The No-Nonsense, Technician Class License Study Guide

(for tests given after July 1, 2006)

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NOT FOR SALE!!

What is amateur (ham) radio?

Amateur radio, also known as ham radio, is a hobby enjoyed by hundreds of thousands of Americans and millions around the world. They enjoy communicating with one another via two-way radios and experimenting with antennas and electronic circuits.

All kinds of people are amateur radio operators, also known as "hams." Hams are young, old, men, women, boys, and girls. Kids as young as seven years old have gotten amateur radio licenses and many hams are active into their 80s and beyond. You never know who you'll run into on the amateur radio bands: young and old, teachers and students, engineers and scientists, doctors and nurses, mechanics and technicians, kings and entertainers.

For example, did you know that most of the astronauts sent up to the International Space Station (ISS) in the last five to ten years have been licensed radio amateurs? They use the amateur radio station on board the ISS to communicate with school groups all over the world as they are flying over.

How do you get into amateur radio?

With just a little study, you can learn all you need to know to get a Technician Class license, which is the license most popular with beginners. To get a Technician Class license, you must take a test with 35 multiple-choice questions. The test covers basic regulations, operating practices, and electrical and electronics theory. Knowing Morse Code is no longer required to get this license, or any class of license. Technician Class licensees have all amateur radio privileges above 30 MHz, including the very popular 2-meter band. Technicians can also operate Morse Code (CW) on portions of the 80m, 40m, 15m, and 10m bands, and phone on portions of the 10m band.

There are two other license classes: the General Class license and the Amateur Extra Class license. To get a General Class license, you must pass another 35-question test; the Amateur Extra Class test has 50 questions. The tests are progressively more difficult.

General Class licensees get phone and digital mode privileges on portions of the 160m, 80m, 60m, 40m, 20m, 15m, and 10m bands. They can also operate CW and digital modes on the 30m band. Amateur Extra licensees have all amateur privileges.

How much does it cost?

Basic study materials for passing the FCC test--including a copy of "*Now You're Talking!*" --and getting your first license--usually cost less than $40. Once you have your first license, most hams find it best to start with simple equipment and grow over time. A handheld VHF FM transceiver can be purchased for as little as $80 new, and excellent used equipment is often available at low prices. All things considered, the cost to get the first license and radio should be less than $200.

Where do I take the test?

Amateur radio license examinations are given by Volunteer Examiners, or VEs. VEs are licensed radio amateurs who have been trained to administer amateur radio tests. To find out when the VEs in your area will be giving the test go to the American Radio Relay League's (ARRL). On the Exam Session Search page (http://www.arrl.org/arrlvec/examsearch.phtml), you will be able to

search for test sessions that are close to you. If you do not have access to the Internet, you can phone the ARRL at 860-594-0200.

Can I really learn how to be an amateur radio operator from a simple manual like this?

Yes and no. This manual will help you get your license, but getting your license is only the beginning. There is still much to learn, and to get the most out of amateur radio, you will have to continually learn new things.

I am normally not a big fan of this type of approach to getting an amateur radio license. It will teach you the answers to the test questions, but not give you a deep understanding of electronics, radio, or the rules and regulations. That will be up to you after you get your license.

I hope that by helping you get your license that you'll be encouraged to become an active radio amateur and get on the air, participate in public service and emergency communications, join an amateur radio club, and experiment with radios, antennas, and circuits. These are the activities that will really help you learn about radio in depth, and in the end, help you be confident in your abilities as an amateur radio operator.

How do I use this manual?

Simply read through the manual and take some practice tests. You will find the answers to questions in **bold**. You can take practice tests online at

- QRZ.Com,
- AA9PW.Com, and
- HamTestOnline.Com.

You can use all three for free. HamTestOnline does, however, offer some features that the others don't, and you have to subscribe to use them.

Good luck and have fun!

I hope that you find this study guide useful and that you'll become a radio amateur, Remember that getting your license is just a start, and that you will be continually learning new things.

If you have any comments, questions, compliments or complaints, I want to hear from you. E-mail me at cwgeek@kb6nu.com. My goal is to continually refine this study guide and to continually make it better.

Acknowledgment

I would like to acknowledge Bruce Spratling, W8BBS for his support and his work on an earlier version of this study guide.

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Radio and Electronics Fundamentals

Names of electrical units, DC and AC, radio signals, conductors and insulators, electrical components

You don't have to be an electronics engineer to get a Technician CLass license, but it does help to know the basics of electricity and and some of the units we use in electronics. The most important units are current, voltage, resistance, power, and frequency.

Voltage is the force that causes electrons to flow in a circuit. Voltage is sometimes called electromotive force, or EMF. An automobile battery, for example, usually supplies about **12 volts**. The instrument used to measure Electromotive Force (EMF), or voltage, between two points such as the poles of a battery is called a **voltmeter**.

Current is the name for the flow of electrons in an electric circuit. Electrical current is measured in **Amperes**. The instrument used to measure the flow of current in an electrical circuit is called an **ammeter**.

When current flows only in one direction, we call that **direct current**. The name of a current that reverses direction on a regular basis is **alternating current**. The number of times that the current reverses direction is called the **frequency**. The standard unit of frequency is the **Hertz**.

Resistance is the term used to describe opposition to current flow in ordinary conductors such as wires. The basic of resistance is **the Ohm**.

Electrical power is the rate at which electrical energy is generated or consumed. Electrical power is measured in **Watts**.

Conductors are materials that conduct electrical current well. Metals are usually good conductors. For example, **copper** is a good electrical conductor.

Insulators are materials that do not conduct electrical current very well. Plastics and **glass**, for example, are good electrical insulators.

Relationship between frequency and wavelength, identification of bands, names of frequency ranges, types of waves

Frequency is the number of times that an alternating current flows back and forth per second. Frequency is measured in Hertz. 60 Hertz (Hz) means **60 cycles per second**. Electromagnetic waves that oscillate more than 20,000 times per second as they travel through space are generally referred to as **radio waves**. A radio wave travels through space at **the speed of light**, or approximately 300 million meters/second.

Wavelength is the name for the distance a radio wave travels during one complete cycle. The **wavelength of a radio wave gets shorter as the frequency increases**. The formula for converting frequency to **wavelength in meters is 300 divided by frequency in megahertz**.

The property of a radio wave that is often used to identify the different bands amateur radio operators use is **the physical length of the wave**. For example, the frequency range of the 2 meter band in the United States is **144 to 148 MHz**. The frequency range of the 6 meter band in the United States is **50 to 54 MHz**. The frequency range of the 70 centimeter band in the United States is **420 to 450 MHz**.

Sound waves in the range between 300 and 3000 Hertz are called **voice frequencies**.

How radio works: receivers, transmitters, transceivers, amplifiers, power supplies, types of batteries, service life

As a radio amateur, you will be using various types of devices to communicate with other amateur radio stations.

A **receiver** is used to convert radio signals into sounds we can hear.

A **transmitter** is used to convert sounds from our voice into radio signals?

A **receiver** and **transmitter** are the two devices that are combined into one unit to make a transceiver.

