INTERNATIONAL AMMUNITION TECHNICAL GUIDELINES

IATG 05.60

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Hazards of electromagnetic radiation

UN SaferGuard
Securing ammunition, protecting lives

IATG 05.60:2021[E]

Warning

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Foreword

Ageing, unstable and excess conventional ammunition stockpiles pose the dual risks of **accidental explosions at munition sites** and **diversion to illicit markets**.

The humanitarian impact of ammunition-storage-area explosions, particularly in populated areas, has resulted in death, injury, environmental damage, displacement and disruption of livelihoods in over 100 countries. Accidental ammunition warehouse detonations count among the heaviest explosions ever recorded.

Diversion from ammunition stockpiles has fuelled armed conflict, terrorism, organized crime and violence, and contributes to the manufacture of improvised explosive devices. Much of the ammunition circulating among armed non-State actors has been illicitly diverted from government forces.[1] In recognition of these dual threats of explosion and diversion, the General Assembly requested the United Nations to develop **guidelines for adequate ammunition management**.[2] Finalized in 2011, the International Ammunition Technical Guidelines (IATG) provide voluntary, practical, modular guidance to support national authorities (and other stakeholders) in safely and securely managing conventional ammunition stockpiles. The UN SaferGuard Programme was simultaneously established as the corresponding knowledge-management platform to oversee and disseminate the IATG.

The IATG also ensure that the United Nations entities consistently deliver high-quality advice and support – from mine action to counter-terrorism, from child protection to disarmament, from crime reduction to development.

The IATG consist of 12 volumes that provide practical guidance for 'through-life management' approach to ammunition management. The IATG can be applied at the guidelines' **basic, intermediate, or advanced levels**, making the IATG relevant for all situations by taking into account the diversity in capacities and resources available. Interested States and other stakeholders can **utilize the IATG for the development of national standards and standing operating procedures**.

The IATG are reviewed and updated at a minimum every five years, to reflect evolving ammunition stockpile-management norms and practices, and to incorporate changes due to changing international regulations and requirements. The review is undertaken by the UN SaferGuard Technical Review Board composed of national technical experts with the support of a corresponding Strategic Coordination Group comprised of expert organizations applying the IATG in practice.

The latest version of each IATG module can be found at www.un.org/disarmament/ammunition.

[1] S/2008/258.

[2] See also the urgent need to address poorly-maintained stockpiles as formulated by the United Nations Secretary-General in his Agenda for Disarmament, *Securing Our Common Future* (2018).

Introduction

There has been a significant global increase in the use of electronic communication and detection devices. Their uses include mobile telephones, wireless communication links to high-powered transmitters for voice communication, electronic data transmission, asset tracking and radar. These items produce and receive radio frequency (RF) fields of varying intensity. This intensity is controlled by their output power and antenna gain. This is potentially hazardous when used in close proximity to explosives that have an installed electrical means of initiation.

The undesired coupling of RF energy can cause inadvertent actuation of electrically initiated devices (EIDs). This hazard can be minimised by intrinsic design characteristics, screening and specialised packaging. However, there are situations when EID are vulnerable to unintended initiation such as during transportation, removal or replacement procedures.

This IATG module identifies the potential dangers and provides advice on the level of national technical authority statutory regulations required as well as the basic precautions that should be taken during storage, movement and processing of ammunition susceptible to RF hazards.

Hazards of electromagnetic radiation

1 Scope

This IATG module introduces potential hazards to ammunition and explosives posed by electromagnetic (sometimes called radio frequency) radiation. It provides guidance on the development of national technical authority statutory regulations for the precautions that should be taken during the storage, handling, processing and movement of ammunition susceptible to RF hazards.

2 Normative references

A list of normative references is given in Annex A. These documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

A further list of informative references is given in Annex B in the form of a bibliography, which lists documents that contain additional information related to the contents of this IATG module.

