. Ferrite choke

119

RF Interference (RFI)

Interference from Amateur Transmissions.

- Very strong signals from a properly-operating transmitter can cause interference to a nearby receiver through a process called *fundamental overload*.
  - The signal is so strong it overwhelms the filtering built into the receiver.

120

RF Interference (RFI)

Interference from Amateur Transmissions.

- A transmitter that is not operating properly can cause interference by transmitting:
  - Harmonics,
  - Other spurious signals.

121

RF Interference (RFI)

Interference from Amateur Transmissions.

- The cure for fundamental overload is to reduce the strength of the signals entering the receiver.
  - Install a filter at the antenna terminals of the receiver.
  - Filtering at the transmitter will not help. The problem is with the receiver.

122

T7B02 -- What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?

A. The receiver is unable to reject strong signals outside the AM or FM band
B. The microphone gain of the transmitter is turned up too high
C. The audio amplifier of the transmitter is overloaded
D. The deviation of an FM transmitter is set too low

123

T7B03 -- Which of the following can cause radio frequency interference?

A. Fundamental overload
B. Harmonics
C. Spurious emissions
D. All of these choices are correct

124

T7B05 -- How can fundamental overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated?

A. Block the amateur signal with a filter at the antenna input of the affected receiver
B. Block the interfering signal with a filter on the amateur transmitter
C. Switch the transmitter from FM to SSB
D. Switch the transmitter to a narrow-band mode

125

T7B07 -- Which of the following can reduce overload of a VHF transceiver by a nearby commercial FM station?

A. Installing an RF preamplifier
B. Using double-shielded coaxial cable
C. Installing bypass capacitors on the microphone cable
D. Installing a band-reject filter

126

RF Interference (RFI)

Harmonics, Spurious Emissions, & Leakage.

- Due to design imperfections, **EVERY** transmitted signal contains harmonics of the desired signal and other spurious emissions.
  - Harmonics are prevented by installing low-pass or band-pass filters at the output of your transmitter.
    - Most modern transmitters have adequate filtering built in to reduce harmonics to acceptable levels.

127

RF Interference (RFI)

Harmonics, Spurious Emissions, & Leakage.

- Another interference problem is from *leakage*.
  - Cable TV systems use frequencies that are used by other radio services:
    - Amateur radio,
    - Police, fire & ambulance,
    - Air traffic control,
    - Business,
    - etc.

128

RF Interference (RFI)

Harmonics, Spurious Emissions, & Leakage.

- Imperfections in the shielding of a cable TV system allow cable signals to be radiated and allow external signals to enter the cable system.
  - Radiated cable signals cause interference to over-the-air radio services.
  - External signals entering the cable system cause interference to the cable subscribers.
  - Imperfections may not be in the cable system itself, but in the interconnecting cables in the subscribers' homes.

129

T7B09 -- What should be the first step to resolve non-fiber optic cable TV interference caused by your amateur radio transmission?

A. Add a low-pass filter to the TV antenna input
B. Add a high-pass filter to the TV antenna input
C. Add a preamplifier to the TV antenna input
D. Be sure all TV feed line coaxial connectors are installed properly

130

RF Interference (RFI)

Good Practices in Your Station.

- In solving any interference problem the **FIRST** thing that you must do is make certain that your station is operating properly and is not the cause of the interference.
  - Check all station filtering, grounding, and connections.
  - Use shielded wire and cables to prevent coupling or radiating unwanted signals.
    - Connect shield to equipment ground.

131

RF Interference (RFI)

Good Practices in Your Station.

- Eliminate any interference to your own TV and other appliances first.
- Eliminate any sources of interference in your own home.
  - Motors,
  - Poorly filtered power supplies (wall-warts),
  - etc.

132

T6D03 -- Which of the following is a reason to use shielded wire?

A. To decrease the resistance of DC power connections
B. To increase the current carrying capability of the wire
C. To prevent coupling of unwanted signals to or from the wire
D. To couple the wire to other signals

133

T7B06 -- Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception?

A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel
B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
C. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated
D. All these choices are correct

134

RF Interference (RFI)

RFI and Neighbors.

- When your neighbor complains of interference from your transmitter:
  - Make certain that your transmitter is not the source of the interference.
  - Offer to help determine the source of the interference.

135

RF Interference (RFI)

RFI and Neighbors.

