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MEMORANDUM TO CCW DELEGATES

A GLOBAL OVERVIEW OF EXPLOSIVE SUBMUNITIONS

Prepared for the Convention on Conventional Weapons (CCW) Group of Governmental Experts on the Explosive Remnants of War (ERW)

May 21-24, 2002

Introduction

In December 2001 a Group of Governmental Experts was mandated by the Second Review Conference of the 1980 Convention on Certain Conventional Weapons (CCW) to examine the types and factors of weapons that produce ERW. Weapons that deliver submunitions deserve special consideration in this process because of their ability to rapidly deliver large quantities of submunitions over wide areas and the demonstrated failure rates of submunitions. Perhaps the most significant ERW problem is the hazard presented by unexploded submunitions.

Some armed forces are unilaterally taking measures to reduce the number of unexploded submunitions to protect themselves from the effects of their own unexploded submunitions that they may encounter during subsequent operations. There is a confluence of humanitarian interests and military equities in reducing or eliminating the hazards posed by unexploded submunitions. This goal can be accomplished through technical improvements in the munitions or by regulating the way the munitions are used, or both.

This memorandum provides information on the types of submunitions and the factors that contribute to them becoming ERW. The countries that produce, stockpile, transfer, and use submunitions are listed to assist in the development of effective and universal international prohibitions or regulations to alleviate the ERW problem. Weapons that deliver nuclear, biological, chemical, electronic, or pyrotechnic submunitions are beyond the scope of this work. The information contained herein reflects the best publicly available information known to Human Rights Watch. However, there is still much that is unknown or uncertain regarding submunitions worldwide, and Human Rights Watch welcomes comments and corrections.

A Prevalence of Submunitions

The pervasiveness of submunitions can be seen in the following findings:

- thirty-three countries produce at least 208 different munitions that contain submunitions;
- fifty-six countries currently stockpile submunitions;
- at least nine countries have transferred thirty different types of munitions containing submunitions to at least forty-five other countries; and,
- At least nine countries have used submunitions in thirteen different countries.

These huge global numbers are even more cause for concern if one looks at the characteristics of just one of the munitions that contain submunitions. Iraqi troops dubbed it "steel rain" when Coalition surface-launched rockets and artillery projectiles impacted on their fighting positions during the Desert Storm phase of the 1990-1991 Persian Gulf War. A Multiple Launch Rocket System (MLRS) firing unit could sequentially launch twelve rockets containing 7,728 submunitions (dual-purpose grenades) designed to explode on impact into an area of 120,000 to 240,000 square meters at a range of up to 32 kilometers. The reliability rate for the M77 submunitions is 84 percent according to a U.S. Department of Defense report to the U.S. Congress on unexploded ordnance (UXO) published in 2000. Using this reliability rate, the MLRS firing mission described above would result in 1,236 unexploded submunitions scattered randomly in the impact area. Only a trained military expert could tell whether they are armed and hazardous or whether they failed to arm. Because the fuze is extremely sensitive, each submunition would need to be cleared one-at-a-time.

The preceding illustration uses only one launch unit firing its payload once. Typically there are four launch units in a battery of MLRS. At least twelve countries have the MLRS

system. A unitary high explosive warhead (no submunitions) has not been produced for the MLRS.

The United States alone stockpiles over one billion submunitions in weapons currently in service, based on an analysis of submunition procurement history. Indeed, the United States' stockpile of rockets for the MLRS contains over 309 million submunitions. Other countries thought to stockpile submunitions to this magnitude include China and Russia.

Information regarding the complete composition of any country's stockpile of submunitions is generally not publicly available, nor is there any transparency requirement for such data in any international treaty or agreement. The information set forth in this memorandum is likely incomplete, particularly regarding non-Western weapon systems, which are not well accounted for in standard international reference publications.

In some cases a deliberate decision was made to exclude certain weapons and countries from this memorandum because of this uncertainty. The best example of this exclusion is the 122mm BM-21 Grad multiple launch rocket. At least forty-eight countries possess this weapon and at least fifteen countries produce warheads for the missiles. However, less is publicly known about which countries produce a cargo rocket for the BM-21 that delivers submunitions. Even less is known about the proliferation of BM-21 rockets that contain submunitions to other countries. This may significantly increase the findings noted above; twenty-nine of the forty-eight countries that possess the BM-21 system are not listed in this memorandum.

Landmines, both antipersonnel and antivehicle, are addressed only tangentially in this memorandum. Mines delivered by projectiles, bombs, and rockets are submunitions and are accounted for in the country inventories in Appendix 1. Other international treaties and negotiations are currently addressing landmines.

Types and Delivery Methods of Submunitions

Table 1 lists the means by which submunitions are delivered:

Surface	Aerial
Artillery Projectile	Bomb
Mortar Bomb	Rocket
Rocket	Guided Missile
Guided Missile	Fixed Dispenser
Ground Vehicle	

Table 1: Methods of Delivering Submunitions

Broadly speaking there are three categories of submunitions: improved conventional munitions, dual-purpose improved conventional munitions (which include combined effects munitions); and, advanced submunitions. Each generation will be briefly described below and represent the changes in the military requirements for submunitions and the evolution of munitions technology.

Improved conventional munitions (ICM) were designed in a way to increase the amount of fragmentation created by individual submunitions and spread this effect over a wide area. The small size of the submunition also meant a large number of them could be deployed from simple dispensers by exploiting physical and aerodynamic forces. This accounts for the spherical, wing-like, and dart-like shapes of early generation submunitions.