A **power supply** is a device that is used to convert the alternating current from a wall outlet into low-voltage direct current.

An **amplifier** is a device that is used to increase the output power of a transmitter. For example, an amplifier may increase the output power of a 10 watt radio to 100 watts.

Batteries are commonly used power radios. They come in many different types, each having advantages and disadvantages. It is important to know how to select them and how to use them.

A **lithium-ion** battery offers the longest life when used with a hand-held radio, assuming each battery is the same physical size.

The nominal voltage per cell of a fully charged nickel-cadmium battery is **1.2 volts**.

Carbon-zinc batteries are not designed to be re-charged.

To keep rechargeable batteries in good condition and ready for emergencies, **all of these answers are correct:**

- they must be inspected for physical damage and replaced if necessary,
- they should be stored in a cool and dry location, and
- they must be given a maintenance recharge at least every 6 months.

The best way to get the most amount of energy from a battery is to **draw current from the battery at the slowest rate needed**.

Ohms law relationships

Ohm's Law is the relationship between voltage (E), current (I), and resistance (R) in a circuit.

When you know the current and resistance, use the formula **Voltage (E) equals current (I) multiplied by resistance (R)** to calculate the voltage in a circuit. We can also write this formula as

$$E = I \times R.$$

When you know the voltage and resistance, use the formula **Current (I) equals voltage (E) divided by resistance (R)** to calculate current in a circuit. We can also write this formula as

$$I = E \div R.$$

When you know the voltage and current, use the formula **Resistance (R) equals voltage (E) divided by current (I)** to calculate resistance in a circuit. We can also write this formula as

$$R = E \div I.$$

Examples

The resistance of a circuit when a current of 3 amperes flows through a resistor connected to 90 volts is **30 ohms**.

$R = E \div I = 90\,V \div 3\,A = 30\,\Omega$

The resistance in a circuit where the applied voltage is 12 volts and the current flow is 1.5 amperes is **8 ohms**.

$R = E \div I = 12\,V \div 1.5\,A = 8\,\Omega$

The current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms is **1.5 amperes**.

$I = E \div R = 120\,V \div 80\,\Omega = 1.5\,A$

The voltage across the resistor if a current of 0.5 amperes flows through a 2 ohm resistor is **1 volt**.

$E = I \times R = 0.5\,A \times 2\,\Omega = 1\,V$

The voltage across the resistor if a current of 1 ampere flows through a 10 ohm resistor is **10 volts**.

$E = I \times R = 1\,A \times 10\,\Omega = 10\,V$

The voltage across the resistor if a current of 2 amperes flows through a 10 ohm resistor is **20 volts**.

$E = I \times R = 2\,A \times 10\,\Omega = 1\,V$

The current flowing through a 100 ohm resistor connected across 200 volts is 2 **amperes**.

$I = E \div R = 200\,V \div 100\,\Omega = 2\,A$

The current flowing through a 24 ohm resistor connected across 240 volts is **10 amperes**.

$I = E \div R = 240\,V \div 24\,\Omega = 10\,A$

Power calculations, units: kilo, mega, milli, micro

Because FCC regulations spell out how much power you can use as a radio amateur, it is important to know the terminology and how to calculate power. The **watt** is the unit used to describe electrical power. The formula used to calculate electrical power in a DC circuit is **power (P) equals voltage (E) multiplied by current (I)**, or

$P = E \times I$

So, for example, in a DC circuit where the power supply voltage of 13.8 volts DC and the current is 10 amperes, the power is

$P = 13.8\,V \times 10\,A =$ **138 watts**

When the voltage is 120 volts DC and the current is 2.5 amperes, the power being used by a circuit is

$P = 120\,V \times 2.5\,A =$ **300 watts**

You can use different forms of the equation, $P = E \times I$ to determine the current flowing in a circuit when you know how much power it is consuming and the voltage supplied to it. The equation to do this is

$I = P \div E$

For example the number of amperes flowing in a circuit when the applied voltage is 120 volts DC and the load is 1200 watts is

$I = 1200 \div 120 =$ **10 amperes**

You can determine how many watts are being drawn by your transceiver when you are transmitting if you **measure the DC voltage at the transceiver and multiply by the current drawn when you transmit**.

When dealing with electrical parameters, such as voltage, resistance, current, and power, we use a set of prefixes to denote various orders of magnitude:

- micro- is the prefix we use to denote 1 millionth of a quantity. A microvolt, for example, is 1 millionth of a volt, or .000001 V. Often you will see the Greek letter mu, or μ, to denote the prefix micro-. 1 microvolt is, therefore, 1 μV.
- milli- is the prefix we use to denote 1 one-thousandth of a quantity. A milliampere, for example, is 1 one-thousandth of an ampere, or .001 A. Often, the letter m is used instead of the prefix milli-. 1 milliampere is, therefore, 1 mA.
- kilo- is the prefix we use to denote 1 thousand of a quantity. A kilovolt, for example, is 1000 volts. Often, the letter k is used instead of the prefix kilo-. 1 kilovolt is, therefore, 1 kV.
- mega- is the prefix we use to denote 1 million of a quantity. A megahertz, for example, is 1 million Hertz. Often, the letter M is used instead of the prefix mega-. 1 megahertz is, therefore, 1 MHz.

Here are some examples:

- 1.5 amperes is the same as **1500 milliamperes**.

- Another way to specify the frequency of a radio signal that is oscillating at 1,500,000 Hertz is **1500 kHz**.
- **One thousand volts** are equal to one kilovolt.
- **One one-millionth of a volt is eq**ual to one microvolt.
- If the output power of a hand-held transceiver is 500 milliwatts, it is putting out **0.5 watts**.

Electrical and RF Safety

AC power circuits, hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance

As amateur radio operators, it's certainly possible to come into contact with dangerous voltages and currents. Because it would be a shame to lose a single person, it's important to know how to be safe when working with electricity. Having said that, **30 volts** a commonly accepted value for the lowest voltage that can cause a dangerous electric shock, and **100 milliamperes** is the lowest amount of electrical current flowing through the human body that is likely to cause death.

Three-wire electrical outlets and plugs are more safe than two-wire outlets and plugs. The reason for this is an independent ground. **Ground** is connected to the green wire in a three-wire electrical plug. To guard against electrical shock at your station, **all of these answers are correct:**

- Use 3-wire cords and plugs for all AC powered equipment
- Connect all AC powered station equipment to a common ground
- Use a ground-fault interrupter at each electrical outlet

Metal cabinets are generally connected to this ground. Should an internal short occur that would put a dangerous voltage on the metal cabinet, an overload condition will occur and a fuse will blow. The purpose of a fuse in an electrical circuit is **to interrupt power in case of overload.**

Fuses also protect your equipment. That's why you should never replace a blown fuse with a fuse of a higher value. For example, if you install a 20-ampere fuse in your transceiver in the place of a 5-ampere fuse, an electrical fault could cause a high value of current to flow, and that **excessive current could cause a fire**.

Some amateurs install emergency disconnect switches. The most important thing to consider when installing an emergency disconnect switch at your station is that **everyone should know where it is and how to use it**.

