



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE SAFETY CENTER

13 Mar 03

MEMORANDUM FOR ALMAJCOM/SE
USCENTAF/SE

FROM: HQ AFSC/SEW
9700 G Avenue, SE
Kirtland AFB NM 87117-5670

SUBJECT: AFSC/SEW Policy #2003-1, Electromagnetic Radiation (EMR) and Lightning Protection Requirements

The following change to AFMAN 91-201, Explosives Safety Standards (18 Oct 01), is effective immediately:

a. Replace the existing Paragraph 2.54.1.3.1 with the following: "In the following sentences and paragraphs 2.54.1.3.1.1 and 2.54.1.3.1.2, the term "major maintenance" is the disassembly or performance of maintenance operations which could result in exposure of the weapon's internal components to electrical energy. When conducting major maintenance operations inside a PAS, maintain a seven-foot minimum distance between an LPS unmodified Weapons Maintenance Truck (WMT) and the walls, ceiling, metallic conductor (e.g., tool box or metal cabinet), or any structural member capable of conducting electrical energy (e.g., steel columns, rebar-reinforced columns or beams). If no WMT is being used, maintain that same seven feet distance from the weapon itself and the PAS's walls, ceiling, metallic conductors, or structural member(s). When using an LPS unmodified WMT, include the stairs and attached support equipment while measuring the seven-foot distance. When using an LPS modified WMT, no minimum distance is required provided all additional safety requirements are adhered to in accordance with TO 11N-20-7."

b. Replace the existing Paragraph 2.54.1.3.1.1 with the following: "For major maintenance operations being performed at locations other than in a PAS/WMT, maintain a seven-foot minimum distance from the weapon itself and the facility walls, ceiling, metallic conductors, and structural members capable of conducting electrical energy."

c. Replace the existing Paragraph 2.54.1.3.1.2 with the following: "If a metallic conductor is within seven feet of a facility's wall, ceiling, or other structural member capable of conducting energy, ensure there is a seven foot separation distance between the metallic conductor and the nuclear weapon. For example, a weapon may not be placed any closer than ten feet from a wall having a three-foot wide toolbox against it."

d. Replace the existing Paragraph 2.58.1.1 with the following: “If an electromagnetic hazard to EEDs cannot be solved by technically qualified personnel at the local level, obtain consultation and measurement survey assistance as shown in 2.58.9.”

e. Replace the existing Paragraph 2.58.5 with the following. “Table 2.5 should be used as a guide in setting up safe separation distances between EEDs in conventional munitions and the transmitting antenna of all RF emitters or determining the maximum power density allowable for an EED. Table 2.6 applies similarly to EEDs in all nuclear weapons. These calculations are based on “worst-case” assumptions, such as EEDs subjected to direct line-of-sight main-beam illumination in far-field conditions. The far field of the antenna provides a more consistent power density environment than that found in the near field. The following formulas can be used to determine where the far field begins:

$$\text{when } L > \frac{c}{f}, R_{ff} = 2L^2 \left(\frac{f}{c} \right)$$

$$\text{when } L < \frac{c}{f}, R_{ff} = 0.1592 \left(\frac{c}{f} \right)$$

R_{ff} = distance, in meters (or feet), from transmitting antenna where the far field begins

L = largest dimension of the antenna, meters (or feet)

f = frequency (Hz)

c = speed of light, 3×10^8 m/s (or 984×10^6 ft/s)

When the size or dimensions of the emitter aperture are not known, the following equation should be used to determine the worst-case aperture size:

$$L = 0.3372 \sqrt{G_t \left(\frac{c}{f} \right)}$$

For near-field conditions, see TO 31Z-010-4, Chapter 6, Section 2.”

f. Replace the existing Paragraph 2.58.6.6.1 with the following: “When handling or installing EEDs, apply the distance listed in Table 2.5 or 2.6, column B, even though leadless EEDs are involved, since weapon systems wiring could form a resonant antenna during installation.”

g. Replace the existing Paragraph 2.58.6.7 with the following: “When unclear about the appropriate configuration and column to apply from Table 2.5 or 2.6, use the most conservative, i.e., the greatest distance or largest power density.”

