

# MCAA

Mechanical Contractors Association of America

## Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service



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Mechanical Service Contractors of America

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# Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service

Provided as a service of MCAA's Safety Excellence Initiative

## Table of Contents

Introduction	2
Primary Hazard	3
Secondary Hazards	3
Health Effect of Overexposure to RF	4
Avoiding Overexposure	4
Safe Work Practices	6
Appendix A – RF Safety Assessment Checklist	8
Appendix B – Identification of RF Emitting Cellular and Telecommunications Antennas and Related Items	10

# **Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service**

## **Introduction**

Radio frequency (RF) radiation is the transfer of energy by radio waves. It is used to provide cellular phone and telecommunications services, such as satellite communications, television broadcasting, and portable radio communications, without wire. RF sometimes affects mechanical service technicians since radio waves are transmitted by antennas, which are prevalent on commercial building rooftops. Under the right conditions, exposure could occur when you're servicing equipment close to RF antennas.

Overexposure to RF is extremely rare for mechanical service technicians. Most of the antennas mounted on building rooftops are cellular antennas. These antennas are typically mounted on roof edges and they transmit out and away from the building. When this is the case, there is no significant exposure. However, substantial exposure could occur in rare cases. For example, if you were working close enough to a microwave antenna transmitting RF directly through your work area, it would result in overexposure. Therefore, MCAA/MSCA believes that service technicians should have some knowledge about RF where its presence overlaps with mechanical service work.

This guide will help you understand where you could be exposed to RF while working, the health effects of overexposure, and how to avoid overexposure.

## **Disclaimer**

This guide is intended to provide the user with basic information and safe work practices for working near radio frequency radiation-emitting antennas. It is not intended to provide exhaustive treatment on the subject of radio frequency radiation safety, and it should never be used as a substitute for reading and interpreting applicable federal or state OSHA standards or regulations or any other pertinent state or local laws, rules, regulations or standards. Further, it is not intended to provide legal advice. Employers must make independent determinations regarding the need for legal assistance.

## Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service

The primary radio frequency (RF) radiation hazard for mechanical service technicians stems from work near cellular and telecommunications antennas emitting RF in their work areas. Overexposure is extremely rare, but it's important to know the effects that overexposure to RF could have on the human body, how it could occur while servicing rooftop mounted equipment, and how to avoid it. There are secondary hazards associated with RF and RF emitting antennas as well.

### Primary Hazard

The primary hazard is overexposure to radiation. RF is non-ionizing radiation, so it is not known to cause long-term health effects associated with ionizing radiation, such as X-ray and radiation generated by nuclear power. However, under the right circumstances, it can be harmful to humans. When it comes to RF antennas, power and frequency determine the scale of the hazard.

**Power** – Power output is the actual wattage of RF energy that an antenna produces at its output. The higher the power the greater the energy.

**Frequency** – Frequencies between 30 and 300 megahertz appear to be the most harmful because humans absorb RF most efficiently within this range when they're in an RF field, but still some distance away from the source. Cellular antennas typically operate between 300 and 3,000 megahertz, with most of them operating between 850 megahertz and 1900 megahertz. That's good news for those working around cellular antennas.

**Measuring RF** – RF is measured with an electromagnetic field (EMF) monitor (see picture #1 in Appendix B). Using an EMF monitor is the only way to determine the level of the RF hazard emitted by an antenna, or cluster of antennas, at an exact time. EMF monitors are capable of measuring both power and frequency. The monitors are available in different types. If you need to use one while performing mechanical service work, it will be the portable type designed to be attached outside your clothing. EMF monitors are calibrated and pre-set to an established exposure level. When the RF in the area exceeds that level, the built-in alarm system will warn you. If that ever happens to you, vacate the area immediately and report the incident to your supervisor.

### Secondary Hazards

There are three secondary hazards associated with RF and RF emitting antennas that you need to consider before working near them.

**Antenna Heat** – RF antennas are extremely hot. However, if you stay far enough away to keep from being overexposed to RF, you'll never have to worry about getting burned by a hot antenna.

**Pacemakers** – In some cases, RF can negatively affect the proper function of pacemakers. If you have a pacemaker, be sure to speak with your doctor about your potential exposure to RF before you work anywhere near RF emitting antennas. And be sure to follow his or her advice accordingly.

**Rooftop Penthouses** – Some commercial building penthouses contain heating, ventilation and/or air conditioning equipment. In some cases, wires connected to RF antennas mounted outside penthouses go through the walls to the inside of the structures. In such cases, there could be RF exposure from those wires. When you find yourself in this situation, protect yourself accordingly.

# Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service

## Health Effect of Overexposure to RF

The health effect of overexposure to RF is overheating of body tissue. If you were working close enough to one or more RF emitting antennas, the antenna(s) had sufficient power and were emitting RF within a certain frequency range, and you were exposed for a long enough period, the penetrating energy would overheat your body tissue, including your internal organs. It's really no different than heating meat in a microwave oven.

## Avoiding Overexposure

### Understanding Cellular and Telecommunications Antennas

The best way to avoid overexposure to RF is to stay out of RF fields as much as possible. Being able to recognize RF antennas, identify their types, and understand each type's individual characteristics will go a long way toward helping you avoid overexposure.

**Cellular Antennas** – Cellular antennas are shaped like rectangles with vertical panels (see picture #2 in Appendix B). They emit RF straight out and away from the antenna. In fact, if you were to place an electromagnetic field monitor (EMF) anywhere around the back side of a cellular antenna, you would get no response from the monitor. However, place the monitor in front of the antenna and it will sing out loud and clear. The point is, there's no significant exposure when this type of antenna is emitting RF away from you and your work area.

**Parabolic Antennas** – Parabolic antennas are dish shaped (see picture #3 in Appendix B) and emit RF in one general direction. The RF travels out in a cylindrical shape about the same size as the circumference of the dish – picture a spotlight beam. If you're not in the path of that spotlight beam-like pattern of radiation, there's no significant exposure. Keep in mind that some parabolic antennas don't transmit at all, and therefore, don't emit RF. A good example is a satellite dish for television reception.

**Cylindrical Rod Antennas** – Cylindrical rod antennas are shaped just like the name suggests (see picture #4 in Appendix B). These types of antennas emit RF in all directions, i.e. 360° from the rod. It can sometimes be a little more challenging to avoid exposure when working close to this type of antenna so protect yourself accordingly.

**Microwave Antennas** – Microwave antennas are typically shaped like giant drums (see picture #5 in Appendix B). They emit RF in a single direction out and away from the face of the antenna. However, the RF emitted from microwave antennas is much more potent than RF emitted from cellular, parabolic, and cylindrical rod antennas. Microwave antennas are much less common on building rooftops than other types of antennas. When they are mounted on buildings, they're typically mounted high up on a frame, tower, or another structure, so that nobody can inadvertently walk through the RF field. More commonly, microwave antennas are mounted high up on towers and far away from buildings. However, learn to identify them and be on the lookout for them, even on building rooftops. You'll need to stay far away from the RF fields emitted by these antennas to avoid overexposure.

**Stealth Antennas** – Stealth antennas are cellular and telecommunications antennas designed to blend into the building or landscape. They are all about aesthetics, made to look like trees, plants, flag poles, clock towers, steeples, Christian crosses, parts of actual building structures, etc. Learn to identify stealth antennas

## **Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service**

(see picture #6 in Appendix B), so that you won't end up working near them unexpectedly.

**Antenna Clusters** – Several antennas mounted in a cluster (see picture #7 in Appendix B) will emit more RF than a single antenna. Watch carefully for clusters of antennas in your work areas.

**Antennas on Adjacent Structures** – Watch carefully for one or more RF emitting antennas mounted on nearby buildings or other adjacent structures. If they're emitting a significant amount of RF in your direction, and they're close enough to your work area, overexposure could occur.

### **Distance**

RF dissipates and loses its potency the farther it travels from its antenna. Therefore, the farther away you are from an RF emitting antenna or antennas, the less likely you are to be exposed. Distance is your best ally when it comes to protection from overexposure to RF. Staying as few as 3 feet away from the RF emissions of cellular, satellite, and cylindrical rod antennas would most likely protect you from overexposure. However, RF can be fickle, so we include a safety factor as follows.

**Single Cellular, Parabolic, or Cylindrical Rod Antennas** – Keep at least 6 feet away

**Multiple Cellular, Parabolic, or Cylindrical Rod Antennas** – Keep at least 10 feet away

### **Time**

Time is another great ally when it comes to protection from overexposure to RF. The less time you spend in an RF field the less likely you are to be overexposed. Think again about meat heating in a microwave oven. The longer it's in the oven exposed to RF, the hotter it gets.

### **Personal Protective Equipment**

There may be times when you'll have to service equipment that's near one or more RF emitting antennas in an RF field. When that's the case, there is personal protective equipment that can protect you from overexposure to RF.