The physical factors used to facilitate the deployment of the submunitions also influenced the design of the fuzing system. Many of these submunitions relied on mechanical fuzes that armed based on the rate of spin of the submunition and were designed to explode on impact, after a time delay, or by the contact of a person. Some of these early submunitions incorporated other materials, like zirconium to create a secondary incendiary effect. It was in the conflict in Southeast Asia during the 1960s and 1970s that this early generation of submunitions was used in large numbers.

Submunitions evolved as military requirements and munitions technology also changed. These factors allowed for enhancements in the way submunitions are delivered and changes in their terminal effects. The desire for submunitions to also damage armored vehicles and other battlefield material gave rise to dual-purpose improved conventional munitions (DPICM). A shaped charge to penetrate light armor or materiel was incorporated into the design to these new types of submunitions. The metal casing of some submunitions was also scored to produce uniform fragment sizes and patterns to enhance the antipersonnel effect. Some submunitions retained the capability of producing other effects and are called combined effects munitions (CEM).

While dart-like shapes remained common, these dual-purpose and combined effects submunitions moved away from a spherical shape to a cylindrical shape. A decelerating device was added to insure that the shaped charge impacted the target at the proper orientation to be most effective. There are a number of common decelerating devices, all of which are deployed by the air rushing past the submunition as it falls. These devices include parachutes, ballutes (balloon-parachutes), attached inflatable decelerators, or a ram air-inflated decelerator. The addition of decelerating devices also ended reliance on mechanical spin-armed fuzes and required incorporation of piezo-electric fuzes and stab detonators in the submunition. These types of fuzes were designed in a way as to use the physical forces of the deployment of the retarding device to arm and impact to detonate the submunition. Some manufacturers also began to incorporate a pyrotechnic or mechanical self-destruct feature to the submunition. Others have added guidance packages to aerial bomb dispenser to correct for winds that may intervene between the munitions release point and the target area.

A new generation of advanced submunitions is beginning to enter into service with several militaries. These submunitions are quite different from previous because they are primarily designed to sense and destroy armored vehicles without creating antipersonnel effects. Advanced sensors, autonomous guidance packages, and ability to loiter above a target area are the new features of these advanced submunitions.

Because of their size, the number of these submunitions deployed from the carrier munition is starkly reduced; instead of several hundred ICM, DPICM, or CEM submunitions, these systems often carry less than ten (sometimes only two) advanced submunitions. If the submunition is unable to identify, characterize, and engage a target, it is typically equipped with a self-destruct or self-neutralizing capability.

ICM	DPICM-CEM	Advanced Submunitions
AO-1SCh (Russia)	BL-755 (United Kingdom)	BLU-108B SFW (U.S.)
BLU-63/B (U.S.)	BLU-97/B (U.S.)	BONUS (Sweden, France)
LBOk-1 (Poland)	KB-1 (Yugoslavia)	Motiv-3M (Russia)
M43A1 (U.S.)	M85 (Israel)	SADARM (U.S.)
Type 314 (France)	PM-1 (Chile)	SMArt 155 (Germany)
	Type-81 (China)	

Table 2: Examples of Types of Submunitions

Factors that Cause Submunitions to become ERW

There is no single reason why submunitions fail to operate as designed. Some of the causes are similar to those for all types of explosive ordnance. Other causes are particular to the design, construction, and employment of submunitions. For example, the quality of fuzes used for submunitions differs greatly from the ones used for unitary weapons.

Estimates of submunition failure rates vary widely. Manufacturers often claim a submunition failure rate of two to five percent. Military establishments are known to have accepted a submunition failure rate from five to twelve percent. Mine clearance personnel frequently report submunition dud rates of ten to thirty percent. Even if an unexploded submunition has not been fully armed, subsequent handling may result in completion of the arming sequence and a detonation. Some of the factors that contribute to submunitions becoming ERW are listed in Table 3.

• Component Design and Reliability	• Weather, Wind, and Temperature
• Manufacturing and Materials Quality	• Use Parameters
• Storage Conditions	• Impact Environment (mud, vegetation, sand)

Table 3: Factors Contributing to Submunitions Becoming ERW

Designing submunitions capable of withstanding the physical forces of the deployment of their carrier is a challenge. The stresses of launching and aerodynamics of projectiles, bombs, and rockets are often quite different. The requirement to store these munitions over a period as long as fifteen to twenty years is also a consideration. These engineering problems are often exacerbated by limitations imposed on the total cost of the weapons system, of which the submunition and its components are typically only a small part.

The quality of submunitions is often governed by cost considerations. Relatively inexpensive fuzes and materials are often used, resulting in submunitions that could have a relatively high failure rate. Munitions designers and manufacturers balance safety and reliability versus cost. They want fuzes to be safe enough to tolerate rough handling, robust enough to withstand the combat environment, and sensitive enough to explode when designed, yet still be relatively cheap and simple to produce in the large quantities required by the military.

The safe and arming mechanism is an important component of any submunition. To prevent premature detonation, submunitions are only armed some time after they have been dispersed from the dispensing munition. The arming mechanism is often a vane, ribbon, or parachute-like device that is spun or pulled by the air rushing past the munition as it falls. If this device fails to deploy or function as intended, or the distance of travel from the dispenser is not sufficient to arm the fuze, the submunition will not explode on impact. The arming process can, however, unsuspectingly be completed by someone disturbing, moving, or playing with the weapon.

Submunitions also fail to explode because military fuzes, especially submunition fuzes, are exposed to enormous stresses before they are intended to detonate. Typical artillery projectiles are explosively accelerated almost instantaneously to a velocity of more than 800 meters per second and spun at speeds in excess of 250 revolutions per second. Modern military aircraft fitted with bombs containing submunitions and dispensers frequently fly at speeds exceeding Mach 1 and execute high G-force maneuvers. Rockets and missiles accelerate to velocities of many hundreds of meters a second.