Electrical storms are also safety concerns. A direct lightning hit can cause a fire, so **fire prevention** is the most important reason to have a lightning protection system for your amateur radio station. When a lightning storm is expected, **all of these** are precautions that you should take:

- Disconnect the antenna cables from your station and move them away from your radio equipment
- Unplug all power cords from AC outlets
- Stop using your radio equipment and move to another room until the storm passes

Even though 30 volts is the commonly accepted value for the lowest voltage that can cause a dangerous electric shock, you must be careful when handling 12-volt batteries. **All of these answers are** hazards presented by a conventional 12-volt storage battery:

- It contains dangerous acid that can spill and cause injury
- Short circuits can damage wiring and possibly cause a fire
- Explosive gas can collect if not properly vented

If a storage battery is charged or discharged too quickly, **the battery could overheat and give off dangerous gas or explode**.

Even when disconnected, equipment might be a safety hazard. For example, **you might receive an electric shock from stored charge in large capacitors** in a power supply when it is turned off and disconnected.

Antenna installation, tower safety, overhead power lines

You should also be careful when working on antennas and towers. Perhaps the important consideration when putting up an antenna is to **make sure people cannot accidentally come into contact with it.**

You should wear a hard hat and safety glasses if you are on the ground helping someone work on an antenna tower **to protect your head and eyes in case something accidentally falls from the tower.**

Before you climb a tower, follow the advice in **all of these answers**:

- Arrange for a helper or observer
- Inspect the tower for damage or loose hardware
- Make sure there are no electrical storms nearby

Be sure to **put on your safety belt and safety glasses** before climbing an antenna tower, and also remember that the most important safety rule to remember when using a crank-up tower is that **a crank-up tower should never be climbed unless it is in the fully lowered position.**

The most important safety precaution to observe when putting up an antenna tower is to **look for and stay clear of any overhead electrical wires**. When installing an antenna or tower, make sure that it is a safe distance from power lines. Install it **so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires.**

Make sure that you install the guy wires for an antenna tower in **accordance with the tower manufacturer's instructions.** When erecting a tower or an antenna near an air-

port, make sure that it is lower than **the maximum allowed height with regard to nearby airports**.

Towers also need to be properly grounded to protect them from lightning strikes. An adequate ground for a tower is **separate 8 foot long ground rods for each tower leg, bonded to the tower and each other**.

You can also make towers and antennas more safe by using the appropriate materials. For example, stainless steel hardware used on many antennas instead of other metals because **stainless steel parts are much less likely to corrode** than other metals. This makes them safer because they will be less likely to fail and cause an injury.

RF hazards, radiation exposure, RF heating hazards, proximity to antennas, recognized safe power levels, hand held safety, exposure to others

Even though VHF and UHF radio signals are **non-ionizing radiation**, exposure to high levels of radio-frequency radiation can cause injury. Because of this, the FCC has established RF exposure regulations. **All of these choices are correct** ways for you to determine that your station complies with FCC RF exposure regulations:

- By calculation based on FCC OET Bulletin 65
- By calculation based on computer modeling
- By measurement of field strength using calibrated equipment

50 watts PEP at the antenna is the maximum power level that an amateur radio station may use at frequencies above 30 MHz before an RF exposure evaluation is required. You can make sure your station stays in compliance with RF safety regulations **by re-evaluating the station whenever an item of equipment is changed**.

Radio waves cause injury to the human body **only if the combination of signal strength and frequency cause excessive power to be absorbed**. **Milliwatts per square centimeter** is the unit of measurement is used to measure RF radiation exposure. **All of these** factors affect the RF exposure of people near an amateur transmitter:

- Frequency and power level of the RF field
- Distance from the antenna to a person
- Radiation pattern of the antenna

Another factor used to determine safe RF radiation exposure levels is duty cycle. **It takes into account the amount of time the transmitter is operating**.

The frequency of an RF source be considered when evaluating RF radiation exposure because **the human body absorbs more RF energy at some frequencies than others**.

All of these answers are correct actions amateur operators might take to prevent exposure to RF radiation in excess of FCC supplied limits:
Alter antenna patterns
Relocate antennas
Change station parameters such as frequency or power

If a person accidentally touched your antenna while you were transmitting, **they might receive a painful RF burn injury**.

Radio waves, propagation, and antennas

Antenna types - vertical, horizontal, concept of gain, common portable and mobile antennas, losses with short antennas, relationships between antenna length and frequency, dummy loads

There are many different types of antennas perhaps the simplest is the dipole. A dipole is **a horizontal antenna** mounted so the elements are parallel to the Earth's surface. A dipole is a half wavelength long. The approximate length, in inches, of a 6-meter 1/2 wavelength wire dipole antenna is **112 inches**. The physical size of half-wave dipole antenna **becomes shorter as the frequency increases**.

A vertical antenna is an antenna that consists of a single element mounted perpendicular to the Earth's surface. Vertical antennas are often one-quarter wavelength long. A quarter-wavelength vertical antenna for 146 MHz is approximately. **19 inches**.

A beam antenna is **an antenna that concentrates signals in one direction**. The quad, Yagi, and dish antennas are **directional or beam antennas**.

Many handheld transceivers come with a short antenna called a "rubber duck." A disadvantage of the "rubber duck" antenna supplied with most hand held radio transceivers is that **it does not transmit or receive as effectively as a full sized antenna**. They are even less effective inside a vehicle. A good reason not to use a "rubber duck" antenna inside your car is that **signals can be 10 to 20 times weaker than when you are outside of the vehicle**.

Many mobile antennas are 5/8 wavelengths long. The advantage of 5/8 wavelength over 1/4 wavelength vertical antennas is that **their radiation pattern concentrates energy at lower angles**. One type of antenna that offers good efficiency when operating mobile and can be easily installed or removed is **a magnet mount vertical antenna**.

When testing a transmitter or transceiver, you may not want to connect it to an antenna because the test transmissions may cause interference to other amateur radio stations. Instead, connect the transmitter or transceiver to a dummy load. A dummy load **does not radiate interfering signals when making tests**.

Propagation, fading, multipath distortion, reflections, radio horizon, terrain blocking, wavelength vs. penetration, antenna orientation

VHF/UHF signals not normally heard over long distances because **VHF and UHF signals are usually not reflected by the ionosphere**. Because of this, most VHF and UHF communications is line of sight, although VHF and UHF Radio signals usually travel about a third farther than the visual line of sight distance between 2 stations. This is because t**he Earth seems less curved to radio waves than to light**. The **point where radio signals between two points are blocked by the curvature of the Earth** called the radio horizon. When you do hear a VHF signal from a long distance away, **a possible cause is sporadic E reflection from a layer in the ionosphere.**

While VHF and UHF communications is generally reliable, in some situations problems may occur. If you receive sudden bursts of tones or fragments of different conversations that interfere with VHF or UHF signals, for example, they are most likely caused by **strong signals are overloading the receiver and causing undesired signals to be heard**. If a station reports that your signals were strong just a moment ago, but now they are weak or distorted, **try moving a few feet, random reflections may be causing multipath distortion**. **Picket fencing** is the commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting.