**Protective Equipment** – The protective equipment in this case is specially designed clothing (see pictures #8–10 in Appendix B). It's made from a material called Nomex, which provides resistance to radiation. The protective clothing made from this material reflects RF, and when it's used properly, it provides protection against overexposure up to 1,000% of the maximum permissible exposure level. However, even this protective clothing has its limitations. For example, at some U.S. military facilities, RF can rise to levels above the protective clothing's ability to prevent overexposure. Be sure to learn and carefully follow the manufacturer's instructions for use, and warnings concerning limitations of protection.

**Nomex Material Presents an Electrical Shock Hazard** – Nomex has stainless steel fibers woven into the material. These fibers are highly conductive. Make sure you never approach energized electrical conductors or circuit parts while wearing Nomex clothing.

When you're working on energized equipment, you're required to protect yourself from electrical shock and arc flash hazards. Wearing the personal protective equipment needed for this type of protection presents a

## **Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service**

problem when you also need protection against overexposure to RF. When this is the case, your company will have to negotiate to get the RF antennas powered down, so that you can wear the equipment needed for protection against electrical shock and arc flash hazards without concern about overexposure to RF.

### **Safe Work Practices**

The following safe work practices will help you protect yourself from overexposure to RF.

#### **General**

- When RF emitting antennas are present in your work area, and you're not sure whether they're active, always assume that they are active and protect yourself accordingly.
- Anytime you're looking for RF antennas in what will be your work area, look closely for any stealth antennas.
- When working in a new location for the first time, track down the site manager to find out whether there are any active cellular or telecommunications antennas on the roof.
- Request a copy of the building's current RF survey. The surveys are required by the Federal Communications Commission (FCC) for registered antennas. They will tell you whether the typical RF levels in that work area are less than the maximum permissible exposure level established by the FCC. If so, you can work without concern. However, there may be times when site managers and RF surveys are unavailable or non-existent.

#### **Personal Safety Assessment When RF Hazards Are Unknown**

- When a site manager and/or RF survey is unavailable or non-existent, you'll need to make your own safety assessment.
- From outside the building, look for cellular and telecommunications antennas on the rooftop. Some buildings will be too tall, or your line of sight may be blocked by objects. However, when you can see well enough to make an accurate assessment from the ground, determine what type(s) of antennas are on the roof.
- If you identify any microwave antennas while making your observations, stay off the roof and contact your supervisor.
- If you are unable to determine what type(s) of antennas are on the roof from outside the building, make that determination once you get up to the roof.
- When you first look out on the roof, determine whether you'll be able to keep out of any RF field and/or a safe distance from the antenna(s) while performing your safety assessment. If you determine that you can't make the assessment without potentially overexposing yourself to RF, or if you're not sure, wear the appropriate personal protective equipment and use an EMF monitor (warning alarm) while performing the assessment.
- When the building's roof is accessible from inside the building, look for RF warning signs (see pictures #11–14 in Appendix B) on your way to the roof. The signs should show an electromagnetic radiation warning symbol and indicate that the area is restricted. The signs are typically inside the building at the exit door or hatch.

## **Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service**

- When RF warning signs are not present, never assume that there are no RF emitting antennas on the roof or nearby on other structures.
- Once you're outside on the roof, continue to look for RF warning signs and the antennas themselves.
- Again, if you identify any microwave antennas while making your observations, vacate the roof immediately and contact your supervisor.
- When you observe cellular or telecommunications antenna(s) on a rooftop, identify the type(s) of antenna, and which direction(s) RF is being emitted.
- Determine whether the area that you'll be working is an RF field.
- Determine how close you'll be working to the antenna(s).
- Keep in mind that even when your work area is not in an RF field, you may have to walk through an RF field to get there. When that's the case, remember to stay as far away from the antenna(s) as you can, and spend the least amount of time possible getting through the RF field to your work area.
- Based on what you learn from your personal safety assessment, and the information in this guide, determine whether you could be overexposed to RF while working on the roof, without protection.
- When you determine that you won't be overexposed, you can proceed with the work.
- When you know that you could be overexposed, or you're not sure about it, always assume that you could be overexposed, and proceed accordingly.

### **Safety Procedures When Overexposure Could Occur Without Protective Measures**

- When you're not sure whether you could be overexposed to RF, contact your supervisor and ask for help making an accurate determination on the potential for overexposure.
- If it is determined that the potential for overexposure exists, request that the antenna(s) be temporarily powered down, or ask your supervisor to make the request.
- If temporarily shutting down the antenna(s) is not possible, work with your supervisor to get the appropriate personal protective equipment and an EMF monitor.
- Make sure the EMF monitor is properly calibrated and set to warn you at the appropriate exposure level.
- Get training on the proper use of the personal protective equipment and EMF monitor before you start the work.
- Obtain, read, and carefully follow the personal protective equipment and EMF monitor manufacturers' instructions before use.