Several operational factors influence the reliability of submunitions. These include delivery technique, age of the submunition, ambient air temperature, and type of impact

medium. Submunitions can also hit each other and be damaged as they are dispersed from the spinning artillery round, or hit the ground in a position that fails to set off their impact fuzes.

Impact fuzes require the submunition to hit the target or ground close to perpendicular. For example, the M77 submunition for the MLRS rocket must strike a surface at an angle of approximately sixty-five degrees to ninety degrees to detonate. This requirement could pose a particular problem with finned submunitions dispensed by high-speed aircraft, which need to fall great distances before the angle of decent approaches perpendicular. Military scientists designed parachute-like devices, to overcome this problem, but these devices conversely made the submunitions angle of impact more susceptible to gusts of wind. Parachutes and other deceleration devices can cause the submunition to hit and get hung-up on trees and vegetation or on structures. Alternatively trees and overgrowth can slow the munitions to the point that they have insufficient energy to explode on impact.

Weather and terrain can have a significant impact. Landing in muddy or soft ground can create hazardous unexploded submunitions. The U.S. Army manual on techniques of observed fire instruct troops that ICM or DPICM munitions "should not be fired into forests; mountainous areas (slope greater than 60 percent); or rocky, uneven terrain. This type of terrain may increase the dud rate and reduce the effectiveness of the rounds. Also, the effectiveness of ICM and DPICM rounds may decrease if the target area is marshy or covered with deep snow or water." Heat and cold also affect the reliability of submunitions, and dud rates increase.

To increase functional reliability, many newer submunitions incorporate two or more redundant fuze systems, yet high failure rates remain. The BLU-97 CEM used in Kuwait, Iraq, Yugoslavia (including Kosovo), and Afghanistan has two independent fuze systems (one is an "all-ways fuze" that is capable of functioning at any angle of impact). The U.S. Department of Defense reported to the U.S. Congress that the reliability of the BLU-97 submunition is 98 percent, but deminers in Kosovo have documented an operational failure rate for the BLU-97 of seven percent.

Most military contracts stipulate a required reliability rate, before the weapon is accepted. These failure rates can be surprisingly high. Before a batch, or lot, of munitions are accepted a sample is tested for compliance with reliability requirements. Lot acceptance testing, however, rarely simulates actual operational conditions where failure rates can increase significantly. Few countries have made the results of surveillance testing, which is performed on stockpiles over the time in storage, publicly known.

After encountering their own unexploded submunitions during subsequent operations, several countries are beginning to take steps to reduce the probability of unexploded submunitions. For example, on January 10, 2001, then-U.S. Secretary of Defense William Cohen issued a memorandum stating, "It is the policy of the DoD [Department of Defense] to reduce overall UXO [unexploded ordnance] through a process of improvement in submunition system reliability – the desire is to field future submunitions with a 99% or higher functioning rate….The Services shall design and procure all future submunition weapons in compliance with the above policy."

Several countries have designed and incorporated into submunitions a self-destruct and or self-neutralizing mechanism. At least eleven countries are reported to have developed or deployed submunitions with this capability: France, Germany, Israel, Italy, Romania, Russia, Singapore, Slovakia, Switzerland, United Kingdom, and the United States.

Production of Submunitions

A total of thirty-three countries produce at least 208 munitions that contain submunitions. Figure 1 illustrates and lists these countries. Of these thirty-three countries, seven are not party to CCW.

Argentina	India	Russian Federation
Belgium	Iran*	Singapore*
Brazil	Iraq*	Slovakia
Bulgaria	Israel	South Africa
Canada	Italy	Spain
Chile*	Korea, North*	Sweden
China	Korea, South	Switzerland
Egypt*	Netherlands	Turkey*
France	Pakistan	United Kingdom
Germany	Poland	United States of America
Greece	Romania	Yugoslavia

* denotes a country not party to the 1980 CCW

Figure 1: Countries that Produce Submunitions

Submunitions are produced for surface launched projectiles, aerially delivered bombs, and rockets that can be delivered by surface or aerial means. There is often commonality of the submunition used for surface launched artillery projectiles and surface launched rockets, the only difference is often the number of submunitions contained in carrier munitions of differing sizes. In other cases, countries only produce submunitions for only one type of delivery method, with surface launched rocket systems being the most common. The following statistics illustrate the diversification of the types of submunitions produced and their delivery method:

- Twenty-five countries produce seventy-one different types of surface launched munitions like artillery projectiles or mortar bombs that contain submunitions,
- Fifteen countries produce sixty-eight different types of aerially delivered bombs that contain submunitions, and,

- Twenty-three countries produce sixty-nine different types of surface or aerially launched rockets containing submunitions.

The production of submunitions and their carrier munitions involves the fabrication and integration of a large number of components like metal parts, explosives, fuzes, and packaging materials. It is rare that all components of the submunition or carrier munition are produced at one location by one entity. The culmination of the production process occurs at a facility that loads, assembles, and packs the submunitions into a complete warhead assembly, which is often hermitically sealed. This warhead can then be mated with other components in the weapon system such as rocket motors and guidance systems. The compa nies that produce submunitions and their carrier munitions are listed in Appendix 2 (generally the prime integrating entity that is credited by international reference and marketing publications).

Some types of submunitions and their delivery systems are the product of multinational cooperative research and production programs. These can involve individual companies, teams of companies, or industrial consortiums. This production pattern is often used to spread the development and procurement costs of the weapon across all potential customers and will likely accelerate as new precision, sensor fuzed, and autonomously guided submunition systems currently maturing enter into serial production and service.