- When you are receiving interference from your neighbor:
  - Make sure your station is “up to snuff”.
    - All grounding and filtering in place, secure, & working properly.
  - Offer to help determine the source of the interference.
  - You may have to **politely** explain to your neighbor that FCC rules prohibit them from using a device that causes interference.

136

T7B08 -- What should you do if something in a neighbor's home is causing harmful interference to your amateur station?

A. Work with your neighbor to identify the offending device
B. Politely inform your neighbor about the rules that prohibit the use of devices that cause interference
C. Check your station and make sure it meets the standards of good amateur practice
D. All of these choices are correct

137

RF Interference (RFI)

Part 15 Rules.

- Part 15 of the FCC rules covers the use of devices that can radiate low-level RF signals, either intentionally or unintentionally.
  - Radio & TV receivers (unintentional).
  - Cordless phones (intentional).
  - Computers (both intentional and unintentional).
  - Electric fences (unintentional).
  - Wireless inside/outside thermometers (intentional).
  - etc.

138

RF Interference (RFI)

Part 15 Rules.

- An unlicensed Part 15 device or an unintentional radiator may not cause harmful interference to a licensed communications station.
- An unlicensed Part 15 device must accept interference from a licensed communications station.

139

RF Exposure

RF Exposure.

- Electromagnetic energy can be absorbed by physical objects and cause changes.
  - The type of change depends on the intensity and frequency of the energy.
  - At best, a change in temperature.
    - e.g. – A microwave oven.
  - At worst, a change in molecular structure.
    - e.g. – Radiation treatments for cancer.

140

RF Exposure

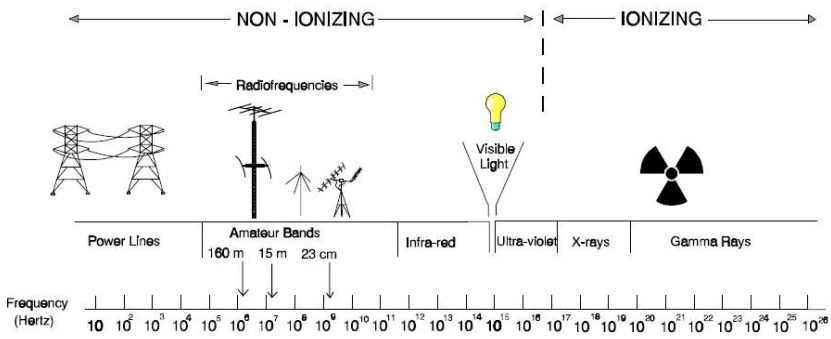
RF Exposure.

- Non-ionizing radiation.
  - The only effect is heating.
    - All radio frequency signals and visible light are non-ionizing radiation.
- Ionizing radiation.
  - Strips electrons from atoms.
    - Ultra-violet light.
    - X-rays.
    - Gamma rays.

141

RF Exposure

RF Exposure.



142

RF Exposure

RF Exposure.

- Recently there has been a lot of discussion, both factual and mythological, about the hazards of exposure to RF radiation.
  - e.g. – Cellphones will give you brain cancer (myth), etc.
- The human body absorbs radio energy differently at different frequencies.

143

RF Exposure

RF Exposure.

- The FCC has adopted regulations to prevent harm from exposure to RF radiation.
  - The station licensee is responsible for ensuring that these regulations are complied with.

144

T0C01 -- What type of radiation are radio signals?

A. Gamma radiation
B. Ionizing radiation
C. Alpha radiation
D. Non-ionizing radiation

145

T0C05 -- 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

146

T0C07 -- What hazard is created by touching an antenna during a transmission?

A. Electrocution
B. RF burn to skin
C. Radiation poisoning
D. All these choices are correct

147

T0C12 -- How does RF radiation differ from ionizing radiation (radioactivity)?

A. RF radiation does not have sufficient energy to cause chemical changes in cells and damage DNA
B. RF radiation can only be detected with an RF dosimeter
C. RF radiation is limited in range to a few feet
D. RF radiation is perfectly safe

148

T0C13 -- 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

149

RF Exposure

Power Density.

- The strength of an RF field is called its *power density*.
  - Power density is the amount of energy in a given area.
  - For RF exposure purposes, power density is measured in milliwatts per square centimeter (mW/cm^2).

150

RF Exposure

Exposure Limits.

