5 SUMMARY OF REQUIREMENTS/CHECKLIST

5.1 COMMON

The tables on the following pages are to be used by the projects to manage compliance of the requirements.

When making a presentation to FMV's advisory groups, the lists should be completed (see *section 2.6*).

Whether a requirement is fulfilled or not, or if it is not applicable, is to be noted in the fulfilment column (Yes, No or Not applicable).

In the column "Justification" it shall be noted as to how the requirement is fulfilled or why it is not applicable.

5.2 REQUIREMENTS IN CHAPTER 2 "SAFETY ACTIVITIES AND REQUIREMENTS COMMON TO ALL EQUIPMENT"

5.2.1 Safety Activity Requirements

	Content	Fulfilment	Justification
1.21001	Safety requirements **shall** be specified in the Request for Proposal (RFP) in accordance with *section 2.5*.		
1.21002	For explosives, advice **shall** be obtained from FMV's Advisory Group for Explosives. See also *section 2.6.3*.		
1.21003	Advice from FMV's other advisory groups for ammunition safety **shall** be obtained when appropriate. See *section 2.6*.		
1.21004	Safety testing **should** be performed by the supplier as part of the safety verification. See also *section 2.7*.		
1.21005	Test directives for safety inspections (part of the In-Service Surveillance of Ammunition) **shall** be produced in conjunction with the procurement. See also *section 2.8* and the *FMV Manual for In-Service Surveillance of Ammunition*.		
1.21006	Supply classification data **shall** be provided and registered in FREJ (Swedish Defence database for registration of materiel).		
1.21007	Draft handling, maintenance and user instructions **shall** be provided.		

5.2.2 Requirements Common to all Equipment

Req.no	Content	Fulfilment	Justification
1.22001	Incorporated explosives **shall** be qualified in accordance with FSD 0214, STANAG 4170 or equivalent. *Comment:* Assessments relating to the scope of the qualification are carried out where appropriate by FMV's Advisory Group for Explosives, see *section 2.6.3*.		
1.22002	Incorporated materials **shall** be compatible so that the product remains safe during its lifetime. *Comment:* Incompatible materials are to be avoided even if their reaction products are harmless. During compatibility testing, all of the organic materials used in the explosives along with other safety critical components are often analysed. This applies to materials that are in direct contact with each other or that can be affected via exchange of gases.		
1.22003	The product **shall** retain its safety properties for at least as long as its specified service life.		
1.22004	Service life and compatibility testing should be carried out in accordance with FSD 0223 or equivalent.		
1.22005	Environmental requirements **shall** be specified as part of the procurement. For example, the Defence Sector's criteria documentation shall be followed and any exceptions approved and documented.		

5.2.3 Requirements of International Law

Req.no	Content	Fulfilment	Justification
1.23001	Weapons **shall not** be designed so that they violate international law. Thus weapons with a non-discriminatory effect that causes unnecessary suffering or excessive injury are forbidden.		
1.23002	Each project concerning the study, development, new acquisition or modification of weaponry or methods of warfare **shall** be reported to the Delegation for Supervision of Weapon Projects. *Comment:* Notification to the delegation shall be carried out at an early stage and in cooperation with the Armed Forces.		

Req.no	Content	Fulfilment	Justification
1.23003	Booby traps that look like civilian utility goods, or which are marked with internationally recognised safety symbols, **shall not** be developed.		
1.23004	Laser weapons mainly for use against people (anti-personnel laser weapons) **shall not** be developed.		
1.23005	Weapons intended to poison **shall not** be developed.		
1.23006	Incendiary weapons that have a non-discriminatory effect, or are mainly intended for anti-personnel use, **shall not** be developed.		
1.23007	Weapons that are difficult to aim at a specific target **shall not** be developed. *Comment:* This requirement applies, among other things, to weapons used for carpet bombing.		
1.23008	Weapons that may cause extensive, long-term, severe damage to the natural environment **shall not** be developed.		
1.23009	High explosive shells designed primarily for anti-personnel purposes **shall** have a minimum weight of 400 grams.		
1.23010	Mines **shall not** be designed to be of similar appearance to civil utility goods, neither may they be marked with internationally recognised safety symbols.		
1.23011	Bullets **shall not** be easily expanded or flattened in the human body.		
1.23012	Bullets **shall** have a full metal jacket and not have notches (cf. dum-dum bullets).		

5.3 Requirements in Chapter 3 "Weapon"

5.3.1 Common requirements relating to weapons

5.3.1.1 Danger area

Req.no	Content	Fulfilment	Justification
1.31001	On the basis of analysis and testing, an assessment of the danger area for all current combinations of weapons, ammunition, and firing procedures **shall** be determined. *Comment:* Refer also to the relevant hazard, e.g. blast pressure, fragmentation, toxic substances.		

5.3.1.2 Safety of friendly forces

Req.no	Content	Fulfilment	Justification
1.31002	There **shall** be an emergency stop function for laying and firing when the ordinary stop function is not sufficient to prevent injury to a person or damage to property. *Comment:* Cf. standard SS-EN ISO 13850:2008.		
1.31003	The emergency stop function for laying and firing should be designed and operate in such a way that the energy source can be disconnected.		
1.31004	The emergency stop function for laying and firing should be located as close to the energy source as possible.		
1.31005	It **shall** be possible to unload a loaded weapon (the removal of the ammunition from the chamber, magazine and equivalent. *Comment:* Some disposable weapons are not possible to unload.		
1.31006	It should be possible to manually override automatic functions.		
1.31007	It **shall** be possible for gun crews to wear specified equipment while at their operator station. *Comment:* Such equipment may comprise personal protective clothing such as gloves, a helmet, eye protectors (e.g. protective mask, anti-laser goggles) and CRBN protective clothing.		
1.31008	Monitors/VDUs should be designed to enable them to be viewed with existing lighting, even outdoors in direct sunlight or in darkness.		

Req.no	Content	Fulfilment	Justification
1.31009	Symbols and texts on switches and other controls **shall** be legible and unambiguous in accordance with applicable standards.		
1.31010	In weapon systems where several operators can fire the weapon, it **shall** be possible for each operator to render the weapon safe independently.		
1.31011	Steps and footholds **shall** be fitted with appropriate anti-slip surfaces.		
1.31012	Locking devices **shall** be provided to ensure that heavier hatches and doors remain in the open position, see also requirements *1.33021* and *1.33022*.		
1.31013	Ventilation and heating/air conditioning systems should be incorporated if applicable.		
1.31014	A safe separation distance **shall** be established for all relevant types of ammunition in the most unfavourable firing conditions. *Comment:* Protective features on the weapon are to be taken into consideration, cf. requirement *1.44017*.		
1.31015	The firing mechanism **shall** have a transport safety device.		
1.31016	The firing system **shall** have a safety device for the transport and operating phases.		
1.31017	It **shall** be possible to render the system safe to prevent inadvertent firing during loading/unloading and during transport of the system.		
1.31018	The necessity of using a specific stance when firing a weapon **shall** be documented in the Safety Restrictions.		
1.31019	When fitting external equipment onto the weapon, consideration **shall** be given to the effect of possible muzzle blast.		
1.31020	Muzzle blast **shall not** cause injury to the gunner.		
1.31021	The weapon should not produce such a muzzle blast that personal protective equipment is required for the crew.		

5.3.1.3 *Toxic substances*

Req.no	Content	Fulfilment	Justification
1.31022	The concentration of toxic substances **shall** be lower than the permissible values stated in AFS.		
1.31023	Requirement *1.31022* **shall** be verified for the worst possible firing conditions and at field conditions.		

5.3.1.4 *Electrical and magnetic fields*

Req.no	Content	Fulfilment	Justification
1.31024	The susceptibility of electrical circuits to interference **shall** be analysed with regard to safety.		
1.31025	The levels of electrical and magnetic fields to which the crew and equipment are subjected **shall** be determined.		

5.3.1.5 *Robustness to extreme climatic conditions*

Req.no	Content	Fulfilment	Justification
1.31026	Weapon requirements **shall** be formulated in a way that handling is possible also when operators are wearing protective clothing and using other equipment.		

5.3.1.6 *Fire*

Req.no	Content	Fulfilment	Justification
1.31027	In the event of fire in a weapon platform or in equipment (ammunition or other) stowed in a confined space the crew should be protected by specific design measures and/or escape routes.		

5.3.1.7 *Sound pressure*

Req.no	Content	Fulfilment	Justification
1.31028	The sound pressure level **shall** be determined for the personnel concerned. Measurements **shall** be carried out in accordance with the Armed Forces' regulations for the measurement of impulse noise from weapons and firing in open areas as well as in built-up areas in accordance with Armed Forces' regulations. The results of measurements form the basis for the type of personal protective equipment required and the number of exposures (rounds) the crew concerned may be subjected to over a specified period of time. *Comment:* Regulations in accordance with HKV document ref. 14990:75816 dated 10 November 2005 or equivalent replacements. The Swedish Armed Forces is conducting continuous work in this area; regulations will therefore most probably be updated. On this basis, checks have to be made to ensure that current regulations are applied.		
1.31029	The use of protective devices and the location of the crew relative to the launcher **shall** be stated in the Safety Instructions.		

5.3.1.8 *Back blast*

Req.no	Content	Fulfilment	Justification
1.31030	The back blast (propellant gases and unexpended gunpowder) from the muzzle brake or equivalent via the rear opening during firing **shall not** have such high particle and energy content that it can cause injury to personnel or damage to equipment outside the specified danger area.		
1.31031	Requirement *1.31030* **shall** be verified by calculation and testing.		

5.3.1.9 *Vibration dose*

Req.no	Content	Fulfilment	Justification
1.31032	Personnel **shall not** be exposed to a harmful vibration dose. *Comment:* Commonly used requirements for exposure to body vibration are stated in SS-ISO 2631 and ISO 5349.		

5.3.1.10 ***Pressure***

Req.no	Content	Fulfilment	Justification
1.31033	When establishing the dimensions and design of the barrel, breech mechanism and other parts exposed to pressure, the pressure definitions and procedures stated in STANAG 4110 or equivalent standard **shall** be applied.		