Stockpiles of Submunitions

Globally, fifty-six countries stockpile munitions that contain submunitions. Figure 2 illustrates and lists these countries. A total of eighteen of these countries are not party to CCW. Munitions containing submunitions are often common ammunition items in the force structure of military establishments. Submunitions are available for use by the basic components like artillery batteries and mortar platoons within a military's table of organization and equipment. Among the fifty-six countries that stockpile munitions containing submunitions:

- twenty-eight countries stockpile surface launched artillery projectiles or mortar bombs containing submunitions,
- thirty-two countries stockpile aerially delivered bombs containing submunitions, and,
- forty-one countries stockpile surface launched or aerially delivered rockets that contain submunitions.

Algeria*	Croatia	Iraq*	Nigeria*	Spain
Argentina	Czech Republic	Israel	Norway	Sudan
Bahrain*	Denmark	Italy	Oman*	Sweden
Belgium	Egypt*	Japan	Pakistan	Switzerland
Belarus	Eritrea*	Jordan	Poland	Turkey*
Bosnia Herzegovina	Ethiopia*	Kazakhstan*	Romania	Turkmenistan*
Brazil	France	Korea, North*	Russia	Ukraine
Bulgaria	Germany	Korea, South	Saudi Arabia*	United Arab Emirates*
Canada	Greece	Kuwait*	Singapore*	United Kingdom
Chile*	India	Moldova	Slovakia	United States of America
China	Iran*	Netherlands	South Africa	Uzbekistan
				Yugoslavia

* denotes a country not party to CCW

Figure 2: Countries that Stockpile Submunitions

Transfers of Submunitions

According to available information, at least nine countries have transferred thirty different types of munitions containing submunitions to at least forty-five other countries. But, the true scope of the global trade in submunitions is difficult to ascertain. International arms exhibitions and marketing publications regularly include projectiles, bombs, and rockets with submunitions. Notifications of arms transfers as required by domestic law in some countries do provide some knowledge of the trade patterns. Some countries simply inherited stockpiles of submunitions when an older state broke up.

The three generations of submunitions (early, current, and advanced) described above are all currently in the international arms market place to varying degrees. Early generation submunitions are nearing the end of their service life and are more apt to be destroyed than sold for profit. However, there is concern that ample stocks of early generation weapons that contain submunitions exist in the warehouses of Soviet successor states and countries of the former Warsaw Pact that could be tapped to fuel on-going conflicts. These early generation submunition systems are of particular concern because the effects of prolonged storage may contribute to high rates of hazardous unexploded duds when the munitions are used.

It appears some submunition transfers have occurred as surplus munitions (excess defense articles) provided to allied governments and armed forces. As current generation submunitions and their delivery systems are phased out of active service in high-technology military forces, they are passed on at little or no cost to lesser-developed allied or friendly militaries.

Some examples of the transfers, by any of the above mentioned means, of submunitions are contained in Table 4. However, these examples are used only for illustration purposes and are not a comprehensive accounting of the global trade in submunitions and their delivery systems.

Supplier	Type	Recipient(s)
Brazil	Rocket	Iran, Iraq
Chile	Bomb	Ethiopia, Eritrea, Iraq, Sudan
Egypt	Rocket	Iraq
Germany	Projectile	Italy, Norway
Israel	Projectile	Germany, Romania, Switzerland, United Kingdom, United States
	Bomb	Argentina
Russia	Rocket	Algeria, Belarus, India, Kazakhstan, Kuwait, Moldova, Turkmenistan, Ukraine, Uzbekistan
United Kingdom	Bomb	Belgium, Eritrea, Germany, Nigeria, Pakistan, Saudi Arabia, Switzerland, Yugoslavia
United States of America	Projectile	Bahrain, Belgium, Greece, Jordan, Korea (South), Netherlands, Pakistan, Turkey
	Bomb	Denmark, Egypt, France, Germany, Israel, Italy, Japan, Korea (South), Netherlands, Norway, Oman, Poland, Saudi Arabia, Sweden, Turkey, United Arab Emirates, United Kingdom
	Rocket	Bahrain, Denmark, France, Greece, Israel, Italy, Japan, Korea (South), Netherlands, Norway, Turkey, United Kingdom
Yugoslavia	Rocket	Bosnia Herzegovina, Croatia, Iraq

Table 4: Examples of Known Transfers of Submunitions

Use of Submunitions

Submunitions have been used in at least thirteen countries by at least nine countries. Submunitions were also used in the Falklands/Malvinas conflict. Additionally, unconfirmed reports cite use of submunitions in conflicts in Colombia, Sierra Leone, Turkey, and the Western Sahara.

- Projectiles containing submunitions have been used in six of thirteen conflicts;
- Bombs containing submunitions have been use in all of the thirteen conflicts; and,
- Rockets containing submunitions have been used in at least five of the thirteen conflicts.

The countries where submunition use is confirmed are illustrated and listed in Figure 3.

Location Used	Country Using Submunitions
Afghanistan	USSR, United States, possibly other various factions
Bosnia Herzegovina	Yugoslavia, various separatist forces and ethnic militias
Cambodia	United States
Eritrea	Ethiopia
Ethiopia	Eritrea
Iraq	United Kingdom, United States
Kuwait	United Kingdom, United States
Laos	United States
Lebanon	Israel
Russia (Chechnya)	Russian Government forces
Sudan	Sudanese Government forces
Yugoslavia (including Kosovo)	Yugoslavian Government forces, Netherlands, United Kingdom, United States
Vietnam	United States