3 Terms and definitions

For the purposes of this module the following terms and definitions, as well as the more comprehensive list given in IATG 01.40 *Glossary of terms, definitions and abbreviations,* shall apply. In this IATG, the term “ordnance” can be interpreted as “ammunition and explosives”.

The term 'national technical authority' refers to *the government department(s), organisation(s) or institution(s) charged with the regulation, management, co-ordination and operation of conventional ammunition management activities.*

In all modules of the International Ammunition Technical Guidelines, the words 'shall', 'should', 'may' and 'can' are used to express provisions in accordance with their usage in ISO standards.

a) **'shall' indicates a requirement**: It is used to indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

b) **'should' indicates a recommendation**: It is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form, 'should not') a certain possibility or course of action is deprecated but not prohibited.

c) **'may' indicates permission**: It is used to indicate a course of action permissible within the limits of the document.

d) **‘can’ indicates possibility and capability**: It is used for statements of possibility and capability, whether material, physical or casual.

4 Background (LEVEL 2)

Many items of ammunition and explosives are, or contain, an electrically initiated device (EID). EIDs are sometimes used instead of percussion or friction initiators and are activated through the application of sufficient electrical energy. Electro-explosive devices (EEDs) are a sub-set of EIDs, but the terms are commonly interchanged. This module uses the more general term EID. In general, EIDs are susceptible to radio frequency (RF) radiation and require specific safety considerations – during classification and throughout their life cycle. In some nations, such considerations are conducted under the term Hazards of Electromagnetic Radiation to Ordnance (HERO).

Ammunition and explosives shall only be stored and logistically transported in the packaging in which they were tested and classified. The testing regime should ensure the ammunition and explosives are not susceptible during storage and transportation in the original packaging and should identify the susceptibility when outside this packaging, whether within the logistics chain (e.g. inspection or maintenance) or after having been issued for use.

RF can cause ammunition accidents, the consequences of which can be catastrophic, resulting in loss of life, major damage to, or destruction of, weapons, and even mission failure. As a result of this susceptibility to RF radiation, this section suggests controls that national authorities should impose throughout the life cycle of the ammunition. It should be noted that the military RF environment is exceptionally challenging.

While this module provides some general guidance to the national authority, it focuses mainly on storage and transportation and not the rest of the ammunition life cycle.

5 Susceptible items (LEVEL 2)

Any length of wire in an RF field will act as an aerial and pick up energy from that field. An electromagnetic (EM) hazard exists if the wire forms part of an EID and the RF level is sufficient to induce a power or current in excess of the no-fire threshold (NFT) power for the device. The NFT power or current is defined as the power required to produce a 0.1% probability of fire at the 95% single-sided lower confidence limit when applied to the EID for a time which is long compared with the thermal time constant (τ) of the device, i.e. >10 τ.

5.1 EID firing circuits

The amount of power fed to a connected EID will depend on the length and configuration of the wires and on the ratio of the source to load impedance of the firing lines and EID. Unless firing circuits are properly designed, sufficient power to fire most EID can be picked up in substantially lower RF field strengths than those experienced during in-service life. Firing circuits associated with EID, or other electrical conductors such as wires, tools and fingers in contact with the EID or firing circuit, when placed in an RF field, will act as antennae and will pick up some electrical energy from the field.

5.1.1. EID circuits and connectors

The wires of an EID, when they are separated, may form an effective dipole antenna and provide an optimum impedance match to the EID giving maximum transfer of power to the EID from the radiation source. Unless appropriate precautions are taken, the power or energy levels induced into a firing circuit from an RF field may be sufficient to initiate an EID. EID separated from their parent systems or systems opened up for maintenance or test shall be regarded as less safe than when installed into the system as intended by design. Well-designed ammunition will fail safe when the EID has been compromised by RF radiation (e.g. Fuze shutter interrupts explosive chain), but this may still result in critical assets being no more than “hittiles”.

5.1.2. Ammunition container assemblies (ACA)

The use of metallic ammunition containers does not automatically provide sufficient attenuation for EID in isolation, or for EID contained in non-metallic systems that are not adequately protected. The attachment of external cables and test sets to systems containing EID will usually increase their susceptibility to EM energy pick-up.