Antenna polarization may also be an issue. If the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization, **signals could be as much as 100 times weaker**. Because repeater antennas are vertically polarized, **keep the antenna as close to vertical as you can** when using your hand-held VHF or UHF radio to reach a distant repeater.

Here are a couple final tips:

- UHF signals often work better inside of buildings than VHF signals because **the shorter wavelength of UHF signals allows them to more easily penetrate urban areas and buildings**.
- If buildings or obstructions are blocking the direct line of sight path, **try using a directional antenna to find a path that reflects signals to the repeater** to reach a distant repeater.

Feedlines types, losses vs. frequency, SWR concepts, measuring SWR, matching and power transfer, weather protection, feedline failure modes

In general terms, standing wave ratio (SWR) is **a measure of how well a load is matched to a transmitter**. A **1 to 1** reading on a SWR meter indicates a perfect impedance match between the antenna and the feed line. If you notice erratic changes in SWR readings, **a loose connection in your antenna or feedline** might be the problem.

If you attempt to transmit into an antenna that is not properly matched to your transmitter, you could damage the transmitter. Fortunately, most modern transceivers have circuits to prevent this. If the SWR value of the antenna system is **2 to 1** or more, the protection circuits in most solid state transmitters begin to reduce transmitter power, thus preventing damage.

Most often, you will use an SWR meter to measure the SWR of an antenna system. You may also use a **directional wattmeter** to determine if your feedline and antenna are properly matched.

It is important to have a low SWR in an antenna system that uses coaxial cable feedline **to allow the efficient transfer of power and reduce losses**. Power lost in a feed line **is converted into heat by losses in the line**.

The most common reason for failure of coaxial cables is **moisture contamination**. If coaxial cables are exposed to weather and sunlight for several years, **losses can increase dramatically.** The outer sheath of most coaxial cables is black in color because **black provides protection against ultraviolet damage**

Coaxial cable is used more often than any other feed line for amateur radio antenna systems because **it is easy to use and requires few special installation considerations**. The impedance of the most commonly used coaxial cable in typical amateur radio installations is **50 ohms**. To achieve a 1 to 1 SWR, the impedance of the transmitter and the antenna should also be 50 ohms.

Communications modes and methods

Modulation modes, descriptions and bandwidth (AM, FM, SSB)

Phone transmissions are **voice transmissions by radio**. **FM** is the type of modulation is most commonly used for VHF and UHF voice repeaters.

Single sideband (sometimes abbreviated SSB) is a form of amplitude modulation. **SSB** is the type of voice modulation is most often used for long distance and weak signal contacts on the VHF and UHF bands. **Upper sideband** is normally used for VHF and UHF SSB communications.

The primary advantage of single sideband over FM for voice transmissions is that **SSB signals use much less bandwidth than FM signals**. The approximate bandwidth of a single-sideband voice signal is **between 2 and 3 kHz**. The approximate bandwidth of a frequency-modulated voice signal is **between 5 and 15 kHz**.

Some signals are even wider. For example, the normal bandwidth required for a conventional fast-scan TV transmission using combined video and audio on the 70-centimeter band is **about 6 MHz**. **CW** is the emission type has the narrowest bandwidth.

The name given to an amateur radio station that is used to connect other amateur stations to the Internet is **gateway**.

Voice communications, EchoLink and IRLP

If you are listening to a 2-meter repeater and hear a brief tone and then a station from Russia calling CQ, chances are that you are listening to **an Internet linked DX station**. Information is transmitted via the **Internet** between stations using Echolink. **Any licensed amateur radio operator** may operate on the Echolink system. **EchoLink** allows computer-to-radio linking for voice transmission.

Stations using IRLP also transmit data via the Internet. The abbreviation IRLP means **Internet Radio Linking Project**, and the term IRLP describes **a method of linking between two or more amateur stations using the Internet**. When using a portable transceiver, **use the keypad to transmit the IRLP node numbers** to select a specific IRLP node.

IRLP uses **Voice over Internet Protocol** to transfer data. Echolink and IRLP have the technology **Voice over Internet Protocol** in common. You can find a list of active nodes using VoIP **in a repeater directory or on the Internet**.

Non-voice communications - image communications, data, CW, packet, PSK31, Morse code techniques, Q signals

Packet radio is an example of a digital communications method. With packet radio, you can send digital messages back and forth. For example, in the 219 -220 MHz frequency range, a Technician class operator may use **point-to-point digital message forwarding.**

APRS is another example. The term APRS means **Automatic Position Reporting System**. To use APRS, **a global positioning system receiver** is required along with your normal radio for sending automatic location reports.

As a Technician, you will also be able to transmit television signals. The term NTSC denotes **a standard fast scan color television signal.**

PSK is another popular digital mode. PSK means **Phase Shift Keying**. PSK31 is a type of emission that uses PSK methods. PSK31 is **a low-rate data transmission mode that works well in noisy conditions**.

Morse Code, sometimes referred to as CW, is actually the original digital mode. When using Morse Code, the recommended sending speed is **any speed at which you can reliably receive**. A practical reason for being able to copy CW when using repeaters is **to recognize a repeater ID sent in Morse code**.

To shorten the number of characters sent during a CW contact, amateurs often use three-letter combinations called Q-signals. The “Q” signal used to indicate that you are receiving interference from other stations is **QRM**. The "Q" signal used to indicate that you are changing frequency is **QSY**.

Station setup and operation

Station hookup - microphone, speaker, headphones, filters, power source, connecting a computer

A microphone connects to **the transmitter** in a basic amateur radio station. A **speaker** converts electrical signals to sound waves. When a microphone and speaker are too close to each other, **audio feedback** may occur. Use a **set of headphones** in place of a regular speaker to help you copy signals in a noisy area.

A good reason for using a regulated power supply for communications equipment is t**o protect equipment from voltage fluctuations**.

To reduce spurious emissions install a filter **at the transmitter**. A **notch filter** should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2-meter transmitter.

A **terminal node controller** is connected between the transceiver and computer terminal in a packet radio station. A packet radio station requires a power source, transceiver, and antenna, but not a **microphone**. For some digital modes, you use a **sound card** to connect a radio with a computer for data transmission.

Operating controls

If a transmitter is operated with the microphone gain set too high, **it may cause the signal to become distorted and unreadable**.

One way to select a frequency on which to operate is to **use the keypad or VFO knob to enter the correct frequency**. To enable quick access to a favorite frequency, you can **store the frequency in a memory channel** on your transceiver. A VHF/UHF transceiver be capable of storing **all** of the following in memory:

- Transmit and receive operating frequency
- CTCSS tone frequency
- Transmit power level

The purpose of the buttons labeled "up" and "down" on many microphones is **to allow easy frequency or memory selection**.

A squelch control on a transceiver is used **to quiet noise when no signal is being received**.

To improve the situation if the station you are listening to is hard to copy because of ignition noise interference, **turn on the noise blanker**.