Figure 3: Countries Where Submunitions have been Used

Appendix 1: Submunition Stockpiles by Country and Type

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Algeria	Rocket				
		300mm	Smerch	72	APAM
Argentina	Projectile				
		155mm	CME	63	DPICM
	Bomb				
			BME 330	180	ICM
			FAS 300	519	CAM-1 DPICM
			FAS 500	1020	CAM-1 DPICM
			TAL-1	270	ICM
			TAL-2	315	ICM
	Rocket				
		105mm	SLAM Pampero		
		127mm	SAPBA		DPICM
		127mm	CP30		DPICM
		160mm	LAR 160	104	M85 DPICM
Bahrain	Projectile				
		203mm	M509A1	108	M42 ICM
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM
		610mm	ATACMS 1	950	M74 DPICM
Belarus	Rocket				
		220mm	Urgan	30	APAM
		300mm	Smerch	72	APAM
Belgium	Projectile				
		81mm	M514A1	12	DPICM
		155mm	NR269	56	M46 DPICM
	Bomb				
			BL 755	147	
	Rocket				
		70mm	Lau-97	9	FZ-100 MPSM
Bosnia Herzegovina	Rocket				
		128mm	M77 Oganj	40	KB-1 DPICM
Brazil	Rocket				
		180mm	Astros II	20	DPICM
		300mm	Astros II	64	DPICM
Bulgaria	Projectile				
		122mm		15	DPICM
	Rocket				
		122mm	KNURS-DM		TMD-1 AVM
Canada	Bomb				
			Rockeye II	247	Mk-118
	Rocket				
		70mm	CRV7	9	M73 MPSM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Chile	Bomb				
			CB-130	50	PM-1 CEM
			CB-250K	240	PM-1 CEM
			CB-500	240	PM-1 CEM
			CB-500K	400	PM-1 CEM
			CB-500K2	431	PM-2 CEM
			CB-770	121	PM-3 DPICM
			WB-250F	130	APAM
			WB-500F	240	APAM
	Rocket				
		160mm	Rayo	120	DPICM
China	Projectile				
		120mm		18	DPICM
		122mm	Type 83	30	Type 81 DPICM
		130mm	Type 59	35	Type 81 DPICM
		152mm	Type 62	63	Type 81 DPICM
		152mm	Type 66	63	Type 81 DPICM
		155mm		72	Type 81 DPICM
		203mm		100	DPICM
	Bomb				
			Anti-Runway	12	
			Anti-Tank	16	
			340 Kg.	189	
			Fuel Air	3	FAE
	Rocket				
		107mm	Type 63	16	Type 81 DPICM
		122mm	Type 81	39	Type 90 DPICM
		122mm	Type 81		AVM & APM
		122mm	Type 84	8	AVM or
				120	APM
		122mm	Type 90A	39	DPICM
		122mm	Type 90A	6	Type 84 AVM or
				128	Type 84 APM
		273mm	WM-80	320	DPICM
		284mm	Type 74	72	Type 69 AVM
		284mm	Type 74	72	Type 70 AVM or
				72	Type 69 AVM
		305mm	Type 79	10	Type 69 AVM
		320mm	WS-1B	466	DPICM
Croatia	Rocket				
		262mm	M87 Orkan	288	KB-1 DPICM
Czech Republic	Rocket				
		122mm	AGAT/JRKK-G	56	ATAM bomblets
		122mm	Trnovniik	63	ICM
		122mm	Krizna R	4	Pt-Mi-D AVM
		122mm	Krizna S	4	Pt-Mi-D AVM
Denmark	Bomb				
			Rockeye II	247	Mk-118
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Egypt					
	Projectile				
		122mm		18	M42D DPICM
		130mm		28	M42D DPICM
		155mm		36	M42D DPICM
	Bomb				
			Rockeye II	247	Mk-118
			CBU-87	202	BLU-97 CEM
	Rocket				
		122mm	BM-21 Grad		
		122mm	SAKR-18	72	DPICM
		122mm	SAKR-18	4	AVM
		122mm	SAKR-36	98	DPICM
Eritrea	Bomb				
			CB-500	240	PM-1 CEM
Ethiopia	Bomb				
			CB-500	240	PM-1 CEM
France	Projectile				
		120mm	AECD	1-2	APAM
		155mm	NR269	56	M46 DPICM
		155mm	OGRE F1	63	DPICM
		155mm	BONUS	2	BONUS SFM
		155mm	OMIG1	6	DISP F1 AVM
	Bomb				
			Alkan 500	20	Type 314 ICM or
				20	TDA AT Grenade
			Alkan 530	40	Type 314 ICM or
				40	TDA AT Grenade
			Alkan 5030	152	Type 314 ICM or
				152	TDA AT Grenade
			Alkan 5050	192	Type 314 and
				96	TDA AT Countermeasures
			Belouga	151	BLG 66
			BM 400	3	SMAB or
				3	SMAP
			Cascad Mk 1	3	SMAB or
				3	SMAP
			Cascad Mk 2	12	SMAB or
				12	SMAP
			CBU-87	202	BLU-97 CEM
			Rockeye II	247	Mk.-118
	Rocket				
		68mm	SNE 28SM		
		70mm	Lau-97	9	FZ-100 MPSM
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Germany	Projectile				
		155mm	DM652	49	DM1383 DPICM
		155mm	DM642	63	DM1383 DPICM
		155mm	DM702	2	SMArt 155
	Bomb				
			BL-755	147	