5.2 Testing for susceptibility

All complete explosive systems containing EID should be assessed for their susceptibility to radiation hazards (RADHAZ). This assessment should be based on national technical authority requirements and should be assessed by a practical trial conducted at a trials site. The assessments should cover the susceptibility of EID during preparation, testing, storage, transportation, loading, and when loaded on the launcher or weapons platform. Table 3 lists susceptibility categories and activities associated with them[3].

Category	Activity
1	Assembly and disassembly of weapons or stores and testing of sub-systems by personnel or test equipment generally in storage depots.
2	Testing of all up weapons or stores in test houses or alongside/on board ships.
3	Storage and transportation of weapons/stores in approved packaging.
4	Storage and transportation of weapons or stores not in approved packaging, whilst handling, assembling, loading/unloading to platform e.g. vehicle, gun, aircraft or launch platform.
5	Weapon or stores loaded to their intended use platform e.g. to an aircraft or in its launcher.

Table 1: Susceptibility categories and associated activities

6 Safety and separation distances (LEVEL 2)

A wide range of communication equipment emitting RF fields may be found near ammunition containing EIDs, including data loggers, mobile phones, pagers, radios etc. This means safe distance restrictions shall be required. EIDs and/or weapons being handled and weapons under preparation, test or maintenance are susceptible to much lower levels of RF and controls shall be required to ensure they remain safe.

The magnitude of an RF field decreases with increasing distance from the source. The hazard area for transmitters using omni-directional or rotating antennas is often defined as a right-cylindrical volume of air space centred on the transmitter. For single and multi transmitter sites that have fixed directional beams radiating predominately in the same direction such as satellite tracking sites, the hazard area is mainly in the direction of the beam.

Where no safety data exists for a particular piece of transmitting equipment, the safe distance should be determined using the simplified method outlined in Annex C. The formulae and graphical methods have been developed to facilitate the determination of safe distances when the output characteristics of transmitters and susceptibility characteristics of EID are known.

7 Storage, processing and transport (LEVEL 2)

EID are encountered in a variety of configurations between their manufacturing stage and their ultimate use or disposal. These configurations range from trade packaging in bulk, in-service packaging and sub-packages, installation in munitions and various stages of separate and exposed states that occur in processing and training.

It is important to understand how these configurations can influence the basic precautions to be adopted in storage and transport. Transportation precautions should also include measures to be taken in emergencies, from straight forward vehicle breakdowns to accidents involving fire and/or casualty evacuation.

[3] Within HERO programs, items are classified as HERO Safe, HERO Susceptible or HERO Unsafe.

Building materials are generally ineffective in providing EM protection for EID. Structures normally provide no protection at all in transmission loss from frequencies below 1MHz but many provide some protection in the form of reflection loss if the polarisation and angle of incidence of the EM energy happens to be favourable, (although this is rare and should not be assumed). Therefore, it should be assumed that the field strength that exists inside a building or vehicle is the same as that of any external field. However, if the attenuation of EM radiation which is provided by a specific building has been determined from, for example, a screened room, then this may be used to determine safe distances from sources of EM radiation. It should be noted that open doors or windows affect the screening integrity.

EID and systems containing EID should only be stored or processed in authorised depot and unit storage and process areas. These areas should be selected on the basis of:

a) the susceptibility of the EID or munitions containing EID during storage or processing as appropriate; and

b) the radiated power of transmitters in the area related to the susceptibility of the most sensitive EID present.

7.1 Storage

In depots where weapon processing is being undertaken, susceptibility levels may be much lower than is normal and it is necessary to fully understand the RF environment in which work is being carried out and the interaction with the ammunition and weapon system firing circuits. The environment will depend on local transmitters both on-site and in the local area.