# **Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service**

## **Appendix A—RF Safety Assessment Checklist**

This checklist is for mechanical service technicians preparing to perform work on building rooftops in proximity to cellular and/or telecommunications antennas. Be sure to read the entire Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service before using this checklist.

### **General Preparations**

\_\_\_\_\_ All Antennas Assumed Active

\_\_\_\_\_ Stealth Antennas Considered

\_\_\_\_\_ Site Manager Contacted

\_\_\_\_\_ RF Survey Requested

### **Personal Safety Assessment When RF Hazards Are Unknown**

\_\_\_\_\_ Work Area Checked for RF Emitting Antenna(s)

\_\_\_\_\_ Stealth Antenna(s) Considered During Observations

\_\_\_\_\_ Antenna Type(s) Identified

\_\_\_\_\_ Area Vacated when Microwave Antenna(s) Identified

\_\_\_\_\_ Supervisor Contacted when Microwave Antenna(s) Identified

\_\_\_\_\_ Direction of Cellular and/or Telecommunications Antenna(s) RF Emissions Determined

\_\_\_\_\_ Antenna(s) Proximity to Work Area Determined

\_\_\_\_\_ Access to Work Area Evaluated for Potential Exposure to RF

\_\_\_\_\_ Potential for Overexposure Without Protective Measures Exists YES \_\_\_\_\_ NO \_\_\_\_\_

If yes, continue below. If no, proceed to perform the work.

### **Safety Procedures When Overexposure Could Occur Without Protective Measures**

\_\_\_\_\_ Assistance from Supervisor Requested

\_\_\_\_\_ Antenna(s) Powered Down YES \_\_\_\_ NO \_\_\_\_

If yes, proceed with work. If no:

\_\_\_\_\_ PPE and EMF Monitor Provided

**Guide to  
Radio Frequency (RF) Radiation Safety  
for Mechanical Service**

\_\_\_\_\_ PPE & EMF Monitor Manufacturers' Instructions Provided/Read/Understood

\_\_\_\_\_ EMF Monitor Properly Calibrated

\_\_\_\_\_ EMF Monitor Set to Alarm at Established Exposure Level

\_\_\_\_\_ Training on PPE & EMF Monitor Received

**Guide to  
Radio Frequency (RF) Radiation Safety  
for Mechanical Service**

**Appendix B—Identification of RF Emitting Cellular and  
Telecommunications Antennas and Related Items**

Pictured below are examples of different types of cellular and telecommunications antennas that emit RF, and related items.

**1) Electromagnetic  
Field Monitor**



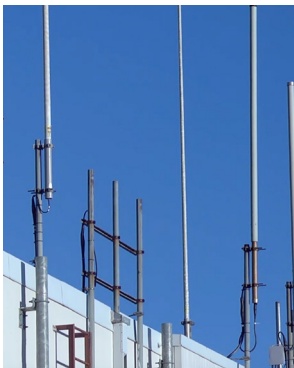
**2) Cellular Antenna**



**3) Parabolic  
Antenna**



**4) Cylindrical Rod  
Antennas**



**5) Microwave  
Antenna**



**6) Stealth Antennas**



# Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service

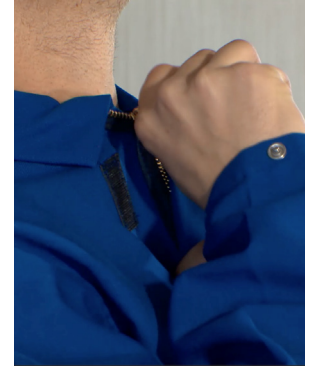
## 7) Cluster of Antennas



## 8) Personal Protective Equipment



## 9) Personal Protective Equipment



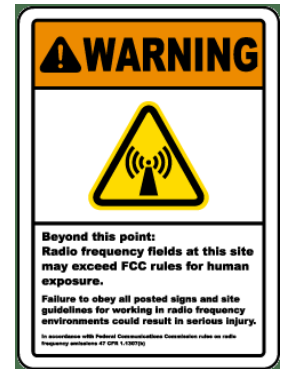
## 10) Personal Protective Equipment



## 11) Radio Frequency Radiation Warning Sign



## 12) Radio Frequency Radiation Warning Sign



## Guide to Radio Frequency (RF) Radiation Safety for Mechanical Service

### 13) Radio Frequency Radiation Warning Sign



### 14) Radio Frequency Radiation Warning Sign



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