			CBU-87	202	BLU-97 CEM
			MW-1	4,704	KB-44 HEAT
			mixture of:	896	MIFF Mine
				672	MUSA APAM
				672	MUSPA Mine
				200	STABO bomblet
	Rocket				
		110mm	LARS	65	M42 M77 DPICM
		110mm	LARS	5	AT2 AVM
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM
Greece	Projectile				
		105mm	24G	24	M24G DPICM
		107mm	M20	20	M20G DPICM
		155mm	M49	49	GM1 DPICM
		155mm			AVM
		155mm	M718	9	M73 RAAM AVM
		155mm	M692	36	M72 ADAM APM
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM
		610mm	ATACMS 1	950	M74 DPICM
India	Rocket				
		214mm	Pinacha		ATAM
		214mm	Pinacha		AVM
		300mm	Smerch	72	APAM
Iran	Rocket				
		122mm	Fadjr 6	8	AVM or APM
		180mm	Astros II	20	DPICM
Iraq	Bomb				
			NAAMAN 250	240	
			NAAMAN 500	400	
	Rocket				
		100mm	FIROS 25	77	M42 DPICM
		122mm	Type 81	30	Type 81 DPICM
		122mm	SAKR 36	98	DPICM
		180mm	Astros II	20	DPICM
		262mm	Ababil 50	288	DPICM
		300mm	ASTROS II S60	64	DPICM
		400mm	Ababil	300	DPICM or
				25	AVM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Israel	Projectile				
		105mm	M116	16	M85 DPICM
		105mm		6	APAM
		120mm	M971	24	M87 DPICM
		122mm	M335	24	M85 DPICM
		130mm	M347	24	M85 DPICM
		152mm	M350	49	M85 DPICM
		152mm	M351	56	M85 DPICM
		155mm	M395	63	M85 DPICM
		155mm	M396	49	M85 DPICM
		155mm	M397	49	M85 DPICM
		175mm	M366	81	M85 DPICM
		203mm	M373	120	M85 DPICM
	Bomb				
			ATAP 300	320	M85 DPICM
			ATAP 500	512	M85 DPICM
			ATAP 1000	900	M85 DPICM
			BARAD	72	M85 DPICM
			TAL-1	270	ICM
			TAL-2	315	ICM
			Rockeye II	247	Mk.-118 HEAT
	Rocket				
		160mm	LAR-160	104	M85 DPICM
		160mm	LAR-160		AVM
		227mm	M26 MLRS	644	M77 DPICM
		300mm	MAR-350	770	M85 DPICM
		350mm	MAR-160	770	M85 DPICM
Italy	Projectile				
		81mm	RS6A2	9	
		81mm	S6A2	9	
		120mm	S12B	12	
		155mm	BCR	63	DM1383
	Bomb				
			CBU-87	202	BLU-97 CEM
	Rocket				
		81mm	SNIA Medusa	11	
		122mm	FALCO 122/H, 122/A	77	APAM
		122mm	FIROS 25/30	77	M42 DPICM
		122mm	FIROS 25/30	6	AVM
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM
Japan	Bomb				
			CBU-87/B	202	BLU-97B CEM
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM
Jordan	Projectile				
		155mm	M483A1	64	M42 DPICM and
				24	M46 DPICM
Kazakhstan	Rocket				
		220mm	Urgan	30	APAM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Korea, North	Rocket				
		122mm	BM-11		
		122mm	BM-21		
		170mm	M1978		
		240mm	M1985		
		240mm	M1991		
Korea, South	Projectile				
		105mm		18	ICM
		105mm		20	DPICM
		155mm	M483A1	64	M42 DPICM
				24	M46 DPICM
		155mm	M718	9	M73 RAAM AVM
		155mm	M692	36	M72 ADAM APM
	Bomb				
			CBU-87	202	BLU-97 CEM
			CBU-97/B	10	BLU-108B SFW
Kuwait	Rocket				
		300mm	Smerch	72	APAM
Moldova	Rocket				
		220mm	Urgan	30	APAM
Netherlands	Projectile				
		155mm	M483A1	64	M42 DPICM and
				24	M46 DPICM
		155mm	M864	48	M42 DPICM and
				24	M46 DPICM
		155mm		56	M46 DPICM
	Bomb				
			CBU-87	202	BLU-97 CEM
			CBU-89/B	72	BLU-91/B AVM
				22	BLU-92/B APM
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM
Nigeria	Bomb				
			BL755	147	
Norway	Projectile				
		155mm	DM652	49	M85 DPICM
	Bomb				
			Rockeye II	247	Mk-118
			CBU-87	202	BLU-97 CEM
	Rocket				
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM
Oman	Bomb				
			Rockeye II	247	Mk-118
Pakistan	Projectile				
		155mm	M483A1	64	M42 DPICM and
				24	M46 DPICM
	Bomb				
			BL755	147	
			Hijara TSD-1	274	DPICM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Poland	Bomb				
			CBU-87	202	BLU-97 CEM
			ZK-300	315	LBOk-1 ICM
	Rocket				
		122mm	PLATAN	5	MN11 1 AVM
		122mm	PLATAN	5	MN121 AVM
Romania	Projectile				
		152mm	CG-540ER	49	GAA-001 DPICM