Historically there has been a total ban on the use of transmitters within an ammunition storage area (ASA) unless approved by the national technical authority. This is now being reconsidered in light of the spread of the usage of these systems into every aspect of the management system. Therefore, the head of the establishment shall assess the use of all radios, including mobile phones, to be used in the vicinity of an EID, or stores containing an EID, for their potential HERO risk. The sub-paragraphs below set out suggested revised rules:

A) no deliberate RF transmitters shall be allowed inside an explosives building unless agreed after specialist ammunition technical advice is provided;

B) no deliberate RF transmitters of any power shall be allowed inside an ASA unless they are essential for an activity – in which case it will be specifically designed to be safely used;

C) risk assessments shall include safe distance calculations for the radios, portable or fixed;

D) portable radios, personnel communication equipment, mobile phones or personal electronic devices (PED) shall not to be used in areas adjacent to an ASA or magazines or close to exposed ordnance or ordnance under preparation unless they meet the general requirements in Clause 7.1.1.;

E) the minimum safe distance for the use of any management radio[4] or other transmitter in the vicinity of an EID, no matter the susceptibility of the explosive nature, when obtained by calculation shall be 3m;

F) the safe distance shall apply equally to the use of radios in vehicles transporting EID unless specific agreement is obtained from the national technical authority; and

[4] Including RFID and other low power Automatic Identification Technology (AIT) devices

G) only certified radios classified safe to the relevant standard may be used in areas where an explosive atmosphere may exist.[5]

7.1.1. Transmitter requirements

Only essential transmitters should be installed within an ASA. They should meet the requirements of this paragraph. Exceptions should be provided by the national technical authority in accordance with the following guidelines:

A) transmitters with a power output of ≤1W and with an aerial gain of ≤6dB across the frequency spectrum are acceptably safe at a distance of ≥10m from the exterior of the buildings; and

B) transmitters with a power output of ≤10W, with an aerial gain of ≤ 6dB and with a frequency of >300MHz are acceptably safe at a distance of ≥5m from the exterior of the buildings. These distances shall also be maintained between the transmitter and ESA transit routes.

7.1.2. Within an ASA

Within an ASA and also external to buildings where EID initiated items are only stored in their approved containers (and not being unpacked, handled or being worked), transmitters with a power output of ≤25W and with an aerial gain of ≤6dB across the frequency spectrum are safe at a distance of 3m from the exterior of the buildings. This rule shall only be permitted where essential and where strong controls are in place and can be assured to be in place for the lifetime of the transmitter.

7.1.3. In a process building

In general, the use of transmitters within buildings of an ASA shall be prohibited. However, this is an area where much research is being conducted and specialist national technical authority advice should be sought on this subject.

7.1.4. External to the perimeter

Outside the ASA and at least 100m from a processing building, radios with a power output of ≤50W or with no significant antenna gain may be safely used. For higher power radios or radars, an assessment should be made to determine the possible field strength in processing areas. For some very high-power broadcast transmitters, air traffic control radars or military radars this may require knowledge of their location out to distances of 3km. In cases such as this, specialist assistance should be sought.

7.1.5. Mobile phones and pagers

The use of mobile phones and pagers shall be controlled in the vicinity of munitions. Mobile phones and pagers shall not be used:

A) in the presence of hazardous vapours;

B) in explosive storehouses (ESH), potential explosion sites (PES), magazines and weapon stowage areas or ammunition process buildings; or

C) close to ammunition and explosives under preparation.

Mobile phones and pagers may be used in other areas provided that only standard handheld phones or pagers are used, and that the minimum separation distances are calculated in accordance with Annex C or are a minimum of 4m, whichever is the larger.

[5] See IATG 05.40 *Safety standards for electrical installations*.

Although most radio pagers are passive devices with respect to electromagnetic power output, they may still contain components capable of causing a spark and are therefore a hazard in an area where there are exposed explosives or flammable vapours. A class of pagers exists, referred to as Talkback pagers, that may transmit messages in addition to receiving them. Typically, the transmission frequency range is 146 to 174MHz and the maximum effective radiated power (ERP) is 50mW.