- The FCC has established maximum levels of exposure to RF radiation.
  - These levels are called the *maximum permissible exposure (MPE)*.

151

RF Exposure

Exposure Limits.

- The rate at which RF energy is absorbed by the human body is called the *specific absorption rate (SAR)*.
- The SAR changes with frequency.
- Therefore, the MPE changes with frequency.

152

RF Exposure

Exposure Limits.

- FCC Rules define two “environments” with different MPEs for each.
  - Controlled environment.
  - Uncontrolled environment.

153

RF Exposure

Exposure Limits.

- Controlled environment.
  - People in the controlled environment are aware of the RF exposure and are knowledgeable about the risks involved.
    - Amateurs, family, & guests.
  - You know where people are standing in relation to your antenna and you can do something about it.
  - More power is allowed because you can make adjustments if needed.

154

RF Exposure

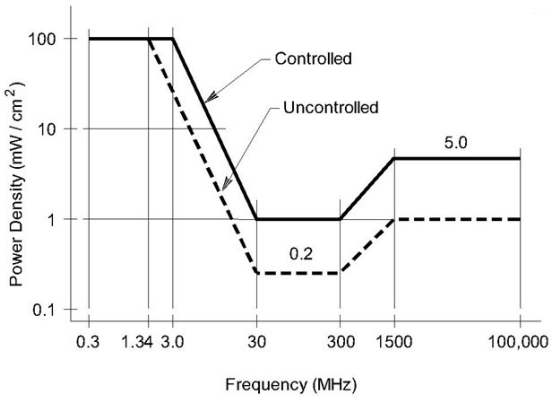
Exposure Limits.

- Uncontrolled environment.
  - People in the uncontrolled environment are not aware of the RF exposure and do not know anything about the risks involved.
    - Neighbors & passers-by.
  - Less power is allowed because you have to assume the worst-case scenario.

155

RF Exposure

Exposure Limits.



156

RF Exposure

Exposure Limits.

- Note that the MPEs are lowest in the VHF portion of the spectrum.

157

T0C02 -- At which of the following frequencies does maximum permissible exposure have the lowest value?

A. 3.5 MHz
B. 50 MHz
C. 440 MHz
D. 1296 MHz

158

RF Exposure

Averaging and Duty Cycle.

- The hazards of RF exposure are from the heating of body tissue which takes place over several minutes.
  - MPE limits are based on average exposure, not peak exposure.
  - Exposure is averaged over a specified period of time.
    - Controlled environment – 6 minutes.
    - Uncontrolled environment – 30 minutes.

159

RF Exposure

Averaging and Duty Cycle.

- Amateur transmitters do not transmit continuously.
  - Exposure is also averaged based on the *duty-cycle* of the transmitter.
    - The duty cycle is the length of time that the transmitter is transmitting divided by the total time.
    - Duty cycle is usually expressed as a percentage (%).
    - If a transmitter is operated at a 50% duty cycle, then the power density can be doubled without exceeding the MPE.

160

T0C03 -- How does the allowable power density for RF safety change if duty cycle changes from 100 percent to 50 percent?

A. It increases by a factor of 3
B. It decreases by 50 percent
C. It increases by a factor of 2
D. There is no adjustment allowed for lower duty cycle

161

T0C10 -- Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

A. It affects the average exposure to radiation
B. It affects the peak exposure to radiation
C. It takes into account the antenna feed line loss
D. It takes into account the thermal effects of the final amplifier

162

T0C11 -- What is the definition of duty cycle during the averaging time for RF exposure?

A. The difference between the lowest power output and the highest power output of a transmitter
B. The difference between the PEP and average power output of a transmitter
C. The percentage of time that a transmitter is transmitting
D. The percentage of time that a transmitter is not transmitting

163

RF Exposure

Evaluating Exposure.

- All fixed stations must perform an exposure evaluation.
  - Mobile & handheld stations are exempt.
- Below certain lower power levels, no evaluation is required.
  - The power levels vary with frequency.

164

RF Exposure

Evaluating Exposure

Band	Power (W)
160m	500
80m	500
40m	500
30m	425
20m	225
17m	125
15m	100
12m	75

Band	Power (W)
10m	50
6m	50
2m	50
1.25m	50
70cm	70
33cm	150
23cm	200
13cm & up	250

165

RF Exposure

Evaluating Exposure.