5.3.1.11 ***Spring forces***

Req.no	Content	Fulfilment	Justification
1.31034	It **shall** be possible to determine whether a spring contains stored energy.		
1.31035	Spring forces that alone, or in combination with other hazards, can result in an accident **shall** be analysed.		
1.31036	Spring forces that can cause an accident **shall** either be provided with double locking devices or protective covers that prevent inadvertent release of the spring forces.		
1.31037	Any spring that constitutes a component in a locking device which, in the event of malfunction, can cause injury, **shall** be analysed with regard to failure modes and characterised.		
1.31038	Fastening elements **shall** be analysed with regard to failure modes and characterised together with the spring.		
1.31039	The characteristics, according to requirements *1.31037* and *1.31038*, **shall** be maintained between inspection intervals for preventive maintenance purposes, so that safety is not impaired.		
1.31040	Springs and their attachment elements that can affect safety **shall** be protected so that inadvertent contact by personnel or the environment around the system does not degrade their safety.		
1.31041	Springs and their attachment elements that can cause a serious injury in the event of malfunction should have a duplicate (redundant) function or have a fail-safe function.		

5.3.1.12 ***Hydraulic and pneumatic forces***

Req.no	Content	Fulfilment	Justification
1.31042	It **shall** be possible to determine whether a hydraulic or pneumatic design contains stored energy.		
1.31043	Accumulated pressure **shall** be monitored and equipped with a device for pressure equalisation if inadvertent actuation in the system can lead to injury during operation, unloading and/or maintenance.		
1.31044	Monitoring as specified in requirement *1.31043* should be duplicated (instrument and control lamp) or have a fail-safe function.		
1.31045	Hydraulic hoses and components should be located in confined spaces outside crew compartments.		
1.31046	Hydraulic fluid should be prevented from penetrating into crew compartments.		

5.3.1.13 ***Recoil forces***

Req.no	Content	Fulfilment	Justification
1.31047	The danger area around the recoilless system **shall** be determined and specified in the Safety Instructions (SI). *Comment:* The actions of the gun crew in all situations (emergency firing, unloading, etc.) shall be taken into account.		
1.31048	If overpressure can occur in the recoil brake and recuperator hence constituting a hazard, they **shall** be equipped with a device for relieving the pressure before disassembly.		
1.31049	The recoil forces in a recoilless system **shall** be determined by calculation and testing.		

5.3.1.14 ***Other forces***

Req.no	Content	Fulfilment	Justification
1.31050	Rotating and other moving parts should be located so as to minimise the risk of injury. *Comment:* This requirement can be satisfied by the provision of safety guards or by preventing the presence of personnel inside the danger area.		
1.31051	It **shall not** be possible for loading devices to be controlled by anyone other than the person performing the loading.		
1.31052	Crew **shall** be protected against the ejection of empty cartridge cases.		

5.3.1.15 ***Lasers***

Req.no	Content	Fulfilment	Justification
1.31053	It should not be possible to activate range-finder lasers in an arbitrary direction. *Comment:* This requirement can be satisfied by aligning the laser to the barrel or equivalent.		
1.31054	Lasers should be equipped with safety circuits for use in training mode.		
1.31055	Lasers should be equipped with protective covers and locking devices.		
1.31056	It should not be possible to look into the laser aperture during normal use.		
1.31057	Lasers **shall** be equipped with warning signs.		
1.31058	Sights, prism windows etc. should either have built-in laser protection filters or be designed in a way that allows be designed so that the operator can wear laser safety goggles.		

5.3.1.16 ***Mechanical stability***

Req.no	Content	Fulfilment	Justification
1.31059	The stability of the chassis, platform, controls, eye-piece, launcher etc. **shall** be such that there is adequate stability during firing.		

Req.no	Content	Fulfilment	Justification
1.31060	It **shall** be possible to secure doors or hatches in the closed and open position.		
1.31061	Weapons/weapon platforms **shall** be designed so that stowed equipment and ammunition **shall not** move or be dislodged from their designated places during use. *Comment:* Requirements regarding resistance to mine shock must be taken into account.		

*5.3.1.17 **Transport***

Req.no	Content	Fulfilment	Justification
1.31062	Racks and bins **shall** be designed so that the environmental impact during transport and movement **shall not** exceed the specified robustness of the ammunition.		

5.3.2 Launchers

*5.3.2.1 **Weapon installation***

Req.no	Content	Fulfilment	Justification
1.32001	Launchers controlled by electronics **shall** have an interface with safety functions so that malfunctions, or failures in software for example, do not affect safety in any crucial way. *Comment*: This is achieved by a design that separates electronics controlling safety functions and electronics designed for other functions.		
1.32002	Clearance between the elevating system and other parts at maximum recoil within the entire laying range in traverse and elevation **shall** be sufficient to prevent damage to the system.		
1.32003	Protective barriers or covers should be fitted to prevent crewmembers from being injured by moving system parts (i.e. within the range of movement of the recoil system, etc). *Comment:* "Dangerous" area should be marked.		

5.3.2.2 *Breech mechanisms*

Req.no	Content	Fulfilment	Justification
1.32004	It **shall** be possible to operate the breech mechanism from outside the zone of motion of the recoil system to prevent injury to crew members by squeezing.		
1.32005	When the breech mechanism is fully closed it **shall** be locked in its position.		
1.32006	The breech mechanism **shall not** open as a result of vibration caused by firing or motion/transport.		
1.32007	It should not be possible to assemble any component of the breech mechanism in an incorrect manner that could cause injury/damage.		
1.32008	When the breech mechanism is operated automatically the firing mechanism **shall** automatically become inactive before the breech mechanism is released from its locked position.		
1.32009	It **shall** be possible to indicate or observe the status of the breech mechanism.		
1.32010	It **shall not** be possible to fire the weapon if the breech mechanism is not fully closed.		

5.3.2.3 *Firing mechanism*

Req.no	Content	Fulfilment	Justification
1.32011	It **shall** be possible to make the firing mechanism safe from outside the zone of motion of the recoil system.		
1.32012	The weapon **shall** be fired by an active operation from outside the zone of motion of the recoil system.		
1.32013	If an electromechanical device is used it **shall** be protected from radiated or conducted interference that could cause unintentional discharge.		
1.32014	If a firing button, pedal, lever or similar is employed it **shall** be provided with protection against inadvertent operation such as by a trigger guard.		

Req.no	Content	Fulfilment	Justification
1.32015	Electrical firing systems **shall not** be susceptible to radiated or conducted interference generated by other electrical installations within the weapon system, or from external sources of interference (radio, radar etc.) without resulting in an inadvertent discharge.		
1.32016	The firing system should be designed in such a way that the electrical connector does not make contact with the base connector of the artillery primer until intended firing.		
1.32017	There should be at least one mechanical safety device that directly prevents the striker from actuating. This feature should not be a part of the firing linkage.		
1.32018	There **shall** be a separate manually operated safety switch that breaks the electrical firing circuit.		
1.32019	The safety switch specified in requirement *1.32018* **shall** be located outside the zone of operation of the recoil system.		
1.32020	The safety switch specified in requirement *1.32018* **shall** be marked with actual position/mode such as: S for safe, P for one round, and A for automatic fire.		

*5.3.2.4 **Breech ring***

Req.no	Content	Fulfilment	Justification
1.32021	For a given load profile, the life of the breech ring **shall** be established by calculation and material testing.		

5.3.2.5 *Obturation*

Req.no	Content	Fulfilment	Justification
1.32022	Obturation **shall** be designed to ensure that the crew is not exposed to either hot gases or harmful concentrations of toxic fumes.		

5.3.2.6 *Secondary combustion*

Req.no	Content	Fulfilment	Justification
1.32023	Secondary combustion, which may cause injury to personnel, **shall not** occur.		

5.3.2.7 *Barrel wear*

Req.no	Content	Fulfilment	Justification
1.32024	The barrel **shall not** constitute an increased risk (such as by imparting extra stress on ammunition or incorrect trajectory) when the ammunition in question is fired in either a new or worn barrel. *Comment:* A barrel is defined as worn when it has less than 25% left of its total service life.		
1.32025	Requirement *1.32024* **shall** be verified by testing.		

5.3.2.8 *Barrel fatigue*

Req.no	Content	Fulfilment	Justification
1.32026	Fatigue life **shall** be determined and verified. Theoretical calculations may be used. *Comment*: See STANAG 4516 and STANAG 4517.		

5.3.2.9 *Barrel rupture*

Req.no	Content	Fulfilment	Justification
1.32027	The barrel **shall not** rupture when firing with a specified amount of snow, sand or gravel in the barrel.		

Req.no	Content	Fulfilment	Justification
1.32028	Requirement *1.32027* should be verified by testing. *Comment:* The requirement applies primarily to small-bore weaponry but if the system is used in such a way that there is a high probability that foreign matter may enter the barrel it may also apply to larger calibre weaponry. Testing may be performed by filling the barrel with various quantities of sand and gravel to determine the durability of the weapon.		

5.3.2.10 ***Cook-off***

Req.no	Content	Fulfilment	Justification
1.32029	Cook-off **shall not** occur during the maximum specified fire engagement in combination with jamming involving rammed ammunition. *Comment:* Refer also to requirements *1.41008*, *1.42011* and *1.43019*.		
1.32030	To determine the risk of cook-off, the temperature and heat flux etc. for a hot barrel **shall** be established. *Comment:* The Safety Restrictions shall state the permitted rate of fire, the permitted number of rounds per salvo, and/or the permitted duration for fire. If different types of ammunition are used in the weapon, this should be taken into account in the test. Refer also to requirement *1.41008*.		

5.3.2.11 ***Fume evacuators***

No separate requirement in this section.

5.3.2.12 ***Muzzle brakes, flame guards and recoil amplifiers***

Req.no	Content	Fulfilment	Justification
1.32031	The muzzle brake should prevent rearward ricochets of driving bands, sabots, obturators, etc.		
1.32032	During modification in the design or new development of ammunition or weapons relating to driving bands, sabots, obturators, jackets etc., or in the event of changed rifling pitch in the barrel or a new muzzle brake, testing **shall** be performed to determine the occurrence of fragmentation.		