The purpose of the "shift" control found on many VHF/UHF transceivers is **to adjust the offset between transmit and receive frequency**.

RIT means **Receiver Incremental Tuning**.

The "step" menu function found on many transceivers **sets the tuning rate when changing frequencies**.

The "function" or "F" key found on many transceivers **selects an alternate action for some control buttons**.

Repeaters; repeater and simplex operating techniques, offsets, selective squelch, open and closed repeaters, linked repeaters

To extend the usable range of mobile and low-power stations, you might use a repeater. The most important information to know before using a repeater are **the repeater input and output frequencies**. A **repeater receives on one frequency and transmits on another**. This is what is meant by the terms input and output frequency when referring to repeater operations.

The most common input/output frequency offset for repeaters in the 2-meter band is **0.6 MHz**. The most common input/output frequency offset for repeaters in the 70-centimeter band is **5.0 MHz**.

Repeaters should be approved by the local frequency coordinator before being installed because **coordination minimizes interference between repeaters and makes the most efficient use of available frequencies**.

A courtesy tone is **a tone used to indicate when a transmission is complete**. When using a repeater, you should pause briefly between transmissions **to listen for anyone wanting to break in**.

Access to any repeater may be limited by the repeater owner. The term is used to describe a repeater when use is restricted to the members of a club or group is **a closed repeater**.

Linked repeater system the term for a series of repeaters that can be connected to one another to provide users with a wider coverage.

Simplex operation means **transmitting and receiving on the same frequency**. One reason to use simplex instead of a repeater is **to avoid tying up the repeater when direct contact is possible**. To find out if you could communicate with a station using simplex instead of a repeater, **check the repeater input frequency to see if you can hear the other station**.

T5D - 1 exam question

Recognition and correction of problems, symptoms of overload and overdrive, distortion, over and under modulation, RF feedback, off frequency signals, fading and noise, problems with digital communications links

When referring to a receiver, fundamental overload is **interference caused by very strong signals from a nearby source**. Other causes of interference include spurious emissions and harmonics. **Doppler shift** is NOT a cause of radio frequency interference.

One of the most likely causes of telephone interference from a nearby transmitter is that **the transmitter's signals are causing the telephone to act like a radio receiver**. A logical first step when attempting to cure a radio frequency interference problem in a nearby telephone is to **install an RF filter at the telephone**.

When a neighbor reports that your radio signals are interfering with something in his home, **check your station and make sure it meets the standards of good amateur practice**. For example, if someone tells you that your transmissions are interfering with their TV reception, **make sure that your station is operating properly and that it does not cause interference to your own television**.

The following may **all** be useful in correcting a radio frequency interference problem:

- snap-on ferrite chokes,
- low-pass and high-pass filters, and
- notch and band-pass filters.

You should do **all** of the following if a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station:

- Work with your neighbor to identify the offending device
- Politely inform your neighbor about the rules that require him to stop using the device if it causes interference
- Check your station and make sure it meets the standards of good amateur practice

If another operator tells you he is hearing a variable high-pitched whine on the signals from your mobile transmitter, **the power wiring for your radio is picking up noise from the vehicle's electrical system**. If another operator reports that your SSB signal is very garbled and breaks up, the problem may be **RF energy may be getting into the microphone circuit and causing feedback**.

If you receive a report that your signal through the repeater is distorted or weak, **all** of the following might be the cause:

- your transmitter may be slightly off frequency,
- your batteries may be running low, or
- you could be in a bad location.

One of the reasons to use digital signals instead of analog signals to communicate with another station is that **many digital systems can automatically correct errors caused by noise and interference**.

Operating practices

Choosing an operating frequency, calling CQ, calling another station, test transmissions

Once you are licensed, you will want to operate, and that means you need to know how to establish contact with another station and deciding where, when, and how to transmit.

The first thing you should do is listen for other stations calling "CQ." The procedural signal "CQ" means "**calling any station**," and you can feel free to respond. To respond a station calling CQ, **say the other station's callsign followed by your callsign**. For example, if I heard W8BBS calling CQ, and I wanted to contact him, I'd say,

> "W8BBS this is KB6NU, over."

If you don't hear any stations calling CQ, you might want to try calling CQ yourself. When selecting a frequency on which to transmit, first **listen to determine if the frequency is busy** before calling CQ.

Remember that calling CQ is an invitation for any station that might be listening to make contact with you. To do this, say **CQ followed by your callsign**. For example, you might say,

> "CQ CQ CQ. This is KB6NU calling."

If they hear your call, they will first say your callsign and then their callsign. For example,

> "KB6NU, this is W8BBS, over."

At this point, you'd reply, "W8BBS, this is KB6NU" and then begin your conversation.

Because repeaters generally provide very reliable communications, it's not necessary to use the procedural signal "CQ." Instead, you need to only **say your call sign** to indicate that you are listening for calls on a repeater. When calling another station on a repeater--a station whose call sign you know--first **say the station's call sign then identify your own station**.

When in contact with another station, station identification is required at least every ten minutes and at the end of every transmission, no matter how short the transmission, no matter how low the power output, and no matter whether your station can be heard or not.

An amateur making a transmission to test equipment or antennas must always **properly identify the station**. **Station identification is required at least every ten minutes and at the end of every transmission**. A brief test transmission that does not include any station identification is **an illegal unidentified transmission**.

When identifying your station using a phonetic alphabet, you should use the International Telecommunication Union (ITU) phonetic alphabet because the words are internationally recognized substitutes for letters. Although it is a common practice, you should avoid using cute phrases or word combinations to identify your station because **they are not easily understood by some operators**.

Use of minimum power, band plans, repeater coordination, mode restricted sub-bands

A band plan is **a voluntary guideline, beyond the divisions established by the FCC for using different operating modes within an amateur band**. Developed by **the amateur community**, bandplans are not mandated by the FCC or the International Telecommunications Union (ITU). Rather, **they are voluntary guidelines for efficient use of the radio spectrum**.

The situation is a little different when it comes to repeaters. To minimize interference, the FCC recognizes certain groups of amateurs as being responsible for coordinating frequency allocations. The main purpose of repeater coordination is to reduce interference and promote proper use of spectrum. The **recognized frequency coordination body** is in charge of the repeater frequency band plan in your local area.

If a repeater station inadvertently retransmits communications that violate FCC rules, **the transmitting station** is responsible for the violation, NOT the repeater trustee or repeater control operator.

Even though an amateur is allowed to use up to 1,500 Watts PEP under some circumstances, the rules state that **an amateur must use the minimum transmitter power necessary to carry out the desired communication**.

Although Technicians may operate on frequencies in the 6-meter, 2-meter, and 1 1/4-meter bands, some of the sub-bands are restricted to particular modes. For example, between 50.0 MHz and 50.1 MHz and between 144.0 MHz and 144.1 MHz, **CW only** is allowed.

Courtesy and respect for others, sensitive subject areas, obscene and indecent language - 1 exam question

When operating, remember that there are more than 600,000 licensed amateur radio operators in the United States, and more than 1.5 million worldwide. In fact, the regulations state that when circumstances are not specifically covered by FCC rules, amateur radio operators should follow **good engineering and amateur practices** when operating their stations. This includes being courteous to other amateur radio operators.