- RF power density is affected by:
  - Transmitter power.
    - Higher power → higher exposure.
  - Antenna gain and proximity.
    - Directional antennas focus available energy.
    - Being physically close to antenna or standing in the beam direction → higher exposure.

166

RF Exposure

Evaluating Exposure.

- You must re-evaluate your station if:
  - You change transmitting equipment.
  - You change antenna.
  - You add a new frequency band.

167

RF Exposure

Evaluating Exposure.

- Several methods are available to do the evaluation.
  - Use tables/formulas found in FCC OET Bulletin 65.
  - Use computer modeling software.
    - Based on formulas found in FCC OET Bulletin 65.
  - Use calibrated equipment to directly measure the field strength.
    - Equipment is extremely expensive.
  - Use a hand-held RF exposure meter.

168

T0C04 -- What factors affect the RF exposure of people near an amateur station antenna?

A. Frequency and power level of the RF field
B. Distance from the antenna to a person
C. Radiation pattern of the antenna
D. All of these choices are correct

169

T0C06 -- 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 of these choices are correct

170

T0C09 -- How can you make sure your station stays in compliance with RF safety regulations?

A. By informing the FCC of any changes made in your station

B. By re-evaluating the station whenever an item in the transmitter or antenna system is changed

C. By making sure your antennas have low SWR

D. All these choices are correct

171

RF Exposure

Exposure Safety Measures.

- RF safety is maintained by controlling power & distance.

172

RF Exposure

Exposure Safety Measures.

- If you find a potential hazard, you should:
  - Locate antennas away from areas people can access.
  - Locate antennas away from the property line.
  - Mount antenna as high as possible.
  - Do not point directional antennas towards occupied areas.
  - Use lower gain antennas or lower average transmitter power.

173

T0C08 -- Which of the following actions can reduce exposure to RF radiation?

A. Relocate antennas
B. Relocate the transmitter
C. Increase the duty cycle
D. All of these choices are correct

174

RF Exposure

Effects of Operating Mode.

- For RF exposure purposes, all modes are not created equal.
  - The average power output will vary according to the mode being used.
    - In some modes, the transmitter is not using full power all of the time.
  - Therefore, a mode factor can be taken into account when calculating average power output.

175

RF Exposure

Effects of Operating Mode.

Mode	Mode Factor
CW	40%
SSB Voice	25%
SSB Voice w/Comp	40%
SSB Digital	100%
SSB SSTV	100%
AM Voice (50% mod)	50%
AM Voice (100% mod)	25%
FM Voice	100%
FM Digital	100%

176

RF Exposure

Effects of Operating Mode.

- Therefore your average power output is calculated using the following formula:

$$P_{AVG} = P_{PEP} \times (\text{Duty Cycle}) \times (\text{Mode Factor})$$

Where:

(Duty Cycle) = (Transmit Time) / (Total Time)

177

RF Exposure

Effects of Antenna Gain.

- You also need to consider the antenna gain & the feedline losses.
  - e.g. -- If the antenna has 8 dB gain & the feedline has 2 dB loss, then the net gain is +6 dB.
    - Need to multiply average power by 4.

178

RF Exposure

Summary.

- In summary, the procedure for doing a station evaluation is:
  1. Determine the average power output taking into account the mode, operating duty cycle, feed line losses, & antenna gain.
  2. Use the tables in OET Bulletin 65 or use a computer program to determine the minimum distance from the antenna to avoid exceeding the MPEs.
  3. Repeat for each band.

179

Mechanical Safety

Putting Up Antennas and Supports.

- Be certain to follow the manufacturer's instructions.
- Be certain to comply with any local zoning code or covenants/restrictions on your property.
- Be certain to adhere to antenna height restrictions if you are close to an aircraft landing area.

180

Mechanical Safety

Putting Up Antennas and Supports.

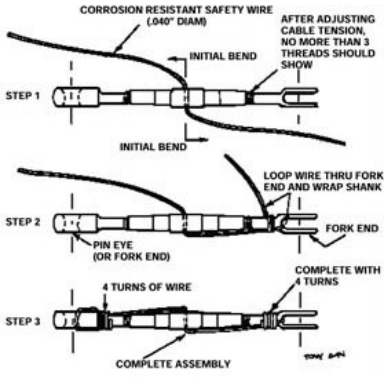
- Install antennas & supports so that they:
  - Are clear of trees and power lines.
  - Won't hit anyone or cross power lines if they fall.
    - Minimum of 10 feet from power lines.
  - Are properly grounded.
    - Separate 8-foot ground rods no more than 12 inches from each tower leg, bonded to the tower leg, and all bonded to each other.