h. Replace the existing Paragraph 2.58.7.1 with the following: “When electrical characteristics of the EEDs are not known or when the minimum safe separation distances cannot be complied with because of lack of real estate or other limitations, a power density and field intensity survey should be made. Compare the measured power density with the recommended maximum power

density calculated from Table 2.5 or 2.6. The measured power density must be no greater than the maximum power density provided in the table.”

i. Replace the existing Paragraph 2.58.8 with the following: “Approximate calculations for safe separation distances can also be made using the nomograph in Figure 2.3 for EEDs in conventional munitions. Example 1 in paragraph 2.58.10 illustrates how to apply this nomograph.”

j. Replace the existing Paragraph 2.58.10 with the following: “Examples of Safe Separation and Power Density Calculations: Note: HQ AFSC/SEW has automated these calculations in an Excel spreadsheet. A copy of this spreadsheet can be downloaded from the Air Force Safety Center/SEW website: <http://safety.kirtland.af.mil/AFSC/RDBMS/Weapons/weapons.html>.”

k. Replace the title to Table 2.5 with the following: “Table 2.5. Recommended EED Safe Separation Distances and Power Densities for Conventional Munitions.”

l. Replace Note 5 to Table 2.5 with the following: “Formulas in Table 2.5 apply to the far field of the antenna only. For near field requirements, see TO 31Z-10-4, Chapter 6, Section 2. Far field is determined as stipulated in paragraph 2.58.5.”

m. Replace Note 6 to Table 2.5 with the following: “For frequencies outside the range of Table 2.5, follow the procedures in paragraph 2.58.9.”

n. Delete Note 7 to Table 2.5.

o. Insert new Table 2.6:

TABLE 2.6. Recommended EED Safe Separation Distances and Power Densities for Nuclear Weapons.⁶

Configuration of EED	Maximum Allowable Power Density ³		Safe Separation Distance ^{3,4}
	Frequency ⁵	Formula	Formula
Exposed ¹	$f < 0.0132\text{MHz}$	$P_o = 100$	$D = 3.28 \sqrt{\frac{P_t G_t}{4p P_o}}$
	$0.0132\text{MHz} \leq f < 8\text{MHz}$	$P_o = \frac{0.017437}{f^2}$	
	$8\text{MHz} \leq f < 4850\text{MHz}$	$P_o = 4.257 \times 10^{-6} f^2$	
	$4850\text{MHz} \leq f < 45\text{GHz}$	$P_o = 100$	
Storage or Transport ²	Frequency ⁵	Formula	Formula
	$f < 1\text{MHz}$	$P_o = 100$	$D = 3.28 \sqrt{\frac{P_t G_t}{4p P_o}}$
	$1\text{MHz} \leq f < 18.42\text{MHz}$	$P_o = 26.53$	
	$18.42\text{MHz} \leq f < 30\text{MHz}$	$P_o = \frac{9000}{f^2}$	
$30\text{MHz} \leq f < 300\text{MHz}$	$P_o = 10$		

	$300\text{MHz} \leq f < 3000\text{MHz}$	$P_o = \frac{f}{30}$	
	$3000\text{MHz} \leq f < 45\text{GHz}$	$P_o = 100$	

Notes:

- Exposed EEDs: EEDs exposed due to maintenance, assembly, or disassembly.
- EEDs in Storage or Ground Transport: EEDs assembled in a weaponized configuration for storage or ground transportation.
- In the formulas for safe separation distance and maximum allowable power density, the following apply:
 - D = distance (ft)
 - f = frequency (MHz)
 - P_t = transmitter power (W)
 - G_t = antenna gain. See paragraph 2.58.4 to convert from G_{dB}
 - P_o = maximum allowable power density (W/m²)
- Use peak power for P_t except for pulsed systems with pulse widths less than one millisecond (ms). In this case, use the larger of 1) the average power or 2) (peak power) x (largest pulse width expressed in ms).
 - 1 ms = 0.001 seconds
 - 1 μs = 0.001 ms = .000001 seconds
- For frequencies outside the ranges specified in Table 2.6, request assistance in accordance with paragraph 2.58.9.
- Formulas in Table 2.6 apply to the far field of the antenna only. To determine where far field begins, see paragraph 2.58.5.

The above requirements will be incorporated into the next interim change to AFMAN 91-201. My POC is Denise Webb, denise.webb@kirtland.af.mil, DSN 246-0237.



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