5.3.2.13 ***Muzzle flash***

Req.no	Content	Fulfilment	Justification
1.32033	When fitting external equipment onto the weapon or weapon platform, consideration **shall** be given to the effect of possible muzzle flash.		

5.3.2.14 ***Sub-calibre barrels and sub-calibre adapters***

Req.no	Content	Fulfilment	Justification
1.32034	Applicable requirements stated in *section 3.2.7–3.2.10* above **shall** apply.		
1.32035	It **shall not** be possible for a correctly fitted sub-calibre barrel or sub-calibre adapter to detach during firing.		
1.32036	It **shall** be possible to inspect a sub-calibre barrel/adapter for cracks and other defects.		
1.32037	Sub-calibre barrels and sub-calibre adapters **shall not** produce different levels of stress on ammunition, if the barrel length of the practice weapon differs from its original design. *Comment:* If, for example, a sub-calibre barrel is longer than a standard barrel, other acceleration and spin stresses may arise. It shall be determined whether the ammunition is designed for such stresses.		
1.32038	Requirements *1.32035* and *1.32037* **shall** be verified by test firing using the actual propelling charges and types of ammunition.		

5.3.2.15 ***Ramming***

Req.no	Content	Fulfilment	Justification
1.32039	The rammer should be provided with safety devices that prevent injury to personnel.		
1.32040	The ramming environment for the weapon in question **shall** be verified by testing. Testing **shall** also be performed at the extreme temperatures that are specified as a basis for the requirements of the ammunition. *Comment:* Cf. requirement *1.44037*.		

Req.no	Content	Fulfilment	Justification
1.32041	During driving in terrain in accordance with specified conditions, the ammunition should not fall back from the rammed position. *Comment:* This requirement should be verified by testing with a barrel that has 50% or less of its service life remaining in terms of wear.		
1.32042	The system should withstand rounds being fired with ammunition that is not rammed in a correct manner (i.e. in fall-back position). *Comment:* Gas leakage around the ammunition can damage both the ammunition and the barrel. Cf. requirement *1.41004*.		

5.3.2.16 ***Recoil brakes***

Req.no	Content	Fulfilment	Justification
1.32043	The system **shall** be designed so that the static pressure of the recoil buffer is retained.		
1.32044	Leakage of recoil buffer fluid and gas should be minimised.		
1.32045	Maximum recoil stresses **shall** be verified.		
1.32046	Forced recoil equipment **shall** withstand recoil forces with a safety margin.		

5.3.2.17 ***Composite and compound barrels***

Req.no	Content	Fulfilment	Justification
1.32047	When designing non-metallic and compound barrels, consideration **shall** be given to expected changes over time of material properties.		
1.32048	When designing fastening of external parts onto non-metallic barrels, consideration should be given to the influence of mountings that are permanently attached by winding for example, so that elongation properties are not negatively affected.		

5.3.2.18 ***Recoilless weapons and rocket systems***

Req.no	Content	Fulfilment	Justification
1.32049	Applicable requirements stated in *section 3.2.3* above **shall** apply.		
1.32050	Any residual recoil for recoilless launch tubes and rocket systems should be directed rearwards.		
1.32051	Recoil forces **shall** be established. This can be carried out by means of calculation and/or testing.		
1.32052	Back blast from a recoilless weapon, rocket or missile motor **shall not** cause injury to the operator.		
1.32053	Requirement *1.32052* **shall** be verified by testing.		

5.3.3 Other weapon systems

5.3.3.1 ***Minelayers for anti-tank mines***

Req.no	Content	Fulfilment	Justification
1.33001	If the minelayer arms the mine via a mechanical device it **shall** be equipped with an automatic monitoring system.		
1.33002	A monitoring system as specified in requirement *1.33001*, **shall** emit both a light and sound signal when a mine becomes jammed in the minelayer. The alarm **shall** be reset manually.		
1.33003	A minelayer that mechanically arms the mine **shall** enable access to a mine that becomes jammed without the necessity for the use of any tools.		
1.33004	It **shall** be possible to decouple a minelayer that mechanically arms the mine from the towing vehicle to enable personnel and the towing vehicle to be moved out of the danger area of the mine within the duration of the safety delay including a safety margin. *Comment:* If the above safety delay is 5+1 minutes it should be possible to decouple the minelayer from the towing vehicle and to move the personnel (with vehicle) outside the mine's danger area within 2 minutes.		

Req.no	Content	Fulfilment	Justification
1.33005	The minelayer should be designed so as to minimise the risk of a mine becoming jammed during laying. *Comment:* The shape of the mine should also be taken into consideration.		

*5.3.3.2 **Launching equipment for underwater mines/depth charges***

Req.no	Content	Fulfilment	Justification
1.33006	The launching equipment **shall not** arm the mine before the mine leaves the mine laying device.		
1.33007	The launching equipment **shall** be designed so that the mine cannot jam during launch. *Comment:* The configuration of the mine shall also be taken into account, see requirement *1.41016*.		

*5.3.3.3 **Launch devices for torpedoes***

Req.no	Content	Fulfilment	Justification
1.33008	Launch tubes **shall** be equipped with sensors that indicate that the torpedo has left the tube after it has been launched.		
1.33009	Launch tubes **shall** be so designed that the torpedo cannot jam on its way out of the tube or in the torpedo room of submarines. *Comment:* The design of the torpedo shall also be taken into account.		
1.33010	It **shall not** be possible for the testing of a launcher to cause inadvertent launch. *Comment:* The test system is normally separated from the launch system.		
1.33011	Power up (such as at system check, simulation or before launch) of a torpedo **shall not** lead to inadvertent launch.		
1.33012	For torpedoes incorporating hydrogen peroxide, the launch tubes and standby storage **shall** be equipped with a draining system connected to the hydrogen peroxide system of the torpedo.		

Req.no	Content	Fulfilment	Justification
1.33013	Material used in the drainage system **shall** be chosen so that it is compatible with hydrogen peroxide.		
1.33014	The drainage system **shall** be designed for the maximum number of torpedoes used on board.		
1.33015	In an emergency situation, it **shall** be possible to jettison the torpedoes from a helicopter, emergency launched from a surface vessel and emergency launched with the use of a separate back-up firing panel from a submarine.		

5.3.3.4 ***Launchers and pylons***

Req.no	Content	Fulfilment	Justification
1.33016	A pylon/launcher **shall** enable a transport safety device in the form of an indicator or equivalent to be clearly visible while the munition is in transport safe mode.		
1.33017	A pylon/ launcher as specified in requirement *1.33016* should enable the transport safety device to be carried together with the munition. *Comment:* This enables replacement of the transport safety device if the aircraft lands at a different site from the ammunition preparation site.		
1.33018	Pylons/launchers **shall** enable separation of the weapon system or munition in such a way that there is no risk of collision with weapon platforms. *Comment:* This includes incorrect manoeuvring of the ammunition.		

5.3.3.5 ***Weapon platforms***

Req.no	Content	Fulfilment	Justification
1.33019	The platform **shall** satisfy applicable traffic regulations for civil and military use. *Comment:* Dispensation may be given.		
1.33020	Sound pressure from the launch/firing **shall** be acceptable for the crew. Verification is required, see *section 3.1.7*.		

*5.3.3.6 **Openings/hatches and doors***

Req.no	Content	Fulfilment	Justification
1.33021	The locking/bolt mechanism **shall** be designed to withstand the stresses arising during operational use.		
1.33022	The locking/bolt mechanism should be accessible and manoeuvrable from both inside and outside.		
1.33023	Locks on hatches and doors should be manoeuvrable by crew wearing regulation personal protective equipment at all extreme temperatures.		

*5.3.3.7 **Sights and aiming systems***

Req.no	Content	Fulfilment	Justification
1.33024	There **shall** be devices to prevent the armament being aimed or fired in prohibited directions such as towards fixed obstacles. *Comment:* During maintenance, it is permissible to aim in prohibited directions.		

*5.3.3.8 **Guidance and control systems***

Req.no	Content	Fulfilment	Justification
1.33025	Sources of radiation (e.g. laser) directed at the fire unit from the guided weapon/munition should be so designed that they do not require any danger zones at the fire unit.		
1.33026	Sources of radiation for guidance that can have a dangerous effect **shall** be indicated to the operator when transmission is in progress.		
1.33027	During exercises the indication specified in requirement *1.33026* should also be visible to anyone anywhere in the vicinity.		
1.33028	It **shall not** be possible for guidance signals to the weapon/munition to initiate motor or warhead igniters.		

Req.no	Content	Fulfilment	Justification
1.33029	The guided weapon/munition should incorporate a function which, in the event of a target miss, or if a malfunction is detected, definitively precludes effect in the target by rendering the weapon safe. This can be achieved, for example, by self-neutralisation, self-destruction or sterilisation.		
1.33030	There should be a system for function monitoring and fault detection for the guidance system. This may result in self-neutralisation or sterilisation of the weapon, etc.		
1.33031	The guidance system **shall** be designed and documented in a way that enables a safety analysis to be performed.		
1.33032	The safety analysis **shall** be performed or audited by a party that is independent of the designer. *Comment:* Another department or special safety function within the same company may be considered as an independent party.		
1.33033	All materials incorporated **shall** be selected and combined in such a way that effects detrimental to safety do not arise during the life of the guidance system, for example as a result of corrosion, ageing, chemical change or short circuits.		
1.33034	Data transfer between the weapon and fire control, both before and after launch, should conform to standardised communication protocols.		
1.33035	Data transfer between the weapon and fire control, both before and after launch, **shall** be subject to function monitoring. *Comment:* Function monitoring can, for example, be by means of parity checking or a 'watch-dog' function.		

5.3.4 Other

5.3.4.1 Pressure vessels

Req.no	Content	Fulfilment	Justification
1.34001	Pressure vessels **shall** be type approved in accordance with the Swedish Work Environment Authority's directives.		