For example, if you hear a newly licensed operator that is having trouble with their station, the courteous thing to do is to **contact them and offer to help with the problem**.

The proper way to break into a conversation between two stations that are using a particular frequency is to **say your call sign between their transmissions**.

While **there is no official list of prohibited obscene and indecent words**, indecent and obscene language prohibited in the Amateur Service for all three of these reasons:

- **it is offensive to some individuals,**
- **young children may intercept amateur communications with readily available receiving equipment, and**
- **such language is specifically prohibited by FCC Rules**.

Amateur radio operators should avoid the use of racial or ethnic slurs when talking to other stations because **it is offensive to some people and reflects a poor public image on all amateur radio operators**. **Political discussions, jokes and stories, and religious preferences** are not prohibited communications while using amateur radio, but again, please use good judgment when discussing these topics.

When operating on a repeater, **monitor a frequency before transmitting and keep transmissions short**, identify legally (at least once every ten minutes), and use the minimum amount of transmitter power necessary to establish a reliable contact with the repeater.

FCC rules state that **no frequency will be assigned for the exclusive use of any station and neither has priority** , regardless of license class, transmitter output power, or geographical location. So, if two amateur stations want to use the same frequency, be courteous in determining which station will get to use the frequency. Even though no station has priority when it comes to frequency use, before calling on a particular frequency or responding to another station's call, **make sure you are operating on a permissible frequency for your license class**.

Interference to and from consumer devices, public relations, intentional and unintentional interference

At some point, your transmissions will cause interference with telephones, television sets, or other consumer devices. One of the causes of interference is receiver front end overload. Receiver front-end overload is **interference caused by strong signals from a nearby source**.

If signals from your transmitter are causing front end overload in your neighbor's television receiver, **the owner of the television receiver is responsible** for taking care of the problem, but the courteous thing to do is to help your neighbor solve the problem. For example, if there is a break in a cable television transmission line, **TV interference may result when an amateur station is transmitting, or interference may occur to the amateur receiver**.

Your signals may also be picked up by your telephones or your neighbor's telephones. The major cause of telephone interference is that **the telephone was not equipped with ade-**

quate interference protection when manufactured. Even though you may not be responsible for this interference, the courteous thing to do would be to work with your neighbor to resolved the problem, perhaps installing a filter on the telephone line.

Your signals may also interfere with other amateur radio stations. You may **NEVER** deliberately interfere with another station's communications. If you unintentionally interfere with another station, the proper course of action is to **properly identify your station and move to a different frequency**. If you receive a report that your transmissions are causing splatter or interference on nearby frequencies, **check your transmitter for off-frequency operation or spurious emissions**.

You may also cause interference to other amateur transmissions if you're just testing. The best way to reduce on the air interference when testing your transmitter is to **use a dummy load when testing**.

No station has exclusive use of any frequency unless the FCC has declared a communication emergency. **FCC** rules--NOT RACES or ARES or FEMA rules--apply to your station when using amateur radio at the request of public service officials or at the scene of an emergency. RACES and ARES are **both organizations provide communications during emergencies**.

FCC Rules, station license responsibilities

Basis and purpose of the Amateur Radio Service, penalties for unlicensed operation, other penalties, examinations

One of the basic purposes of the Amateur Radio Service as defined in Part 97 i**s to provide a voluntary noncommercial communications service to the public, particularly in times of emergency**. Two of the other five fundamental purposes for the Amateur Radio Service are **to increase the number of trained radio operators and electronics experts, and improve international goodwill**.

A person named in an amateur operator/primary license grant in the FCC ULS database is an amateur operator as defined in Part 97. **Technician, General, Extra** are the classes of US amateur radio licenses may currently be earned by examination. An amateur radio station is **a station in an Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications.**

A Volunteer Examiner is **an amateur accredited by one or more VECs who volunteers to administer amateur license exams**. To administer an Element 2 Technician written exam, there must be present **three Examiners holding a General Class license or higher**.

A CSCE valid for **365 days** for license upgrade purposes.

The Federal Communications Commission makes and enforces the rules for the Amateur Radio Service in the United States.

A transmission that disturbs other communications is called **harmful interference**

ITU regions, international regulations, US call sign structure, special event calls, vanity call signs

Call signs are assigned in sequential order when the FCC selects new amateur radio call signs. **A, K, N and W** are the letters that must be used for the first letter in US amateur call signs, and US amateur call signs contain **a single digit, 0 through 9**. **KB3TMJ** is an example of a valid US amateur call.

The vanity call sign program is an FCC call sign program you might use to obtain a call sign containing your initials. **By applying through a Club Station Call Sign Administrator,** an amateur radio club might obtain a club station call sign. **Any FCC-licensed amateur** is eligible to apply for temporary use of a 1-by-1 format Special Event call sign.

The ITU is the International Telecommunication Union. The ITU has established regions that **are used to assist in the management of frequency allocations.**

You allowed to operate your amateur station in a foreign country **when there is a reciprocal operating agreement between the countries.**

Authorized frequencies (Technician), reciprocal licensing, operation near band edges, spectrum sharing

Before you can control an amateur station in the US, **you must be named in the FCC amateur license database, or be an alien with reciprocal operating authorization**. A US amateur radio license allows you to transmit **from wherever the Amateur Radio Service is regulated by the FCC or where reciprocal agreements are in place**.

Amateur stations are allowed to communicate with stations operating in other radio services **when authorized by the FCC**. **Communications on a regular basis that could reasonably be furnished alternatively through other radio services** are not permitted in the Amateur Radio Service. A US amateur radio operator may communicate with an amateur in a foreign country **at any time unless prohibited by either government**. **Amateurs may not cause harmful interference to primary users** when the FCC rules say that an amateur frequency band is said to be available on a secondary basis.

Amateur radio operators have bands of frequencies that they are licensed to use:

- **52.525** MHz is a frequency within the 6-meter band.
- When transmitting on 146.52 MHz, the amateur band are you using is rhe **2 meter band.**
- **443.350 MHz** is a 70-centimeter frequency is authorized to a Technician class license holder operating in ITU Region 2.
- **1296 MHz** is a frequency in the 23 centimeter band authorized to a Technician class license holder operating in ITU Region.
- If you are operating on 223.50 MHz, you are using the **1.25 meter band**.

The station license, correct name and address on file, license term, renewals, grace period

The **Amateur Radio Service** is one service for which the FCC issues operator station licenses. It does not issue licenses for the Family Radio Service, General Radiotelephone Service, or the Citizens Radio Service. As a station licensee, you are responsible to see to it that **your station is operated in accordance with the FCC rules**.

Anyone except a representative of a foreign government can become an amateur licensee in the US. **There is no minimum age requirement** to hold an amateur license.

As soon as your license grant appears in the FCC's ULS database, you may begin transmitting and using your call sign. **10 years** is the normal term for an amateur station license grant.