7.1.6. Asset Tracking

Where it is appropriate to attach an RF asset tracking system to a weapon or approved container, or close to it, the safe distance is dependent on the transmit power and frequency. Due to the near field effects, this distance does not allow the use of simplified formulas such as those at Annex C.

There are generally three types of RF asset tracking/radio-frequency identification (RFID) tags in use: active RFID tags, which contain a battery and can transmit signals autonomously; passive RFID tags, which have no battery and require an external source to provoke signal transmission; and battery assisted passive (BAP) RFID tags, which require an external source to wake up but have significant higher forward link capability providing greater range.

Active and battery assisted RFID shall not be taken into an explosives area unless specifically approved by the head of establishment who should seek specialist ammunition technical advice. In the case of the passive tags, the equipment used to read the tags shall not be taken into an explosives area unless specifically approved by the head of establishment who should seek specialist ammunition technical advice.

7.1.7. Data Loggers

In order to provide environmental data, approved data loggers may be attached to a number of munitions or their containers. Many of these devices are passive until interrogated and thus should be removed for interrogation. Removal of these data loggers should be in an approved process facility and the readers approved for use in that area or the logger removed to be read.

7.2 Transportation (LEVEL 2)

7.2.1. Road transportation

It is not practicable to obtain a safe EID environment during transportation through the use of calculated safe distances. For this reason, all EID and systems containing EID and being transported should be safe in a field strength of at least 200V/m ($100Wm^{-2}$) at all frequencies for road transportation.

7.2.2. Other modes of transport and items not cleared for transportation

EID and systems containing EID which have not been cleared to an EM environment of $100Wm^{-2}$, and those requiring protection in a more severe RF environment such as by ship or aircraft movement, shall be protected during transit by enclosure in a metal box or by approved materials providing sufficient screening. Specific instructions on munitions incorporating EID, which are either cleared or not cleared for transportation depending on RF protection, should be obtained from the national technical authority.

Where the items need to be closer than the minimum 3m to vehicle fixed transmitters or antenna, specialist advice shall be sought from the national technical authority. Dependent on the power output, frequency and cable routing, this may in some cases be reduced to 0.5m if the system is packed in approved containers and has been assessed as safe as a result of specialist testing. When it is considered necessary to transport systems containing EID of unknown susceptibility, advice should be obtained from the national technical authority. Personnel engaged in such activities shall be made aware of EM hazards and observe consignor's instructions fully. Note should be made of any special instructions covering loading, unloading and handling when EID are most vulnerable to EM radiation.

7.2.3. Anti-theft tracking devices

Many vehicles are now fitted with anti-theft tracking devices or stolen vehicle recovery systems. The driver may not be aware of this; as such it should be assumed that all vehicles entering an ASA have them fitted. It has been assessed that the probability of accidental initiation of EID is negated by maintaining a distance of 5m between the vehicle and the exterior walls of any building containing explosives.

7.2.4. Emergency situations

In the event of an incident or accident[6] during the movement of ammunition, items that do not normally present a high RADHAZ risk may become vulnerable if there is damage to their inherent protection, be it structural or packaging. In such a situation, controls on the use of RF transmissions in the immediate vicinity should be imposed immediately:

A) no RF transmission shall be allowed within a radius of 10m from the EID;

B) any emergency services using vehicle borne sets with ERP greater than 5W should not transmit within 50m of the damaged equipment; and

C) drivers and/or escorts in vehicles transporting EID should be issued with emergency instructions as approved by the national technical authority.

When an accident occurs in which it is suspected that RADHAZ may be a cause, it is important that the details of nearby transmitters (e.g. which ones were active, on which frequencies, power levels, etc) and the configuration of any ammunition and explosives involved (e.g. proximity to transmitters, whether disassembly, handling, or loading was being performed, etc). . Annex D provides further information on the information to be collected. Specialist technical assistance should be sought to aid in assessing the accident and the information collected.

8 Safety Statement.

No RF emitters, even of very low power, shall be allowed to touch ammunition and explosives. Special consideration may need to be paid to personnel with medical implants and medical body worn devices, particularly those using Wi-Fi® or Bluetooth® technologies.