5.3.4.2 *Lifting devices*

Req.no	Content	Fulfilment	Justification
1.34002	Lifting devices **shall** be CE marked.		
1.34003	The danger area for a lifting device **shall** be established and taken into consideration when formulating Safety Restrictions. *Comment:* The danger area is greater than the area immediately beneath a hanging load, for example.		

5.4 REQUIREMENTS IN CHAPTER 4 "AMMUNITION"

5.4.1 Common Ammunition Requirements

5.4.1.1 Insensitive munitions (IM)

Req.no	Content	Fulfilment	Justification
1.41001	During procurement, overhaul, or modernisation of ammunition for the Swedish Armed Forces, ammunition with sufficient IM properties **shall** be considered. *Comment:* The desired IM properties are to be assessed in each case with regard to the threat, the desired effect (performance), the risk of injury and cost. Requirements for IM properties are to be established in the Armed Forces' Operational Requirements (TTEM).		
1.41002	The potential threats that an ammunition item could be subjected to should be determined with the help of a THA (Threat Hazard Analysis) which covers all the phases in the service life of the munition. *Comment:* For each individual threat, it is necessary to identify what tests should be conducted and the type of reactions that may be permitted in order to verify the desired level of insensitivity . The work is carried out in accordance with STANAG 4439 and AOP-39. If threats are detected which are not defined in STANAG 4439, these shall also be addressed.		

5.4.1.2 Equipment specific requirements

Req.no	Content	Fulfilment	Justification
1.41003	Data for assessment of the danger area **shall** be generated for all combinations of launchers and ammunition. *Comment:* Data is generated by analysis and tests, for example with respect to the danger area for lasers, shrapnel, thermal radiation, and sound pressure etc.		
1.41004	The projectile and propelling charge **shall** be designed so that the projectile remains in the rammed position with the gun at maximum elevation without any special devices for this being needed on the gun. This is particularly important when the projectile and propelling charge are separated. *Comment:* The above applies for ammunition where ramming is desirable. See also *section 3.2.15*.		

Req.no	Content	Fulfilment	Justification
1.41005	The function stated in requirement *1.41004* **shall** be tested using a worn barrel. *Comment:* Refer to the definition of a worn barrel.		
1.41006	Ammunition should be designed so that clearing/unloading can be performed in a safe manner by the crew operating the weapon. *Comment:* This also applies to clearing/unloading after an ammunition misfire.		
1.41007	Verification of requirement *1.41006* **shall** include testing of what forces can be permitted for the unloading tool in question. *Comment:* Testing also includes the force required to achieve clearing/unloading.		
1.41008	To establish the risk of cook-off for the ammunition, the temperature/heat flux etc. for a barrel at its maximum operating temperature and for the shell **shall** be determined. Refer also to requirements *1.32029* and *1.32030*.		
1.41009	Driving bands, casings or equivalent **shall** be designed so that they do not inadvertently disintegrate outside the barrel when firing.		
1.41010	Sabots and separating driving bands **shall** be designed to ensure safe separation. *Comment:* Consideration **shall** be given to the risk of sabot fragments and to any change in projectile trajectory.		
1.41011	Driving bands, sabots, obturators, casings etc. should be designed so that no fragments are formed that can impact with the muzzle brake (if such is fitted) and ricochet rearwards.		
1.41012	The projectile **shall** be designed to achieve external ballistic stability in all permitted types of firing so that specified danger areas are still valid. *Comment:* Worn barrels, driving bands, fins etc. can affect external ballistics.		
1.41013	Explosives incorporated in the ammunition **shall** be qualified in accordance with FSD 0214 or with applicable international standards, such as STANAG 4170. *Comment:* Assessments concerning the scope of qualification can be made by the Advisory Group for Explosives (Rg Expl), see *section 2.6.3*.		

Req.no	Content	Fulfilment	Justification
1.41014	The ammunition should be able to withstand abnormal environments such as accidents or the effects of enemy fire so that together with the system's safety measures, it contributes by making the vulnerability of the system as low as possible. *Comment:* The above is to be based on the robustness of the ammunition and the protection level of the system. Compare STANAG 4439. See also *section 4.1.1, Insensitive Munitions (IM)*.		
1.41015	Torpedoes **shall** be designed so that they do not jam in launch tubes. Cf. requirement *1.33009*.		
1.41016	Landmines, underwater mines and depth charges **shall** be designed so that they do jam in mine-laying equipment. Cf. requirement *1.33007*.		
1.41017	The safe separation distance/time **shall** be established for the severest case of operational use. Refer also to requirements *1.31014*, *1.42021*, *1.43007* and *1.44014*.		
1.41018	The design and the materials used in munition **shall** be chosen to enable the casing to withstand all stresses arising, including pressure in the barrel, without exceeding acceptable deformation. *Comment:* In the design of the ammunition the pressure definitions and procedures stated in STANAG 4110 must be applied.		
1.41019	Incorporated materials **shall** be compatible. *Comment:* See also requirement *1.22002*.		

5.4.2 Warheads

5.4.2.1 Environments for warheads

No separate requirement in this section.

5.4.2.2 Joint requirements for warheads

Req.no	Content	Fulfilment	Justification
1.42001	Warheads of CBRN type (chemical, biological, radioactive, or nuclear weapons) **shall not** be developed.		
1.42002	FAE (Fuel-Air Explosives) warheads, in which fuel is sprayed into the air and detonates owing to the oxygen in the air and where the main purpose is anti-personnel, **shall not** be developed. *Comment:* See also requirements *1.23001* and *1.23006* concerning the prohibition of any indiscriminate effect and incendiary weapons.		
1.42003	Warhead casings whose main effect is fragmentation **shall** be made of material that can be easily detected by X-ray.		
1.42004	Multiple weapons and guided weapons **shall** be considered as several warheads and propulsion devices. Separation charges and guidance or trajectory correction motors **shall** be treated as propulsion devices.		
1.42005	The design of and the materials used in the warhead **shall** be chosen to enable the casing to withstand all stresses arising, including pressure in the barrel, without exceeding acceptable deformation. *Comment:* Example of detailed requirements stipulated: Safety margin for deformation, freedom from cracks, overlaps, pores or incorrect heat treatment that can lead to hazardous events. With regard to pressure in the barrel, refer to *chapter 3*.		
1.42006	When tempered steel is used in the casing the material and heat treatment chosen **shall** be such that hydrogen embrittleness or other dangerous corrosion does not occur.		
1.42007	The internal surface of the casing **shall** be smooth and clean. *Comment:* The warhead casing must be protected from moisture and foreign particles before casting of the explosive.		

Req.no	Content	Fulfilment	Justification
1.42008	The design and composition of the HE charge (High Explosive charge) and the pyrotechnic charge **shall** be such that they can withstand all stresses arising without any risk of a hazardous event occurring. *Comment:* Testing is carried out in accordance with FSD 0060 or other relevant international standard. See also *section 4.1.1, Insensitive Munitions (IM)*.		
1.42009	The warhead **shall** be designed to avoid the presence of high explosive or pyrotechnic composition in threads or joints in such a quantity as to create a risk of inadvertent initiation when screwing components on or off or at launch or release.		
1.42010	Requirements *1.42008* and *1.42009* **shall** be verified by testing. *Comment:* The parts in the warhead can be examined prior to testing by using X-ray, radiography, ultrasonic testing or other methods.		
1.42011	The warhead **shall not** be susceptible to cook-off in the event of a misfire or interruption in firing when the barrel is at its maximum operating temperature for the operational profile in question. *Comment:* Refer also to requirements *1.32029* and *1.43019*.		
1.42012	The melting point of the high explosive should be higher than the temperature reached by the ammunition in a barrel heated to its maximum operating temperature for the operational profile in question.		
1.42013	The warhead in its application should not detonate in the event of fire. *Comment:* This requirement is part of the IM requirements defined in STANAG 4376. See also requirements *1.41001* and *1.41002*.		
1.42014	Requirement *1.42013* should be verified by testing.		
1.42015	The warhead in its application should not detonate from bullet attack from small calibre ammunition. *Comment:* This requirement is part of the IM requirements defined in STANAG 4376. See also requirements *1.41001* and *1.41002*.		
1.42016	Requirement *1.42015* should be verified by testing.		

Req.no	Content	Fulfilment	Justification
1.42017	The design of the warhead **shall** facilitate upgrading, in-service surveillance and disposal.		
1.42018	The possible destruction of any duds (unexploded ammunition) **shall** be taken into account during the design of the warhead.		
1.42019	The blast pressure from a detonating warhead **shall** be determined to be used to calculate the danger area. *Comment:* This applies, among other things, to hand grenades, thunder flashes and spotting charges. See also *section 3.1.7*.		
1.42020	Environmental aspects arising from manufacture, use and clearance of duds (unexploded ammunition), recovery of target materiel, and disposal **shall** be taken into account.		
1.42021	A safe separation distance **shall** be established for all warheads, see also requirement *1.41017*.		

5.4.2.3 *Warheads containing High Explosive (HE)*

HE warheads for tube-launched ammunition

Req.no	Content	Fulfilment	Justification
1.42022	If it is likely that the material from which the shell body is fabricated may contain pipes, a base plate or equivalent **shall** be employed and be attached in a satisfactory manner.		
1.42023	When filling a shell body with high explosive it **shall** be ensured that unacceptable pipes, cavities, gaps or cracks do not occur and that required adhesion is achieved. *Comment:* The level of defects; quantity, size, etc., must be dealt with in each item according to the explosive chosen and environment-specific requirements.		
1.42024	Requirement *1.42023* **shall** be verified by X-ray inspection, sawing the shell bodies, or by the use of bisectable shell bodies.		
1.42025	Pressed shell bodies **shall** be free from explosive dust.		

Req.no	Content	Fulfilment	Justification
1.42026	Pressed shell bodies **shall** meet stipulated requirements and be free from cracks and other defects.		
1.42027	Any joints in the shell body **shall** be satisfactorily sealed to prevent the ingress of high explosive into the joints.		
1.42028	When installing a primary charge it **shall** be ensured that no cavity occurs that could cause inadvertent initiation.		
1.42029	In shells equipped with an end screw or base fuze, the charge in the shell **shall** be well filled against the base of the shell.		
1.42030	In shells fitted with a base-bleed unit, any uncontrolled base-bleed combustion **shall** not lead to deflagration or detonation of the warhead.		