If you forget to renew your amateur license and it expires, **transmitting is not allowed until the license is renewed and appears on the FCC ULS database**. Should your license expire, **2 years** is the grace period during which the FCC will renew an expired 10-year license without re-examination.

An Amateur radio operator must have a correct name and mailing address on file with the FCC, **to receive mail delivery from the FCC by the United States Postal Service**. This is why the FCC requires that **the station licensee mailing address** be kept up to date on the Universal Licensing System database. **If mail is returned to the FCC as undeliverable**, the FCC may revoke or suspend a license.

Control operator duties

Prohibited communications: music, broadcasting, codes and ciphers, business use, permissible communications, bulletins, code practice, incidental music

When you being transmitting, it's important to know what kinds of transmissions you can make, but even more importantly, what kinds of transmissions are prohibited. For example, amateurs may not broadcast, which the FCC defines as **transmissions intended for reception by the general public, either direct or relayed**. An amateur station is **never** authorized to transmit information to the general public. Similarly, **amateurs may not transmit music, except as incidental to an authorized rebroadcast of space shuttle communications.**

While **broadcasts intended for reception by the general public** may not be transmitted in the Amateur Radio Service, some types of one-way communications are allowed. These include: telecommand of model craft, brief transmissions to make adjustments to the station, and Morse code practice.

There are strict regulations about transmitting coded messages. The basic principle behind these regulations is that an amateur station may **never** transmit false or deceptive signals. **Only when transmitting control commands to space stations or radio control craft**, is the transmission of codes or ciphers allowed to hide the meaning of a message transmitted by an amateur station. An amateur station may only transmit unidentified communications **only when sent from a space station or to control a model craft**.

While amateur radio operators may discuss many topics, including politics and programs on broadcast stations, **indecent and obscene language** is specifically prohibited in the Amateur Radio Service.

Finally, there are strict regulations against using amateur radio for profit or for business. For example, **calls to your employer requesting directions to a customer's office** are prohibited when using a repeater autopatch. There are some instances when the FCC allows an amateur radio station to be used as a method of communication for hire or material compensation, but **only when in accordance with part 97 rules**. Note that you may use your station to tell people about equipment you have for sale **when you are offering amateur radio equipment for sale or trade on an occasional basis**.

Basic identification requirements, repeater ID standards, identification for non-voice modes, identification requirements for mobile and portable operation

The rules are very specific about how you must identify your station and how often you must identify your station. A transmission that does not contain a station identification is called **unidentified communications or signals**.

To identify your amateur station, you must transmit **your call sign**. When you are speaking to another amateur operator using a language other than English, **you must identify using the English language**. An amateur station must transmit the assigned call sign **every 10 minutes during communications and at the end of each communication**.

While using a special event call sign, you must identify using your assigned call sign **once per hour**. When using one or more self-assigned indicators with your assigned call sign, you must make sure that **the indicator must not conflict with an indicator specified by FCC rules or with a prefix assigned to another country**.

The longest period of time an amateur station can operate without transmitting its call sign is **10 minutes**. When two amateur stations end communications, **each station must transmit its own call sign**.

Repeater stations must also properly identify themselves. **All** of the following are acceptable methods of transmitting a repeater station identification, including:

- by phone using the English language,
- by video image conforming to applicable standards, and
- by Morse code at a speed not to exceed 20 words per minute.

When visiting a station, if you hold a higher class license than that of the station licensee and you are using a frequency not authorized to his class of license, you should **send his call sign first, followed by your call sign**. If you hear someone using the indicator "/AG", this means they are exercising the operating privileges earned by examination upgrade of an **Authorized General**.

Definition of control operator, location of control operator, automatic and remote control, auxiliary stations

Every amateur station must have **a control operator** when transmitting. The definition of a control operator of an amateur station is **an operator designated by the licensee to be responsible for the station's transmissions to assure compliance with FCC rules**.

Whenever the station is transmitting, an amateur station must have a control operator. The **control operator** is responsible for the transmissions from an amateur station. **Technician** is the minimum class of amateur license you must hold to be a control operator of a repeater station.

There are three types of station control permitted and recognized by FCC rule: **local, remote and automatic control. Automatic control** is the type of control being used on a repeater when the control operator is not present. **Local control** is the type of control being used when transmitting using a handheld radio. **Remote control** is the type of control being used when the control operator is not at the station location but can still make changes to a transmitter.

The control point of an amateur station is **the location at which the control operator function is performed.** Only **an automatically controlled station** does not require a control operator to be at the control point.

A person may hold **only one** amateur operator / primary station license.

Operating another person's station, guest operators at your station, third party communications, autopatch, incidental business use, compensation of operators, club stations, station security, station inspection, protection against unauthorized transmissions

All privileges allowed by the higher class license are allowed when another amateur holding a higher class license is controlling your station. **Only the privileges allowed by your license** are allowed when you are the control operator at the station of another amateur who has a higher class license than yours. **Both of you** are responsible for proper operation if you transmit from another amateur's station.

Family members are not allowed to transmit on your amateur station if you are not there. **They must be licensed before they are allowed to be control operators**. The best way to keep unauthorized persons from using your amateur station is to d**isconnect the power and microphone cables when not using your equipment**.

Using amateur radio for conducting business is a prohibited amateur radio transmission. It is, however, permissible for the control operator of a club station to accept compensation for sending information bulletins or Morse code practice **when the station makes those transmissions for at least 40 hours per week.**

Here are some other regulations you should know:

- Third-party communications is **a message sent between two amateur stations for someone else**.
- **At least 4** persons are required to be members of a club for a club station license to be issued by the FCC.

- You may operate your amateur station aboard an aircraft **only with the approval of the pilot in command and not using the aircraft's radio equipment**.
- The FCC allowed to inspect your station equipment and station records **at any time upon request**.

Emergency and Public Service Communications

FCC declarations of an emergency, use of non-amateur equipment and frequencies, use of equipment by unlicensed persons, tactical call signs

Emergency communications is one of the main reasons that amateur radio exists. Accordingly, **emergency communications** has priority at all times in the Amateur Radio Service. Priority be given to stations providing emergency communications **at all times and on all frequencies**.

When catastrophes occur, the FCC may declare a communications emergency. When this happens, they will include **any special conditions and rules to be observed during the emergency** in the FCC declaration of a temporary state of communication emergency.

An FCC declaration of a communications emergency is legally required to restrict a frequency to emergency-only communication. After the FCC has declared a communications emergency, **you must avoid those frequencies dedicated to supporting the emergency unless you are participating in the relief effort**. If the FCC has not declared a communication emergency, **no station has exclusive use** (of a frequency) **in this circumstance**.

If you hear someone reporting an emergency, you should **assume the emergency is real and act accordingly**. If you are in contact with another station and an emergency call is heard, you should **stop your contact immediately and take the emergency call**.