[6] Ammunition accidents and incidents should be investigated in accordance with IATG 11.10 *Ammunition accidents and incidents*

Annex A
(normative)
References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this module. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this module are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO maintain registers of currently valid ISO or EN:

a) IATG 01.40 *Glossary of terms, definitions and abbreviations*. UNODA;

b) IATG 02.10 *Introduction to risk management principles and processes*. UNODA; and

c) IATG 05.40 *Safety standards for electrical installations*. UNODA.

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references[7] used in this guideline and these can be found at: www.un.org/disarmament/un-saferguard/references. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/ammunition. National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition management programmes.

[7] Where copyright permits.

Annex B
(informative)
References

The following informative documents contain provisions, which should also be consulted to provide further background information to the contents of this module:

a) AASTP-1, Edition B, Version 1. *NATO Guidelines for the Storage of Military Ammunition and Explosives.* NATO Standardization Organization (NSO). December 2015. http://nso.nato.int/nso/nsdd/listpromulg.html;

b) AECTP-500, Edition E, Version. 1. *Electromagnetic Environmental Effects Tests and Verification, Category 508, Ordnance Test and Verification Procedures*. NATO Standardization Organization (NSO). December 2016. http://nso.nato.int/nso/nsdd/listpromulg.html; and

c) DSA03.OME part 2 provides for the safe storage and processing of Ordnance, Munitions and Explosives (OME). UK MOD. November 2020.

The latest version/edition of these references should be used. The UN Office for Disarmament Affairs (UNODA) holds copies of all references[8] used in this module and these can be found at: www.un.org/disarmament/un-saferguard/references/. A register of the latest version/edition of the International Ammunition Technical Guidelines is maintained by UNODA, and can be read on the IATG website: www.un.org/disarmament/convarms/ammunition. National authorities, employers and other interested bodies and organisations should obtain copies before commencing conventional ammunition management programmes.

[8] Where copyright permits.

Annex C
(informative)
EID and firing circuit sensitivity (LEVEL 2)

C.1 Definition

An EID is a one-shot explosive or pyrotechnic device used as the initiating element in an explosive or mechanical train and that is activated by the application of electrical energy. They are designed to produce a specific output such as detonation, flame or gas in order to perform a particular task. An explosive reaction process occurs in an EID when either:

A) the temperature of a small amount of primary explosive is raised above its ignition temperature, by the heat generated following an input of electrical energy; or

B) a secondary explosive is detonated by the mechanical shock created when a high voltage is discharged into a low resistance bridge such as an exploding bridge wire (EBW) or exploding foil initiator (EFI).

C.2 Types of EID

EID can be divided into 2 groups— low voltage and high voltage. They can be further categorised into 3 types:

A) low voltage (LV) devices with long thermal time constants, typically 10ms - 50ms, such as EBW. These are often called power sensitive EID;

B) LV devices with short thermal time constants (typically 1μs - 100μs) such as film bridge (FB) and conducting composition (CC), often known as energy sensitive; and

C) high voltage (HV) devices with a secondary explosive such as EBW and EFI, which require a fast, high voltage discharge pulse to initiate them. These are known as HV energy sensitive.

C.3 Firing thresholds

Power sensitive devices tend to integrate transient energy and, in the case of repetitively pulsed radars, they will respond to mean or average power levels. LV energy sensitive devices tend to respond to the peak power level of an electrical transient or pulse and pulse stream such as pulsed radar and this should be taken into account when determining their susceptibility.

HV energy sensitive devices are considered to require such a specialised, fast rising pulse that accidental initiation from a radio or radar field is not credible and risk assessments indicate a very low probability of accidental initiation. Whilst this describes the characteristics of each type of EID it does not mean that they react only to power or energy impulses. In determining No Fire Thresholds (NFT) both types of reactions should be considered in relation to statistical sampling based on 0.1% probability of firing at a single-sided lower 95% confidence level. To illustrate the results of such sampling on a typical EBW EID (Igniter Type F53) and a typical CC device (Type M52) NFT figures are shown below.