HE warheads for rockets and guided missiles

Req.no	Content	Fulfilment	Justification
1.42031	The warhead casing should not consist of separate parts within the zone adjacent to the rocket engine in order to avoid gas leakage.		
1.42032	The HE charge in the warhead should be protected from heat-generating components.		

HE warheads for bombs

Req.no	Content	Fulfilment	Justification
1.42033	If the casing consists of separate parts, there **shall** be a sufficiently good seal to ensure that the ingress of moisture or the leakage of explosive does not occur.		
1.42034	Where separated charges are used the intervening space **shall** be filled with an appropriate filler material.		

HE warheads for land mines

Req.no	Content	Fulfilment	Justification
1.42035	If the casing consists of separate parts there **shall** be sealing to prevent the ingress of moisture.		
1.42036	Metal casings **shall** be protected against corrosion.		

Warheads containing high explosive for depth charges, underwater mines and torpedoes

Req.no	Content	Fulfilment	Justification
1.42037	If there is a risk of overpressure in the warhead it **shall** be possible to remove plugs or other seals without risk of injury to personnel, such as during in-service surveillance of ammunition.		
1.42038	Fuzes that are installed from the outside **shall** form a seal with the casing or have a sealed seat/location.		
1.42039	Metal casings **shall** be protected against corrosion internally and externally.		
1.42040	Where separate charges are used, any intervening space **shall** be filled with an appropriate filler material.		
1.42041	Explosives in warheads should be compatible with the surrounding media. *Comment:* This applies particularly when adequate sealing cannot be guaranteed.		
1.42042	Explosives in warheads should be easy to inspect with respect to environmental impact, such as moisture. *Comment:* This applies particularly to ammunition that is used internationally and is expected to be returned to Sweden.		

HE warheads for other ammunition

Req.no	Content	Fulfilment	Justification
1.42043	Ammunition should be such that co-storage and joint transportation with other types of ammunition are in accordance with IFTEX and the ‘UN Recommendations on Transport of Dangerous Goods, Model regulations’ can be permitted. *Comment:* The choice of packaging can affect the classification.		

5.4.2.4 ***Pyrotechnic warheads***

Req.no	Content	Fulfilment	Justification
1.42044	Pyrotechnic ammunition should be designed and the compositions selected such that co-storage with other types of ammunition in accordance with IFTEX and the 'UN Recommendations on the Transport of Dangerous Goods, Model regulations' can be permitted.		
1.42045	The charge **shall** meet the prescribed moisture content.		
1.42046	The charge **shall** meet the prescribed purity from foreign particles.		
1.42047	The pyrotechnic composition used should have good storage stability.		
1.42048	Compressed pellets **shall** meet the prescribed structural strength.		
1.42049	Insulation adhesion **shall** meet the prescribed value.		
1.42050	Requirement *1.42049* **shall** be verified by testing, if necessary by destructive testing.		
1.42051	Insulation **shall** be free from cracks, cavities and symmetry deviations.		
1.42052	The charge casing **shall** be sealed.		

Pyrotechnic warheads for tube-launched ammunition

Req.no	Content	Fulfilment	Justification
1.42053	The base of the shell **shall** be completely sealed against hot propellant gases, moisture etc. and against composition dust.		
1.42054	At final assembly the charge **shall** have the correct moisture content. *Comment:* If necessary the charge may need to be dried before final assembly.		

Pyrotechnic warheads for rockets and bombs

Req.no	Content	Fulfilment	Justification
1.42055	The dividing wall (partition) between the warhead and rocket motor **shall** be sealed and insulated so that ignition of the composition does not occur through the ingress of propellant gases or by heat transmission.		
1.42056	At final assembly the charge **shall** have the correct moisture content. *Comment:* If necessary the charge may need to be dried before final assembly.		

Other pyrotechnic warheads

No separate requirement in this section.

*5.4.2.5 **Other warheads***

Req.no	Content	Fulfilment	Justification
1.42057	Applicable parts of the requirements specified for pyrotechnic charges in *section 4.2.4* **shall** apply.		

5.4.3 Launching and propulsion systems

*5.4.3.1 **Launching and propulsion systems***

No separate requirement in this section.

*5.4.3.2 **Joint requirements for launching and propulsion systems***

Req.no	Content	Fulfilment	Justification
1.43001	The design of, and materials in, a propelling charge casing **shall** be selected so as to ensure that the casing resists all specified loads without exceeding the permissible deformation or stress.		
1.43002	Adjacent materials, and materials in the propellant, **shall** be compatible. These materials may comprise internal protective paint, sealing agents, insulation materials, combustion catalysts, wear protectants, etc. Refer also to requirements *1.22002*, *1.22003* and *1.22004*.		
1.43003	When using hardened steel the material and heat treatment chosen **shall** be such that neither hydrogen brittleness nor detrimental corrosion occurs.		

Req.no	Content	Fulfilment	Justification
1.43004	The propelling charge **shall** be of a type, quality, and size to ensure that the required safety margin for permissible maximum pressure in all specified environments is not exceeded *Comment:* The requirement applies to both tube-launched ammunition (limited by the strength of the barrel) and rocket motors (limited by the strength of the casing), see also the guideline text in the first paragraph in *section 4.3*.		
1.43005	The propulsion force development and pressure–time curves **shall** be reproducible within the stated requirement specification.		
1.43006	The propelling charge should be designed to minimise fragments propelled rearwards from e.g. the base plate or nozzle plug.		
1.43007	The safe separation distance/time **shall** be established for all propulsion systems for the most unfavourable operating conditions. Refer also to requirement *1.42017*.		
1.43008	Metal additives, if any, **shall not** be able to block the exhaust nozzle.		
1.43009	The propelling charge casing **shall** be sealed as required.		
1.43010	The propelling charge casing **shall** withstand handling throughout its service life.		
1.43011	The composition of the propellant should be such that itself, its components and its combustion products are of minimal toxicity and have as little environmental impact as possible. This applies to manufacture, use, clearance of duds and disposal.		
1.43012	The design should facilitate disassembly (e.g. for upgrading, in-service surveillance and disposal).		
1.43013	The propulsion device in its tactical application should not detonate when subjected to the specified attack from bullets, fragments etc. *Comment:* This requirement is part of the IM requirements defined in STANAG 4439.		
1.43014	Requirement *1.43013* should be verified by testing.		

Req.no	Content	Fulfilment	Justification
1.43015	The propulsion device in its tactical application should not detonate if subjected to fire. *Comment:* Compare also general IM requirements.		
1.43016	A fuel fire test should be performed to verify requirement *1.43015*.		

5.4.3.3 ***Propulsion devices in tube-launched ammunition***

Req.no	Content	Fulfilment	Justification
1.43017	Within the permitted temperature range the propelling charge **shall** produce a pressure (MOP) that is lower than the permitted maximum value for the barrel and shell. *Comment:* In the design of the ammunition the pressure definitions and procedures stated in STANAG 4110 must be applied.		
1.43018	For recoiling barrels the combustion of the propelling charge should be designed so that the charge has burnt out before the projectile exits the muzzle. This is to avoid giving rise to backflash/secondary combustion when the weapon's breach is opened.		
1.43019	Maximum fire engagement with regard to the risk of cook-off when firing is interrupted for a barrel at its maximum operating temperature **shall** be determined. *Comment:* Refer also to requirement *1.32029*.		
1.43020	The cartridge case **shall** seal against the chamber seat so that unpermitted gas leakage does not occur.		
1.43021	When using percussion caps in artillery primers etc., the impact surface **shall** be countersunk so that the risk for inadvertent initiation during use is minimised.		

5.4.3.4 *Propulsion devices and gas generators for rockets, guided missiles, unmanned vehicles, torpedoes, etc*

Solid propellant rocket motors and gas generators

Req.no	Content	Fulfilment	Justification
1.43022	Propulsion devices should be designed such that the pressure vessel does not burst or detonate as a result of the impact of shrapnel from fragment-forming ammunition (or equivalent). *Comment:* This requirement is part of the IM requirements defined in STANAG 4439.		
1.43023	Propulsion devices should be designed such that if the pressure vessel bursts a minimum of dangerous fragments are formed.		
1.43024	Propulsion devices **shall**, with regard given to transport and storage, be designed such that a specified fire does not cause uncontrolled flight.		
1.43025	Propulsion devices containing propellants with metallic powder **shall** be analysed with regard to risks in the event of electrostatic charging.		

Liquid propellant rocket engines and gas generators

Req.no	Content	Fulfilment	Justification
1.43026	Requirements *1.43015*, *1.43016*, *1.43022* and *1.43023* **shall** apply.		
1.43027	The tank system **shall** be designed such that direct contact between propellants cannot occur inadvertently.		
1.43028	Tanks for propellants **shall** have adequate space for the expansion of the liquids.		
1.43029	Leakage of propellants **shall not** cause the engine to start.		
1.43030	Leakage of propellants **shall not** cause the pressure vessel to burst.		

Jet engines

Req.no	Content	Fulfilment	Justification
1.43031	Requirements *1.43013*, *1.43015*, *1.43016* and *1.43022* **shall** apply.		

Req.no	Content	Fulfilment	Justification
1.43032	The quantity and size of discarded parts (debris) at the start of ramjet function should be minimised.		
1.43033	The number of components containing pyrotechnic or explosive charges should be minimised.		

Ram rocket engines

Req.no	Content	Fulfilment	Justification
1.43034	Requirements *1.43013*, *1.43015*, *1.43016*, *1.43022*, *1.43032* and *1.43033* **shall** apply.		