An appropriate way to initiate an emergency call on amateur radio is to **say "Mayday, Mayday, Mayday" followed by "any station come in please" and identify your station**. But, never under any circumstances make a false emergency call. **All of these answers are correct regarding** the penalties for making a false emergency call:

- You could have your license revoked
- You could be fined a large sum of money
- You could be sent to prison

When specially authorized by the FCC, or in an actual emergency, amateur stations are allowed to communicate with stations operating in other radio services. Sometimes, instead of using your amateur call sign, you might use a "tactical call sign." One reason for using tactical call signs such as "command post" or "weather center" during an emergency is that **they are more efficient and help coordinate public-service communications.**

Preparation for emergency operations, RACES/ARES, safety of life and property, using ham radio at civic events, compensation prohibited

To be prepared for an emergency situation where your assistance might be needed, **all of these answers are correct**:

- Check at least twice a year to make sure you have all of your emergency response equipment and know where it is
- Make sure you have a way to run your equipment if there is a power failure in your area
- Participate in drills that test your ability to set up and operate in the field

You use your amateur station to transmit a "SOS" or "MAYDAY" signal, **when there is immediate threat to human life or property**. **In a genuine emergency you may use any means at your disposal to call for help on any frequency**, including non-amateur frequencies or equipment to call for help. For example, you in a geniune emergency, you may use a modified amateur radio transceiver to transmit on the local fire department frequency.

There are two main organizations that provide emergency communications. The first is RACES. RACES organizations are restricted to serving local, state, and federal government emergency management agencies. Before you can participate in RACES activities, you must register with the responsible civil defense organization.

The second is ARES. **ARES supports agencies like the Red Cross, Salvation Army, and National Weather Service.** Before you can join an ARES group, you **must have an amateur radio license**.

In an emergency, alternate sources of power must often be used. Alternate sources of power to operate radio equipment during emergencies include **all of these answers**:

- The battery in a car or truck
- A bicycle generator
- A portable solar panel

Amateurs are often called upon to provide communications for public service events, such as parades or bicycle tours. Even though communications are less critical during these events, casual conversation between stations during a public service event should be avoided because **idle chatter may interfere with important traffic**.

If a reporter asks to use your amateur radio transceiver to make a news report in an emergency situation or during a public service event, **advise them that the FCC prohibits such use**.

Net operations, responsibilities of the net control station, message handling, interfacing with public safety officials

In an emergency situation or during a public service event, there may be many amateur radio stations operating on the same frequency. To prevent confusion, amateurs set up nets, which have specific procedures for their operation.

To control net operation, one station is designated net control station. Of primary importance for a net control station is **a strong and clear signal.** If a large scale emergency has just occurred and no net control station is available, **open the emergency net immediately and ask for check-ins**.

Other stations on the net, check in to the net by giving their call signs to the net control station. To minimize disruptions to an emergency traffic net once you have checked in **do not transmit on the net frequency until asked to do so by the net control station**. If someone breaks into a net with emergency traffic, the net control station should **stop all net activity until the emergency has been handled.**

Messages passed over a net is called traffic, and there are several different kinds of traffic. **Emergency traffic** has the highest priority. When passing emergency messages, you must include **the name of the person originating the message.**

There are rules for handling traffic. For example, the recommended guideline for the maximum number of words to be included in the text of an emergency message is **25 words**.

Messages have several different parts, including the preamble, the body, and the check. The preamble of a message is **the information needed to track the message as it passes through the amateur radio traffic handling system**. **The check is a count of the number of words in the message**.

Personal information concerning victims should not be transmitted over amateur radio frequencies during emergencies. One way to reduce the chances of casual listeners overhearing sensitive emergency traffic is to **pass messages using a non-voice mode such as packet radio or Morse code**.

Special operations

Operating in the field, radio direction finding, radio control, contests, special event stations

For many Technician class licensees, their first radio is a handheld VHF or UHF transceiver. Here are some tips for operating this type of radio:

- When operating a hand-held transceiver away from home, it is a good idea to bring along **one or more fully charged spare battery packs.**
- To make the signal from a hand-held radio stronger when operating in the field, **use an external antenna instead of the rubber-duck antenna.**
- When operating from a location that includes lots of crowd noise, use **a combination headset and microphone.**

Often, radio amateurs are called on to help out in an emergency. Many hams maintain an emergency response kits, often call a "jump kit" or "go kit," that they can quickly grab when they are called to provide emergency communications. This kit might include:

- an external antenna and several feet of connecting cable,
- a cable and clips for connecting your transceiver to an external battery, and
- a listing of repeater frequencies and nets in your area

A 1500 watt output linear amplifier would probably not be very useful to include in an emergency response kit.

Many amateurs find hidden transmitter hunts, also called "fox hunts," to be an enjoyable activity. To find the "fox," they use radio direction finding techniques to locate a small transmitter. Honing these skills can also be very useful, because **radio direction finding** is a method used to locate sources of noise interference or jamming. **A directional antenna** is the item that would be the most useful for a hidden transmitter hunt.

Contesting is another popular activity. During a contest, the objective is to contact as many stations as possible during a specified period of time. In some contests, stations exchange grid locators. A grid locator is a **letter-number designator assigned to a geographic location.**

For some events, such as a local festival or a sporting event like the Super Bowl, amateur radio operators set up special event stations. A special event station is a **temporary station that operates in conjunction with an activity of special significance.**

You can use your amateur radio license to transmit in the amateur radio bands when playing with radio-controlled models. The maximum power allowed when transmitting telecommand signals to radio controlled models is **1 watt**. When sending commands to a radio-controlled model, the identification requirements are somewhat different. Instead of identifying every ten minutes, **a label indicating the licensee's call sign and address must be affixed to the transmitter.**

Satellite operation, Doppler shift, satellite sub bands, LEO, orbit calculation, split frequency operation, operating protocols, AMSAT, ISS communications

One interesting aspect of amateur radio is satellite operation. **AMSAT** is the name of the group that coordinates the building and/or launch of the largest number of amateur radio satellites. When using an amateur radio satellite, you can **talk to amateur radio operators in other countries.**

Any amateur whose license allows them to transmit on the satellite uplink frequency may use an amateur satellite. As with other amateur radio communications, you should use the **minimum amount of power needed to complete the contact** when using an amateur satellite.

An interesting aspect of operating satellites is Doppler shift. Doppler shift is **a change in signal frequency caused by motion through space**. This can make tuning into and transmitting to a satellite challenging.

Most satellites are not in geosynchronous orbit, meaning that they are not overhead all the time. Rather, most are in a low earth orbit, and they are overhead for only small portion of their orbit. When a **satellite is in a Low Earth Orbit**, we use the initials LEO to denote this. To determine when you can access an amateur satellite, you would use **a satellite tracking program**.

You might also find out more information about a particular satellite by listening for the satellite beacon. The satellite beacon is **a signal that contains information about a satellite.**

The International Space Station is a satellite with amateur radio capabilities, and most astronauts now get their amateur radio licenses before they go up to the Space Station. **Any amateur with a Technician or higher class license** may make contact with an astronaut on the International Space Station using amateur radio frequencies.

Most VHF and UHF bands have a satellite sub-band. A satellite sub-band is a **portion of a band where satellite operations are permitted**. For example, the satellite sub-band on 70-CM, is **435 to 438 MHz**.