		152mm	CG-540	56	GAA-001 DPICM
Russian Federation	Projectile				
		120mm		35	DPICM
		152mm	3O23	42	DPICM
		152mm	3O13	8	DPICM
		203mm	3O14	24	DPICM
	Bomb				
			KMGU	Mix of:	
				96	AO 2.5 APAM
				8	ODS-OD FAE
				98	PTAB 2.5
				248	PTAB-1M
			PROSAB-250	90	PROSAB bomblet
			RBK-250	48	ZAB 2.5 Incendiary
			RBK 250-275	60	AO-2.5 APAM
			RBK 250-275		AO-2.5-2 APAM
			RBK 250-275	150	AO-1SCh bomblet
			RBK 250-275	30	PTAB 2.5M
			RBK-500	108	AO-2.5 APAM
			RBK-500	108	AO-2.5-2 APAM
			RBK-500	75	PTAB 2.5
			RBK-500	268	PTAB 2.5M
			RBK-500	565	ShOAB-0.5 bomblet
			RBK-500	12	BetAB bomblets
			RBK-500	117	ZAB 2.5 Incendiary
			RBK-500	15	SPBE-D SFW
			RBK-500U	10	OFAB-50 APAM
				26	OFAB 2.5 APAM
				10	BetAB
				15	SPBE-D
				352	PTAB
	Rocket				
		122mm	BM-21	45	APAM
		122mm	BM-21	3 or 5	PGMDM AVM or POM-2S APM
		220mm	Urgan	30	APAM
		220mm	Urgan	24	PTM-1 AVM
		220mm	Urgan	312	PFM-1 APM
		220mm	Urgan	9	PTM-3 AVM
		300mm	Smerch	72	APAM
Saudi Arabia	Bomb				
			BL755	147	
			CBU-87	202	BLU-97 CEM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Singapore	Projectile				
		155mm		64	DPICM
Slovakia	Projectile				
		152mm	Trnovnik	42	ICM
	Rocket				
		122mm	AGAT/JRKK-G	56	APAM
		122mm	Trnovniik	63	APAM
		122mm	Krizna R/S	4	Pt-Mi-D AVM
South Africa	Projectile				
		155mm	M1	56	DPICM
		155mm	M2001	42	DPICM
	Bomb				
			CB 470	40	Alpha
Spain	Projectile				
		120mm	ESPIN 15	15	DPICM
		120mm	ESPIN 21	21	DPICM
		120mm	MAT 120	21	DPICM
	Bomb				
			ABL 250	250	
			BME 330 AR	8	SAP
				26	SNA
			BME 330 AT	512	SAC-1
				4	MAC-2
			BME 330C	180	CP, CH, SNA
	Rocket				
		140mm	Teruel	42	GCP AP ICM
				42	GCC AV ICM
		140mm	Teruel	6	MCC AVM
Sweden	Projectile				
		155mm	BONUS	2	BONUS SFM
	Bomb				
			Rockeye II	247	Mk118 HEAT
Switzerland	Projectile				
		120mm	SME	32	ICM
		155mm	KaG90	49	M85 DPICM
	Bomb				
			BL755	147	
Turkey	Projectile				
		155mm	M483A1	88	64 M42 DPICM
					24 M46 DPICM
		155mm	M718	9	M73 RAAM AVM
		155mm	M692	36	M72 ADAM APM
		155mm	M731	36	M67 ADAM APM
	Bomb				
			Rockeye II	247	Mk-118
	Rocket				
		227mm	MLRS	644	M77 DPICM
		610mm	ATACMS 1	950	M74 DPICM
Turkmenistan	Rocket				
		220mm	Urgan	30	APAM
United Arab Emirates	Bomb				
			CBU-87	202	BLU-97 CEM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
United Kingdom	Projectile				
		155mm	L20A1	49	M85 DPICM
	Bomb				
			R/BL755	147	
			CBU-87	202	BLU-97 CEM
	Rocket				
		70mm	CRV7		
		227mm	M26 MLRS	644	M77 DPICM
		227mm	EPG MLRS	28	AT2 AVM
United States of America	Projectile				
		105mm	M444	18	M39 ICM
		105mm	M915	42	M80 DPICM
		105mm	M916	42	M80 DPICM
		155mm	M449	60	M43A1 ICM
		155mm	M449A1	60	M43A1 ICM
		155mm	M483A1	64	M42 DPICM and
				24	M46 DPICM
		155mm	M692	36	M72 ADAM APM
		155mm	M718	9	M73 RAAM AVM
		155mm	M731	36	M67 ADAM APM
		155mm	M741	9	M70 RAAM AVM
		155mm	M864	48	M42 DPICM and
				24	M46 DPICM
		155mm	M982	48	M42 DPICM and
				24	M46 DPICM
		155mm	M982	85	M80 DPICM
		203mm	M404	104	M43 ICM
		203mm	M509A1	180	M42 DPICM
	Bomb				
			AGM-154A	145	BLU-97 CEM
			AGM-154B	6	BLU-108B SFW
			CBU-55/B	3	BLU-73/B FAE
			CBU-72	3	BLU-73/B FAE
			CBU-78/B	45	BLU-91/B AVM and
				15	BLU-92/B APM
			CBU-87	202	BLU-97 CEM
			CBU-103		
			CBU-89/B	72	BLU-91/B AVM and
			CBU-104	22	BLU-92/B APM
			CBU-97/B	10	BLU-108B SFW
			CBU-105		
			Rockeye II	247	Mk-118
			CBU-99/100		
	Rocket				
		70mm	M261 MPSM	9	M73
		227mm	M26 MLRS	644	M77 DPICM
		227mm	M26A1 MLRS	518	M85/M77 DPICM
		610mm	ATACMS 1	950	M74
		610mm	ATACMS 1A	300	M74
		610mm	ATACMS 2	13	BAT SFW
			TLAM-D	166	BLU-97/B CEM