EID	Resistance Range (Ω)	NFT Power (mW)	NFT Energy (mJ)	Time Constant (ms)
Igniter Type F53	0.9 -1.6	130	2.3000	18.000
M52 CC Igniter	1k – 1.2M	14	0.0022	0.157

Table C.1: Example no-fire thresholds for EID

C.4 Transmitters and field strength calculation

Any radios being used should be of known field strength as supplied by the manufacturer or the national technical authority. A graph of field against distance is the preferred data format. Radios being used by establishment personnel or contractors should ideally not be used in areas where ammunition is being handled or in the vicinity of routes when ammunition is being handled, during loading or unloading operations or close to ammunition being loaded onto a firing platform or launcher. Where this cannot be avoided a safe distance shall be calculated and applied.

The following information is the minimum required to calculate transmitter field strength:

A) type of aerial, directional or omni-directional;

B) the mean power being supplied to the transmitter antenna in Watts;

C) the frequency or frequency band of the transmitter; and

D) the antenna gain.

If the transmitter has a pulse waveform and the EID is one whose thermal time constant is small (i.e. energy sensitive) the following is also required:

A) the pulse repetition frequency (PRF) in pulses per second; and

B) the pulse width (PW) in seconds.

This information is normally found in the equipment handbooks, from equipment manufacturers or from the national technical authority. Calculation of field strength should only be undertaken by qualified personnel and the national technical authority should be consulted.

When susceptibility levels have been calculated, this information should be used to determine minimum separation distances, i.e. the hazard area, for explosive stores from radio and radar transmitters. There will generally be several minimum distances, which will take into account the specific activity being undertaken.

Where the transmitter information and the susceptibility of the EID are known, the transmitter power density hazard graph (see Figure C.1 below) can be used to determine the safe distance for the operation of radios or other equipment emitting RF radiation. The susceptibility data normally provided applies to a continuous wave (CW) environment. In this environment, all EID are susceptible to induced power (i.e. average power over a period > τ). However, conducting composition (CC) and thin film EID are pulse sensitive such that in a pulsed RF environment they are also susceptible to energy induced from a single pulse or a pulsed stream.

Where the transmitter information is known, but the susceptibility of the EID or explosive store is unknown, then reference should be made to Table C.2. The table is an example only and assumes the 0.003W/m^2 susceptibility figure for an F53 EBW with a 2m length of firing lead to calculate the minimum safe distance. These distances may then be used for frequencies up to 1GHz. This table should be used against data from a specific EID and is provided as an example only.

The safe distances determined under this module are subject to any over-riding limitation laid down elsewhere for the protection of personnel against biological effects of RF radiation.