Propulsion devices for torpedoes

Req.no	Content	Fulfilment	Justification
1.43035	Requirements *1.43005*, *1.43015*, *1.43016*, *1.43022* and *1.43023*, *1.43027* and *1.43028* **shall** apply.		
1.43036	Hydrogen peroxide (HP/HTP) **shall** be provided with a stabiliser.		
1.43037	HP tanks **shall** be provided with adequate pressure relief and draining devices.		
1.43038	Material in the HP tanks **shall not** contain catalytic substances that can lead to a reaction to the HP.		
1.43039	Water leakage or battery failure **shall not** lead to the inadvertent start of the torpedo.		
1.43040	Torpedoes **shall** be designed in such a way that any inadvertent contact between battery acid and explosives does not occur.		
1.43041	A short circuit which can lead to a battery explosion **shall not** occur.		
1.43042	Explosive gases formed during the self-discharge or charging of batteries **shall** be ventilated away and/or disposed of in order to avoid initialisation occurring.		

5.4.4 Fuzing systems for warheads and propelling charges

5.4.4.1 Environments for fuzing systems

No separate requirement in this section.

5.4.4.2 Common requirements for fuzing systems

Design requirements

Req.no	Content	Fulfilment	Justification
1.44001	Fuzing systems **shall** be designed to enable safety analysis to be performed.		
1.44002	The safety level of the fuzing system should be specified numerically as a probability and should be verified by analysis. *Comment:* An analysis can be carried out with the help of the FTA (Fault Tree Analysis) and FMECA (Fault Modes, Effects and Criticality Analysis).		
1.44003	Single failures that can lead to inadvertent initiation of explosives after the interrupter or circuit safety device within the arming distance/time **shall not** occur. *Comment:* For certain applications, the requirement for redundancy to prevent inadvertent initiation can be resolved so that a system failure results in a fail-safe state.		
1.44004	Explosive trains containing primary explosives or sensitive explosives (not approved for use after an interrupter) **shall** have at least one mechanical interrupter. Only explosives in accordance with requirement *1.44005* are permitted after that interrupter. *Comment:* Refer also to requirements *1.44142*, *1.44143* and *1.44144*.		
1.44005	Explosives after the interrupter or for use in systems without an interrupter **shall** be qualified for such use as specified in FSD 0214 or STANAG 4170 or other relevant international standard.		
1.44006	Fuzing systems should not contain stored energy – such as mechanical, pyrotechnical or electrical – for removing the interrupter towards an armed position in the explosive train. *Comment:* Energy for removing an interrupter can best be provided by some unique environmental factor after launch/release.		
1.44007	Stored energy **shall not** be used for both disabling safety features and removing interrupters.		

Req.no	Content	Fulfilment	Justification
1.44008	The probability of inadvertent initiation of an explosive after the interrupter or circuit safety device **shall not** be higher than the probability for inadvertent arming. *Comment:* A failure must thus not lead to initiation unless all the steps normally required for arming have been completed.		
1.44009	Encapsulation of the explosive train **shall** be designed such that hazard initiation of the explosive train before the interrupter while the interrupter is in unarmed mode does not provide ejection of fragments or other effect that can cause injury or damage to personnel, property or the environment.		
1.44010	Fuzing systems **shall** be designed and documented in such a manner as to facilitate an effective production control and quality inspection.		
1.44011	All constituent materials **shall** be selected and combined such that no effects detrimental to safety occur during the life of the fuzing system, e.g. as a result of corrosion, mechanical fatigue, mutual interference, or insufficient chemical stability resulting in the formation of copper azide for example.		
1.44012	All explosives **shall** be encapsulated and/or be fixed so that they remain intact when subjected to specified environmental severities.		
1.44013	The initiator in the ignition system **shall** not inadvertently be triggered by a specific external environmental factor such as electrical, mechanical or climatic.		
1.44014	The safe separation distance/time **shall** be established with regard to warhead effect and intended tactical use. Refer also to requirements *1.31014* and *1.41017*. *Comment:* Three different cases can be identified: a. The safe separation distance is so great that the risk to friendly forces is tolerable in the event of a burst occurring when that distance has been reached. No evasive action is assumed. b. The safe separation distance is shorter than in case a. above owing to tactical reasons. Evasive action or taking cover is assumed. c. The safe separation time is sufficiently long to allow for leaving the danger area.		

Req.no	Content	Fulfilment	Justification
1.44015	Fuzing systems should be designed so that a failure in the system results in a fail-safe state. *Comment:* This requirement can lead to a degradation of any deactivation or self-destruction function.		
1.44016	Fuzing systems should be designed such that incorrect assembly of safety-critical parts is not possible.		
1.44017	Final assembly of, or installing, a fuzing system when armed **shall** be prevented. This is achieved when at least one of the following conditions are met. a. It **shall** be so designed that during manufacture it is not be possible to complete the assembly of an armed fuzing system. b. It **shall** be so designed that installing a fuzing system when armed on the ammunition is not possible. c. It **shall** be equipped with an indicator which clearly indicates whether the fuzing system, is armed or not (safe. *Comment:* Arming may have occurred without being detected as a result of incorrect assembly during manufacture or maintenance, or because the SAI/SAU was not returned to its safe state after final testing.		
1.44018	If there is a requirement for system testing after manufacture (AUR testing), functions for reliable testing **shall** be built into the fuzing system so that tests can be carried out in a safe manner.		
1.44019	Fuzing systems **shall** be designed so that maintenance, upgrading, in-service surveillance, disposal and destruction can be carried out safely. *Comment:* Necessary instructions etc. for dismantling shall be prepared during the development work.		
1.44020	The composition and integration of the booster should be such that it does not detonate or deflagrate before the main charge when subjected to heating (e.g. by fire).		
1.44021	Well-proven components should be used.		
1.44022	Arming **shall** not occur until the safe separation distance/time has been reached at the earliest.		

Req.no	Content	Fulfilment	Justification
1.44023	The arming process should be as simple as possible.		
1.44024	The arming process should be functionally and physically separated from other processes in the system.		
1.44025	Inadvertent arming **shall** be prevented by at least two mutually independent safety features. *Comment:* The safety features can be: a. mechanical safety features in an interrupter, b. mechanically operated electric switches, c. relays, d. semiconductor switches.		
1.44026	If a system with only two safety features is used, both **shall** be mechanical.		

Requirements regarding testing

Req.no	Content	Fulfilment	Justification
1.44027	Constituent components and subsystems that are vital to the safety of the fuzing system **shall** undergo separate safety qualification (type testing).		
1.44028	Fuzing systems **shall** undergo safety qualification as specified in FSD 0213, STANAG 4157 or equivalent. *Comment:* Safety-critical functions should be monitored during testing and be inspected after testing.		
1.44029	Testing **shall** be performed at a safety level at which arming is not permitted. *Comment:* Safety level, in this case, means the stress level which exceeds by an acceptable margin the most severe level reached during transport, operation, ramming or the firing/launch process. Testing is intended to verify requirement *1.44037*. See also comment to requirement *1.44039*.		
1.44030	The choice of materials in a fuzing system **shall** – if it is considered necessary – be verified by testing that demonstrates with acceptable probability that no effects detrimental to safety occur during the life of the fuzing system. Refer also to requirements *1.22002*, *1.22003* and *1.22004*.		

Req.no	Content	Fulfilment	Justification
1.44031	Testing **shall** be performed to demonstrate whether the design used for encapsulation of the explosives meets the stipulated requirements. *Comment:* With this testing, dimensions, compacting pressure and other properties are selected within their respective tolerance range such that the probability for failures is considered to be highest. Testing is to be performed in the environment (within the operating range of the fuzing system) that is considered to be the most unfavourable from the safety aspect.		
1.44032	Testing **shall** be performed to verify that the fuzing system does not initiate within the safe separation distance/time owing to passage through mask, impact with the ground, contact with the seabed, broaching, or collision with obstacles. *Comment:* The concept of 'inherent safety' is used for torpedoes".		
1.44033	Testing **shall** be performed to establish the distance or time from launch or equivalent at which the transmission safety feature arms. If there are other safety features in the explosive train, they **shall** be neutralised prior to testing.		
1.44034	Testing **shall** be performed to verify that the fuzing system does not initiate in flight or after deployment after the arming process is completed as a result of the environmental stress specified in the requirement specification for the object. *Comment:* This requirement applies primarily to ammunition with a split danger area.		
1.44035	Fuzing systems **shall** be designed to enable the required functional testing to be performed safely.		

Requirements for systems with access to application-specific environmental factors

Req.no	Content	Fulfilment	Justification
1.44036	Fuzing systems should be designed so that safety is not dependent upon operating procedures.		
1.44037	Arming **shall** only take place during use. *Comment:* The lower limit for arming shall exceed by a good margin the maximum stress level experienced during operation, transport and other relevant environmental conditions.		

Req.no	Content	Fulfilment	Justification
1.44038	Arming **shall** only take place if two mutually independent, application-specific, environmental conditions are satisfied, provided that reasonable such conditions are available. *Comment:* Examples are stated below of environmental conditions that can be used to activate arming and/or as sources for arming energy: a. acceleration, b. angular acceleration, c. spin, d. sensing of launching/mine-laying device (e.g. barrel bore-ride). This is not considered as a good condition, but may be accepted, e. dynamic pressure, f. drag (via a turbine or parachute for example), g. hydrodynamic and hydrostatic pressure, h. lanyards, i. back pressure. All conditions to be considered before the most suitable are selected.		
1.44039	If only one realistic environmental condition is available, or two dependent conditions, there **shall** be at least one manual operation (such as removal of a safety pin) required for arming prior to loading/launching. *Comment:* When safety relies entirely on one environmental condition after the manual operation has been performed, a major effort must be made to verify practically and theoretically that this condition cannot occur inadvertently after the manual operation, such as if a shell is dropped during loading.		
1.44040	A manual operation or safety pin **shall** also block the function controlled by the only available environmental condition.		
1.44041	At least one of the safety features **shall** lock the interrupter during the arming phase until the munition has left the launcher/laying device.		
1.44042	In systems with access to one or more unique application-specific environmental conditions, at least one of these **shall** be used. At least one of the safety features **shall** be released after the launcher/release device has been cleared and the safe separation distance has been reached.		