181

Mechanical Safety

Putting Up Antennas and Supports.

- Use a safety wire on any turnbuckles used on guy wires to prevent them from loosening.



182

T0B04 -- Which of the following is an important safety precaution to observe when putting up an antenna tower?

A. Wear a ground strap connected to your wrist at all times
B. Insulate the base of the tower to avoid lightning strikes
C. Look for and stay clear of any overhead electrical wires
D. All of these choices are correct

183

T0B05 -- What is the purpose of a safety wire through a turnbuckle used to tension guy lines?

A. Secure the guy line if the turnbuckle breaks
B. Prevent loosening of the turnbuckle from vibration
C. Provide a ground path for lightning strikes
D. Provide an ability to measure for proper tensioning

184

T0B06 -- What is the minimum safe distance from a power line to allow when installing an antenna?

A. Add the height of the antenna to the height of the power line and multiply by a factor of 1.5
B. The height of the power line above ground
C. 1/2 wavelength at the operating frequency
D. Enough so that if the antenna falls, no part of it can come closer than 10 feet to the power wires

185

T0B08 -- Which is a proper grounding method for a tower?

A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
B. A ferrite-core RF choke connected between the tower and ground
C. A connection between the tower base and a cold water pipe
D. Separate eight-foot ground rods for each tower leg, bonded to the tower and each other

186

T0B09 -- Why should you avoid attaching an antenna to a utility pole?

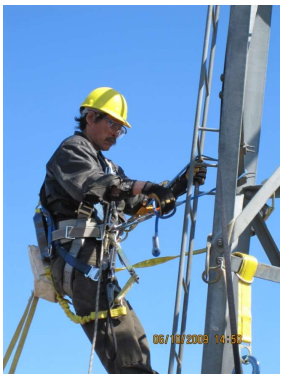
A. The antenna will not work properly because of induced voltages
B. The 60 Hz radiations from the feed line may increase the SWR
C. The antenna could contact high-voltage power lines
D. All these choices are correct

187

Mechanical Safety

Tower Work and Climbing Safety.

- Inspect the tower, all equipment, and safety gear **BEFORE** anyone goes up.
- Wear proper clothing, hard hat and eye protection at all times.
  - **Including ground personnel!**
- Wear a climbing harness.
- Don't forget the sunscreen!
- **Don't work alone!**

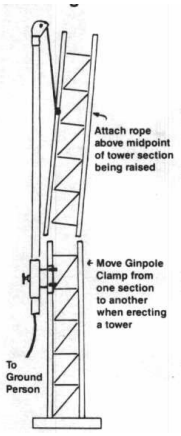


188

Mechanical Safety

Tower Work and Climbing Safety.

- Use a gin pole
  - A gin pole is used to lift tower sections and antennas.
- **Don't work alone!**



189

Mechanical Safety

Tower Work and Climbing Safety.

- Lower a crank-up tower before climbing.
- **Don't work alone!**

190

T0B02 -- What is required when climbing an antenna tower?

A. Have sufficient training on safe tower climbing techniques
B. Use appropriate tie-off to the tower at all times
C. Always wear an approved climbing harness
D. All these choices are correct

191

T0B03 -- Under what circumstances is it safe to climb a tower without a helper or observer?

A. When no electrical work is being performed
B. When no mechanical work is being performed
C. When the work being done is not more than 20 feet above the ground
D. Never

192

T0B07 -- Which of the following is an important safety rule to remember when using a crank-up tower?

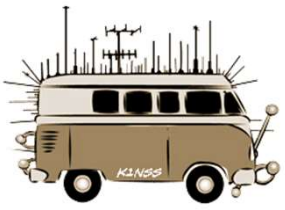
A. This type of tower must never be painted
B. This type of tower must never be grounded
C. This type of tower must not be climbed unless it is retracted, or mechanical safety locking devices have been installed
D. All these choices are correct

193

Mechanical Safety

Mobile Installations.

- Be certain to follow the manufacturer's instructions.



194

Mechanical Safety

- Mobile Installations.
  - Secure all equipment.
  - Place equipment where you can operate it safely while driving.

195

Questions?

196

Technician Class

Next Week Examination

197