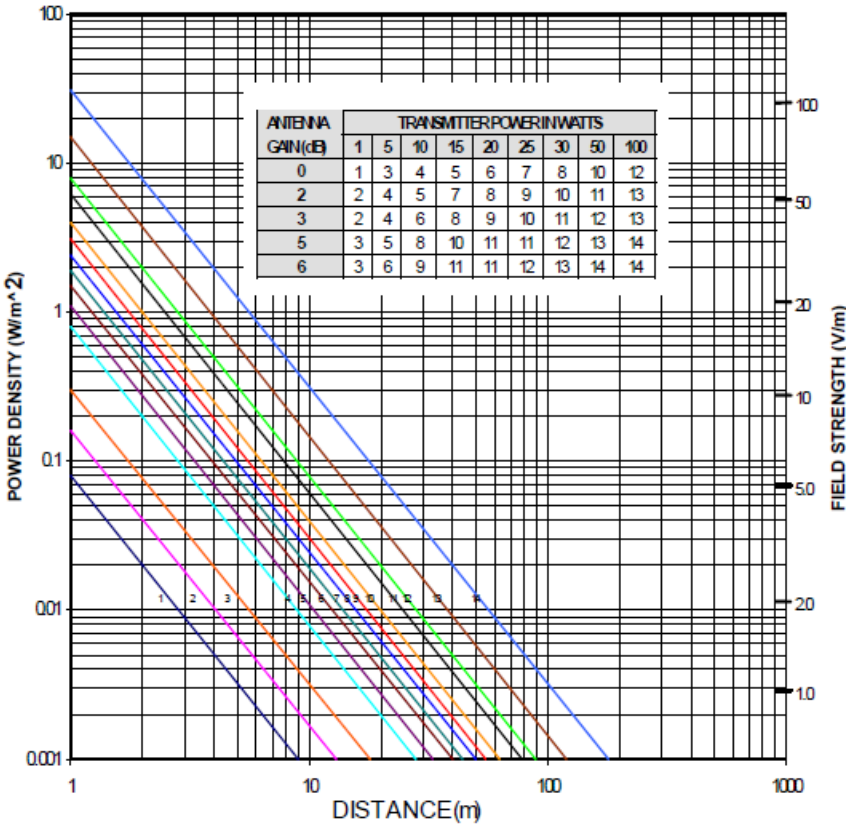

Figure C.2: RF power density hazard graph for frequencies from 60 to 500MHz

Antenna Gain Ratio (dBi)	Transmitter Power (W)							
	1W	4W	6W	10W	15W	25W	30W	50W
Unity	5.0m	10.0m	13m	17.5m	20.0m	26.0m	28.0m	36.5m
Special	6.5m	13.0m	16m	20.5m	25.0m	32.5m	35.5m	46.0m
Standard	7.5m	15.5m	18m	23.0m	28.0m	36.5m	40.0m	51.5m
High Gain	10.0m	18.5m	22m	29.0m	35.5m	46.0m	50.0m	65.0m

Table C.3: Worst case separation distance

Annex D
(informative)
RF Report

1. For all emitters that could potentially pose an RF hazard, record the following emitter specifications. You are encouraged to interpret “potentially” in a broad manner.

A) RF emitter

B) transmit antenna

C) RF emitter operating mode

D) transmit frequency;

E) power output, both peak and average if known;

F) modulation;

G) antenna rotation rate or settings;

H) bore sight or aspect angle of radiating antenna to the A&E location;

I) approximate distance between the transmitter antenna and A&E; and

J) for radars and satellite communication transmitting systems:

i. pulse width;
ii. duty cycle; and
iii. pulse repetition frequency.

2. For handheld transmitters, smart phones, cell phones, tablets, computers and computer accessories record the:
A) manufacturer;
B) model;
C) location;
D) mode/setting (AM/FM, wi-fi, Bluetooth, cellular, airplane mode)

3. Describe any discrepancy between the standard operating procedures and the actual operating procedures that were followed.

4. If applicable, record the exact location of where personnel physically touched an A&E item, and under what conditions.

5. As appropriate, and to aid in the detailed technical investigation, record contact details for:
A) unit RF safety officer or general safety officer;
B) unit explosives safety officer;
C) officer of the day;
D) weapons officer; and
E) fire department.

6. Ensure the details of all A&E items involved are recorded.

7. Attach this report to the accident case file.

Amendment record

Management of IATG amendments

The IATG are subject to formal review on a five-yearly basis. This does not preclude amendments being made within these five-year periods for reasons of operational safety, efficacy and efficiency or for editorial purposes.

As amendments are made to this IATG module they will be given a number, and the date and general details of the amendment will be shown in the table below. The amendment will also be shown on the cover page of the IATG by the inclusion of the amendment number and date.

As the formal reviews of each the IATG module is completed, new editions will be issued. Amendments will be incorporated into the new edition and the amendment record table cleared. Recording of amendments will then start again until a further review is carried out.

The most recently amended, and thus extant, IATG module is posted on www.un.org/disarmament/ammunition

Number	Date	Amendment Details
0	01 Feb 15	Release of Edition 2 of IATG.
1	31 March 21	Release of Edition 3 of IATG.