Requirements for systems without access to unique application-specific environmental factors

Req.no	Content	Fulfilment	Justification
1.44043	If a fuzing system requires human intervention to start the arming process, there **shall** be a device that provides unambiguous indication of whether the system is in the safe state.		
1.44044	During mechanical deployment of ammunition (such as when laying mines with a minelayer) the arming **shall** take place at the earliest when the mine leaves the laying device.		
1.44045	Fuzing systems **shall** be designed such that the packaged ammunition and fuzing systems remain safe during storage, transport, handling and use. This applies until the point in time when the ammunition is deployed, or when the fuzing system or initiator is installed and arming or activating is performed in accordance with the specified operating instructions.		
1.44046	Incorrect installation of a fuzing system should not be possible.		
1.44048	At least two different and almost simultaneous manual operations **shall** be required for arming to take place. *Comment:* These manual operations should be sequential, i.e. carried out in a predefined order.		
1.44049	Electric ignition energy **shall not** occur in the firing circuit until after the specified arming delay or safe separation time has elapsed.		
1.44050	Fuzing systems **shall** be equipped with a device which – after arming – provides sufficient safety time for the operator to leave the danger zone.		
1.44051	The probability of incorrect connection of fuzing systems to explosives, signal and spotting charges owing to a mistake, clumsiness or carelessness **shall** be taken into account.		
1.44052	In cases where safety is based on operational procedures, operating instructions **shall** accompany the packaging or the ammunition.		
1.44053	The fuzing system and components of the fuzing system **shall** be designed such that installation of the initiator can be performed as the final operation in the readiness procedure.		

Req.no	Content	Fulfilment	Justification
1.44054	An intentional manual operation, such as removing a safety pin, **shall** be necessary before initiation of the warhead can take place. *Comment:* The safety pin is to be designed so that it is not inadvertently removed during normal handling of the ammunition.		
1.44055	The initiation device for demolition charges **shall** be designed so that the connected system can be disassembled safely after connection and be re-used if so stipulated.		
1.44056	When the application permits, fuzing systems for demolition charges should incorporate an interrupter that is remotely controlled from the initiation device.		
1.44057	Time fuzes should incorporate an interrupter that arms after the fuze is set and after personnel have taken cover. The initiation device is armed when the interrupter is removed from the explosive train. *Comment:* Where application-specific environmental conditions are available (such as hydrostatic pressure for underwater time fuzes) they shall be used. For other time fuzes manual time-delayed arming, for example, can be used.		
1.44058	Ignition cables **shall** be long enough to enable connection of the initiation device without it being necessary for personnel to be inside the danger area of the warhead.		
1.44059	If requirement *1.44057* cannot be met, the initiation device **shall** incorporate a time function that provides a delay in arming of sufficient duration to enable the operator to leave the danger area or take cover.		
1.44060	Initiation devices should be designed so that the risk of ignition failure is minimised. *Comment:* Consequently, it should be equipped with a continuity tester and an indicator to show that it can deliver sufficient ignition energy.		
1.44061	To minimise the risk of inadvertent initiation, initiation devices **shall** be designed so that at least two manual operations are required to enable firing.		

Req.no	Content	Fulfilment	Justification
1.44062	There **shall** be at least one mechanical/galvanic interrupter in the firing circuits of initiation devices. *Comment:* The output on the initiation device can also be short-circuited up to the moment of firing (e.g. by one or more electromechanical switches).		

Neutralisation, deactivation, recovery and disposal

Req.no	Content	Fulfilment	Justification
1.44063	Firing capacitors **shall** be equipped with duplicate discharge (bleeder) circuits. At least one of these circuits **shall** be physically located as close to the firing capacitor as possible.		
1.44064	The leakage resistance of firing capacitors, or for grounding in twin conductor systems, **shall** be as low as the system permits.		
1.44065	Fuzing systems incorporating a deactivating function **shall** contain a device that indicates in an unambiguous way whether the system is safe.		
1.44066	Deactivation **shall** provide at least the same level of safety as when the system was initially in safe mode.		
1.44067	Deactivation should not require special tools.		
1.44068	Deactivation should remove all initiation energy.		
1.44069	The fuzing system should be designed such that deactivation/neutralisation is not prevented by a malfunction in any part of the fuzing system that is not used for deactivation/neutralisation.		
1.44070	If clearance for disposal or recycling is intended the fuzing system **shall** be designed for subsequent safe handling.		

Requirements of International Law

Req.no	Content	Fulfilment	Justification
1.44071	Land mines **shall** have a self-destruction, neutralisation or deactivation function that renders the mine safe after a certain time. This function can be automatic or remotely controlled.		
1.44072	Drifting mines **shall** have fuzing systems that ensures that the mine is rendered safe one hour after deployment at the latest.		
1.44073	Moored mines **shall** be neutralised as soon as the mine is no longer moored.		
1.44074	Torpedoes **shall** be neutralised if they do not hit the target.		
1.44075	Submunitions **shall** be equipped with an auto destruction function (AD), if this is feasible with regards to the design, in order to reduce the risk of unexploded ammunition (UXA). *Comment:* The design must be analysed in terms of functionality and safety. For example, the AD function must not lead to a lower functional probability of the regular initiator or that the risks of ammunition disposal of UXA increases.		
1.44076	Submunitions should be equipped with a neutralisation/sterilisation function which renders the submunition safe after a certain period of time.		

*5.4.4.3 **Mechanical subsystems***

Req.no	Content	Fulfilment	Justification
1.44077	The interrupter **shall** prevent the booster charge in the fuzing system from initiating in the event of an inadvertent initiation of the explosive train before the interrupter.		
1.44078	The interrupter **shall** in the safe position, be locked by at least two independent safety features.		
1.44079	The interrupter in an explosive train should, before arming, remove the sensitive explosive (out-of-line) from the explosive train.		
1.44080	Each of the safety features **shall** individually retain the interrupter in the safe position.		

Req.no	Content	Fulfilment	Justification
1.44081	Safety features in an interrupter should lock directly into the interrupter, not via any linkage or similar device.		
1.44082	Testing **shall** be performed to establish that an interrupter remains locked in the safe position with sufficient margin when subjected to the most severe load (cf. the environmental specification) when only one safety feature is installed. The safety features are to be tested separately.		
1.44083	Testing **shall** be performed to establish that explosives located after the interrupter are not initiated by the detonator while the safety device is in the safe state. *Comment:* The following is to be taken into consideration: • the critical thickness of a mechanical barrier, • the critical charge quantity and compacting pressure of a detonator located before the interrupter, • the critical gap and dimensions etc. of gas passages through or around the interrupter. The term 'critical' denotes the value when transmission in some form takes place. Testing can be supplemented by calculations.		
1.44084	Testing **shall** be performed to determine at which point transmission is achieved when the interrupter is gradually moved from safe to armed position. Dimensions **shall** be chosen within each tolerance range so as to facilitate transmission. Between safe posi-tion and the boundary limit for transmission, any ejection of fragments, deformation or fragmentation **shall** not entail a risk of injury. *Comment:* For interrupters with an instantaneous arming motion, testing can be performed in fewer positions (at least one) between safe and armed positions		

*5.4.4.4 **Electrical subsystems***

Req.no	Content	Fulfilment	Justification
1.44085	Fuzing systems should not be capable of accumulating sufficient energy to initiate the warhead within the safe separation distance/time.		
1.44086	Connector pins in external connectors connected to an EED should be semi-enclosed.		

Req.no	Content	Fulfilment	Justification
1.44087	The casing of an external connector should make contact and provide electromagnetic shielding before the pins engage.		
1.44088	The shielding of ignition cables should be connected to the casing of the connector around the complete circumference of the cable. *Comment:* This is particularly important with the casing of an EED to obtain good high frequency protection. The connection pins in a connector should not be used to connect shields.		
1.44089	The switch that finally connects an EED to the electric supply should be located as close to the initiator as possible.		
1.44090	The lead/leads between the switch and the EED **shall** be shielded from external electromagnetic fields and be protected against static electricity.		
1.44091	The capacitance across the switch should be kept sufficiently low to prevent initiation by electrostatic discharge.		
1.44092	Twin conductors should be twisted.		
1.44093	If one pole is earthed/grounded to an EED the earthing/grounding should take the shortest route to a shield surrounding the igniter.		
1.44094	Ignition cables **shall not** be located in the same shield as other conductors.		
1.44095	An EED **shall** have documented electrical characteristics as specified in FSD 0112, STANAG 4560 or equivalent.		
1.44096	Fuzing systems containing EEDs **shall** be system tested in accordance with FSD 0212, STANAG 4324 or equivalent.		
1.44097	EED used in fuzing systems with an in-line explosive train intended for warheads **shall** have an ignition voltage of at least 500 V.		
1.44098	When two electric signals are used for arming at least one of them **shall** be dependent on a continuous current supply.		

Req.no	Content	Fulfilment	Justification
1.44099	If the current supply ceases before arming is completed the fuzing system **shall** be neutralised or deactivated.		
1.44100	In a system where the arming process is controlled by electrical safety features, at least two of them **shall** be in the form of an interruption from the current supply.		
1.44101	Fuzing systems in which arming is performed by connecting the circuit to earth/ground (single conductor system) should be avoided.		
1.44102	Arming **shall not** occur as a result of plausible short circuits such as short circuits between adjacent leads in harnesses, in connectors, on PCBs and in integrated circuits.		
1.44103	Arming **shall not** occur as a result of a plausible interruptions caused by, for example, soldering defects, oxidised connector surfaces, or cracks in PCBs or substrates.		
1.44104	For systems with only semiconductors as safety features, at least three independent 'closings' **shall** be required at system block level for arming. *Comment:* The closings are best actuated by different signal levels.		
1.44105	A system containing only semiconductors **shall not** be able to arm as a result of static failures in the safety features (failure mode either closed or open), which can mean that at least one of the safety features requires a dynamic signal. *Comment:* The dynamic signal must be of such a nature that it cannot reasonably occur inadvertently.		
1.44106	The safety analysis of a fuzing system **shall** be performed by at least one independent party. For system solutions with semiconductors only, the analysis should be performed by at least two independent parties. *Comment:* A special system safety function within the company that designed the system can be considered to be an independent party.		