Stockpiling Country	Type	Caliber	Carrier Name	Number in Carrier	Submunition Name and Type
Ukraine	Rocket				
		220mm	Urgan	30	APAM
		300mm	Smerch	72	APAM
Uzbekistan	Rocket				
		220mm	Urgan	30	APAM
Yugoslavia	Projectile				
		120mm			KB-1 DPICM
		152mm		63	KB-2 DPICM
	Bomb				
			BL755	147	
			KPT-500	54	PTAB
				34	RAB
	Rocket				
		128mm	M77 Oganj	40	KB-1 DPICM
		262mm	M87 Orkan	288	KB-1 DPICM
		262mm	M87 Orkan	24	AVM

Appendix 2: Companies that Produce Submunitions

Producing Country	Companies Reported to Produce Submunitions (by Weapon Type)
Argentina	• Projectile (155mm) o *CITEFA* • Bomb o *SITEA* • Rocket (105mm, 127mm, 160mm) o *Direccion General de Fabricaciones Militares*
Belgium	• Projectile (81mm mortar) o *MECAR SA* • Rocket (70mm) o *Forges de Zeebrugge*
Brazil	• Rocket (127mm, 180mm, 300mm) o *AVIBRAS* o *Britainite Industrias Quimicas*
Bulgaria	• Rocket (122mm) o *Vazov Engineering Plants*
Canada	• Rocket (70mm) o *Bristol Aerospace Ltd.*
Chile	• Bomb o *Industrias Cardeon SA* • Rocket (160mm) o *FAMAE*
China	• Projectile (120mm, 122mm, 130mm, 152mm, 155mm), Bomb, Rocket (107mm, 122mm, 273mm, 284mm, 305mm) o *China Northern Industries (NORINCO)*
Egypt	• Projectile (122mm, 130mm, 155mm) o *Helipolis Company for Chemical Industries* • Rocket (122mm) o *SAKR Factory for Developed Industries*
France	• Projectile (120mm, 155mm) o *Giat Industries, Thomson Brandt Armements (TDA)* • Bomb o *Matra SA, R. Alkan et Cie, Thomson Brandt Armements (TDA), Vélizy-Villacoublay* • Rocket (68mm, 227mm) o *Aerospatiale, Thomson Brandt Armements (TDA)*
Germany	• Projectile (155mm) o *Diehl, GIWS, Rheinmetall GmbH* • Bomb o *LFK, RTG Euromunition* • Rocket (110mm, 227mm) o *Buck, Daimler Benz Aerospace, Diehl, Dynamit Nobel, Krauss Maffei, Krupp Atlas Elektronik, KUKA Wehrtechnik GmbH, Thyssen Henschel*
Greece	• Projectile (105mm, 107mm, 155mm) o *Greek Powder and Cartridge Company (Pyrkal), Hellenic Explosives/Hellenic Arms Industry*
India	• Rocket (214mm) o *Defense Research and Development Organization*
Iran	• Rocket (122mm) o *Parchin Missile Industries*
Israel	• Projectile (105mm, 120mm, 130mm, 152mm, 155mm, 175mm, 203mm), Bomb, Rocket (160mm, 350mm) o *Israeli Military Industries (IMI) Ltd.*

Producing Country	Companies Reported to Produce Submunitions (by Weapon Type)
Italy	• Projectile (81mm, 120mm, 155mm) o *Simmel Difesa SpA* • Rocket (70mm, 122mm) o *BPD Difesa, SNIA BPD*
Netherlands	• Projectile (155mm) o *Eurometaal EV*
Pakistan	• Projectile (155mm) o *Pakistan Ordnance Factories* • Bomb o *Air Weapons Complex Wah Cantt*
Poland	• Bomb o *Dezanet* • Rocket (122mm) o *Tlocznia Metali Pressta Spolka Akcynjna*
Romania	• Projectile (152mm) o *Romtechnica, Aerotech SA*
Russia	• Projectile (120mm, 152mm, 203mm) o *Mechanical Engineering Research Institute* • Bomb o *Bazalt State Research and Production Enterprise* • Rocket (122mm, 220mm, 300mm) o *Splav State Research and Production Enterprise*
Singapore	• Projectile (152mm) o *Chartered Ammunition Industries Ltd., Unicorn International Pte Ltd*
Slovakia	• Projectile (152mm) and Rocket (122mm) o *Konstrukta Defense*
South Africa	• Projectile (155mm) o *Denel, Naschem* • Bomb o *Denel, Reunert Technology Systems*
Spain	• Projectile (120mm) o *ECIA, Instalaza SA* • Bomb o *Expal Explosivos SA, International Technology SA* • Rocket (140mm) o *Santa Barbara SA*
Sweden	• Projectile (155mm) o *Bofors*
Switzerland	• Projectile (120mm) o *Swiss Munitions Enterprise*
Turkey	• Projectile (155mm) o *Makina ve Kimya Endustrisi Kurumu (MKEK)*
United Kingdom	• Bomb and Rocket (227mm) o *Hunting Engineering, Royal Ordnance*
United States of America	• Projectile (105mm, 120mm, 155mm, 203mm) o *Alliant TechSystems, American Ordnance, Day and Zimmermann, Primex Technologies* • Bomb o *Alliant TechSystems, Ferranti International, GenCorp Aerojet, Olin Ordnance, Raytheon, Textron Defense Systems* • Rockets (70mm, 227mm, 610mm) o *General Dynamics, Lockheed Martin, Northrop Grumman*
Yugoslavia	• Projectile (152mm) o *Yugoimport SDPR*

List of Acronyms

ADAM	Area Denial Antipersonnel Mine
AGM	Air-to-Ground Missile
AP	Antipersonnel
APAM	Antipersonnel Antimaterial
APM	Antipersonnel Mine
AT	Antitank
ATACMS	Army Tactical Missile System
ATAM	Antitank Antimaterial
ATM	Antitank Mine
AVM	Antivehicle Mine
BLU	Bomb Live Unit
CCW	Convention on Certain Conventional Weapons
CEM	Combined Effects Munition
CBU	Cluster Bomb Unit
DPICM	Dual Purpose Improved Conventional Munition
EPG	European Production Group
ERW	Explosive Remnants of War
FAE	Fuel Air Explosive
HEAT	High Explosive Antitank
ICM	Improved Conventional Munition
ICRC	International Committee of the Red Cross
LARS	Light Artillery Rocket System
MLRS	Multiple Launch Rocket System
MPSM	Multi Purpose Submunition
RAAM	Remote Anti Armor Mine
SADARM	Sense and Destroy Armor
SFW	Sensor Fuzed Weapon
U.N.	United Nations
UNMAS	United Nations Mine Action Service
U.S.	United States
UXO	Unexploded Ordnance

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