Electronic circuit safety devices

Req.no	Content	Fulfilment	Justification
1.44107	A fuzing system with an in-line explosive train intended for warheads **shall** be initiated only by a signal that is unique and which cannot be emulated by any undesired internal or external signal. *Comment:* Usually only high power systems (such as EFI) are used in systems containing only electronic fuzes.		
1.44108	Charging of a firing capacitor or equivalent should only be started after the safe separation distance/time has been reached.		
1.44109	The voltage of a firing capacitor or equivalent **shall** be below the lower initiation voltage (maximum-no-fire) until the arming distance/time is reached. *Comment:* This is analogous to the conventional case with one interrupter that moves slowly and enables transmission in the explosive train at some point before final position. Complete arming is achieved when the voltage of the firing capacitor reaches the minimum-all-fire level of the electric igniter.		

*5.4.4.5 **Electronic and software controlled subsystems***

Req.no	Content	Fulfilment	Justification
1.44110	All safety-critical functions in electronic circuits **shall** be implemented in firmware or hardware.		
1.44111	It **shall not** be possible to easily change the software after it has been installed in the circuit.		

Radioactive impact

Req.no	Content	Fulfilment	Justification
1.44112	Data in firmware **shall not** be changed by any environmental impact which the system can otherwise withstand. *Comment:* Environmental impact includes the effects of radiation.		

Redundancy

Req.no	Content	Fulfilment	Justification
1.44113	If all safety features are implemented with logic circuits, at least two of these **shall** be implemented with different types of logic circuits.		

Unused features and environmental durability

Req.no	Content	Fulfilment	Justification
1.44114	The component manufacturer's specifications and recommendations **shall** be followed. *Comment:* The requirement may for example be verified by minutes from completed design reviews.		

Risk of short circuits

Req.no	Content	Fulfilment	Justification
1.44115	The design **shall** be such that the likelihood of short circuits occurring at circuit board level is minimised. *Comment: This means that lead-free solder should not be used for soldering or plating.*		

Competence of the supplier

Req.no	Content	Fulfilment	Justification
1.44116	At least two people at the manufacturer **shall** in detail be familiar with the functionality of the hardware and software, as well as what tests that have been carried out on the system.		

Service life of stored information

Req.no	Content	Fulfilment	Justification
1.44117	The content of the memory circuits **shall** have a service life that with a margin exceeds the system's projected service life if reprogramming (Refresh) is not possible. *Comment:* Service life relates to both how long a memory cell can retain its information in the current operational profile (measured in years), and the number of read and write operations that can be performed on each individual memory cell.		

Power supply

Req.no	Content	Fulfilment	Justification
1.44118	The power supply for the logic system that implements safety features **shall** be designed so that a fault in the power supply does not result in one or more safety features being removed.		

System restart, RESET

Req.no	Content	Fulfilment	Justification
1.44119	The system **shall** assume a safe state at disturbances in the power supply and at start and stop.		

Self-test

Req.no	Content	Fulfilment	Justification
1.44120	After start, a self-test **shall** be carried out which verifies the function and condition of as many safety-critical components as possible with regard to time and performance requirements.		

Program flow control, Watch Dog Timer (WDT)

Req.no	Content	Fulfilment	Justification
1.44121	Programmable circuits **shall** have a monitoring function that puts the system in a safe state if the program execution is disrupted.		

Software

Req.no	Content	Fulfilment	Justification
1.44122	Program development **shall** be carried out systematically and in accordance with a recognised standard or manual. The choice of developing standard **shall** be presented and justified.		
1.44123	For safety-critical systems, software and development methodology **shall** be reviewed by an independent third party.		

Req.no	Content	Fulfilment	Justification
1.44124	An analysis **shall** be carried out in order to estimate the software's contribution to the overall probability of a hazard arming or hazard initiation. *Comment:* This analysis is best done on the fault tree established during the development of the system architecture.		
1.44125	Configuration control **shall** be implemented for all developed software and the revision identification can preferably be included as a constant in the program memory.		
1.44126	Software for safety-critical systems **shall** be designed and documented so that it is possible to analyse its function.		
1.44127	The developed software **shall** be tested extensively. The choice of test method shall be documented and justified.		
1.44128	Software in safety-critical systems **shall** be as straightforward as possible, both in terms of structure and execution.		
1.44129	Interrupts **shall not** be able to cause stack overflow, disruptions to the program execution, inadvertent changes to variables, or a non-deterministic behaviour.		
1.44130	The program execution **shall** be deterministic. *Comment:* An example of a deterministic system is a state machine where each new state is predictable and only depends on the current state and input signals.		
1.44131	All interrupt vectors **shall** be defined and the vectors that are not used **shall** lead to a safe state, such as RESET.		
1.44132	Registers that are important for the function **shall** be verified during operation.		
1.44133	If an error is detected during a self-test or during operation, a planned action **shall** be available and performed.		
1.44134	All input signals to the processor **shall** be assessed for reasonability.		

Req.no	Content	Fulfilment	Justification
1.44135	Code that will never be used, so-called dead or dormant code, **shall not** be present.		
1.44136	Unused memory space **shall** be programmed with code so a jump to such space results in a safe state, e.g. a restart.		
1.44137	All indexed memory operations **shall** be checked so that the index assumes permitted values.		
1.44138	A single bit error **shall not** result in an unsafe state in the software.		
1.44139	Arming **shall** require that a sequence is executed where the previous state is a necessary condition for the subsequent arming condition to be executed.		

5.4.4.6 Subsystems with wave-borne signals

Req.no	Content	Fulfilment	Justification
1.44140	In systems with wave-borne signals the probability of unauthorized arming/influence **shall** be sufficiently low with regard to the field of application.		
1.44141	If a signal outside the ammunition is used for arming, the fuzing system **shall** verify the signal before arming takes place.		

5.4.4.7 Laser fuzing systems

No separate requirement in this section.

5.4.4.8 Fuzing systems for other types of ammunition

Explosives

No separate requirement in this section.

Signal and spotting charges

No separate requirement in this section.

Hand grenades

No separate requirement in this section.

Counter mining charges and explosive cutters

No separate requirement in this section.

Auto destruction

No separate requirement in this section.

Submunitions

No separate requirement in this section.

Multi-purpose ammunition

No separate requirement in this section.

Tandem systems

No separate requirement in this section.

Propulsion devices

Req.no	Content	Fulfilment	Justification
1.44142	There **shall** be a transmission safety device in the explosive train of propulsion devices if inadvertent initiation of the propelling charge leads to activation of the fuzing system in the warhead. *Comment:* Guidelines as to when the transmission safety device shall exist in other cases, for example, when an inadvertent initiation can cause great harm, can be found in STANAG 4368.		
1.44143	The electric igniter in the propulsion device **shall** be sufficiently insensitive so as not to be initiated leading to inadvertent initiation of any radiated interference or static electricity. *Comment:* The aim shall be that an electric igniter can be subjected to a current of 1 A and a power of 1 W for a minimum duration of 5 minutes. An analysis of the safety of the complete safety and arming system must, however, as a rule be carried out.		
1.44144	The explosive in a booster charge after an interrupter, or in an initiator in a system without an interrupter, should not be more sensitive than the explosives in the propelling charge.		
1.44145	It should be possible to install the fuzing system into a propulsion device as late as possible before operation.		
1.44146	It should be possible to check easily whether the fuzing system is installed in a propulsion device.		
1.44147	The fuzing system should be easily accessible for replacement.		

Req.no	Content	Fulfilment	Justification
1.44148	The fuzing system **shall** be designed so that normal firing takes place within the specified timeframe (i.e. abnormal delay is prevented).		

5.4.5 Packaging for ammunition

5.4.5.1 Environmental factors

No separate requirements in this section.

5.4.5.2 Joint requirements for packaging for ammunition

Req.no	Content	Fulfilment	Justification
1.45001	The packaging **shall** be able to withstand the tests and meet the requirements set out in the UN Recommendations on the Transport of Dangerous Goods - Manual of Test and Criteria. *Comment:* The requirements relate to selection of materials, packaging design, marking and labelling, etc.		
1.45002	The packaging **shall** protect the ammunition against the environments to which it is predicted that the system will be subjected throughout its life. These environments are stated in the environmental specification. *Comment:* Requirements governing the protective properties of the packaging can be related to the inherent resistance of the ammunition. Furthermore, the packaging must not create an environment the ammunition cannot withstand.		
1.45003	Constituent materials in the packaging **shall** be selected and combined so that effects detrimental to safety do not occur. *Comment:* Such effects can, for example, be caused by corrosion, incompatibility or instability.		
1.45004	Packagings should be designed to prevent mass detonation. *Comment:* This requirement can be achieved by adequate separation of the explosive units as well within a packaging as between packaging.		
1.45005	Packaging should be designed such that the consequences of an inadvertent initiation of the constituent explosive is limited. *Comment:* In the event of a fire a propulsion device, for example, can create a ‘gun effect’ if the package is in the form of a metallic tube.		

Req.no	Content	Fulfilment	Justification
1.45006	The design of, and materials for, packaging **shall** be selected to prevent detrimental effects from handling and storage environments.		
1.45007	Packaging and their contents **shall** be F-classified ("F-coded") in accordance with IFTEX. *Comment:* In order to facilitate interoperability and storage in international operations, the requirement is currently being investigated if the requirement can be deleted and replaced with the UN classification below.		
1.45008	Packaging and their contents **shall** be classified in accordance with the UN classification.		
1.45009	Packaging and their content **shall** be provided with distinct and durable markings in accordance with applicable regulations governing transport and storage to enable rapid and safe identification of the contents.		
1.45010	Re-usable packaging **shall** be checked to ensure that they are equivalent to new ones from a safety aspect.		
1.45011	When selecting materials for packaging, consideration **shall** be given to the applicable regulations for recycling.		
1.45012	The prescribed material recycling symbols **shall** be marked on constituent components.		