Evaluation of Rubber Ball Grenades: Applications for Law Enforcement and Corrections

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Abstract

The purpose of this manuscript is to evaluate rubber ball grenades and their application for law enforcement and correctional officers. This study examines the "Stingball" brand of rubber ball grenade and identified a number of factors that potentially impact its deployment. Two factors were identified that negatively affect the accurate placement of the grenade, both causing unpredictably in deployment. These factors may make application of these devises inconsistent with existing case law.

Introduction

Popular culture, including movies, television shows and other forms of entertainment, routinely shapes the public's perception of law enforcement technology and less lethal weapons. One of the most inaccurate perceptions is that of diversionary devices, or "flash bangs," which are depicted with almost mythical characteristics and allow entire rooms of individuals to be subdued simply by the application of bright light and a loud noise (i.e. *Assault on Precinct 13*). The public, based on perceptions from television science fiction like Star Trek, expects phaser-like weapons that result in immediate incapacitation but do not cause permanent harm or death (Heal, 1999). In reality, these devices simply create a temporary sensory overload and mild disorientation which allow an entry team sufficient time to breach and secure a room. The devices also carry a substantial risk of fire and the potential for secondary objects to be propelled when activated.

Although a variety of less-lethal weapons have been the focus of considerable research, including electronic control weapons, there has been minimal research on these types of diversionary devices that generate light and sound as pain compliance or distraction. This paper will review these weapons, and include an assessment of the potential shortcomings which must be considered before application in the field. At the core of this study, as in previous research on less lethal technology, is the premise that law enforcement and corrections agencies utilize the right tool for the right job.

Literature Review

Diversionary devices are used in a wide range of law enforcement operations (Sandia National Lab, 2003) as their deployment allows operators to enter and secure an area with decreased risk of resistance (Bozeman & Winslow, 2005). These devices create a sensory overload, which is intended to inhibit the suspect from correctly interpreting stimuli, and causes disorientation for six to eight seconds (Heal, 2001). The proximity of the device to the target has a direct impact on its effectiveness and as the distance from the flash bang is doubled, the effects from sound and pressure waves are halved.

Over the last twenty years there has been an evolving body of case law regarding the use of flash bang devices in law enforcement and corrections. Early cases tended to provide guidance toward acceptable deployments while more recent cases tend to place more limitations on their use. The following cases represent the major challenges to flash bang deployments as a violation of 4th and 8th Amendment protections.

<u>Langford v. Superior Court</u>, 43 Cal. 3d 21, 729 P.2d 822 (Cal. 1987)

Flash bangs did not pose an unacceptable threat to property and persons after officers have seen fully into a targeted room.

<u>United States v. Stewart</u>, 867 F.2d 581, 584-85 (10th Cir. 1989)

Court found that the exigencies put forth by the government did not justify this entry, where (1) all the claimed exigencies were known at least 24 hours before the entry; (2) most of the facts used to justify the mode of entry were "generalities that bore no relation to the particular premises being searched or the particular circumstances surrounding the search"; and (3) of the two specific facts known to the officers, one was stale and an isolated incident, and the other was an improper consideration (the suspect's ethnicity).

<u>Commonwealth v. Garner,</u> 423 Mass 735, 672 NE 2d 510 (1996)

Court recognized that the "unreasonable execution of a warrant may violate the Fourth Amendment," found that the police knew the defendants to be armed and vicious and that the risk to the child (present in the room where flash bang was deployed) was less than that posed by a gun battle between police executing a warrant and armed, dangerous criminals.

Richards v. Wisconsin, 520 U.S. 385, 137 L. Ed. 2d 615, 117 S. Ct. 1416 (1997), Rejects an argument that drug dealers are invariably so dangerous that no-knock entries are proper.

United States vs. Green, 1994 U.S. App. LEXIS 11087
There is no evidence that use of a flash bang diversionary device in the present instance was excessive force rendering the search unreasonable. No one was injured. No children were present. Without some evidence to the contrary, the court could not say that the force was unreasonable in light of information known to officers.

United States v. Myers, 106 F.3d 936 (10th Cir. 1997)
The use of a flash bang device is neither per se objectively reasonable nor unreasonable. The reasonableness of its use depends on the facts and circumstances of each case.

Mitchell v. Kansas City, 2000 U.S. Dist. LEXIS 19195 (D. Kan. 2000)
Because the officers believed that drugs and weapons were located within the home, the use of a diversionary device was reasonable to effectuate the safest entry possible.

United States v. Jones, 214 F.3d 836, 837 (7th Cir. 2000)
Police cannot automatically throw a bomb into drug dealers' houses, even if the bomb goes by the euphemism 'flash-bang device.

United States v. Folks, 236 F.3d 384 (7th Cir. 2001)
Court suggested that a sufficiently careful (or perhaps reasonable) use of a flash bang device occurs when officers take a moment to look inside a residence or a room to ensure that no one would be injured by the device before tossing it and where officers carry a fire extinguisher to quickly extinguish any fires resulting from deployment of the device.

Kirk v. Watkins, WL360704 (10th Cir. 2002)
Plaintiff homeowners filed suit after a flash bang device burned them when it landed on their bed during the execution of a no-knock search warrant. The judgment of the lower court that denied qualified immunity to the defendant officer was reversed because the defendant did not violate clearly established law when he threw the flash bang device into the plaintiffs' bedroom.

<u>Molina v. Cooper</u>, 325 F.3d (7th Cir. 2003)

The use of flash bang devices during the execution of a "high risk" search warrant was reasonable because of suspect's violent criminal history and access to a stash of weapons. However, court expressly stated that "we in no way suggest that the use of flash bang devices is appropriate in every case (or even most cases)."

<u>Estate of Smith v. Marasco</u>, 318 F.3d 497, 515-18 (3d Cir. 2003)

Discussed the use of flash bang grenades to enter an individual's home where the purpose was not to arrest him and where the individual was non-threatening, mentally unstable and suicidal. The court determined that a reasonable jury could find that the defendant officers' conduct was unreasonable and excessive under the Fourth Amendment.

<u>United States v. Buchanan</u>, 78 Fed. Appx. 933, 935 (5th Cir. 2003)

The knock-and-announce requirement is not an abstract requirement that officers utter the talismanic word "police" at some point prior to entry, but a requirement that law enforcement officials afford residents "an opportunity to respond to and cooperate with the police presence in lieu of having to face an unexpected and threatening intrusion."

<u>United States v. Dawkins</u>, 83 Fed. Appx. 48 (6th Cir. 2003)

An officers' use of the flash-bang diversionary device was viewed to be objectively reasonable when the suspect possessed an assault rifle and had previously been convicted of a crime of violence. No one in the residence was injured by the flash-bang. Although some property damage from the device's use occurred (a shattered penny jar, a dented file cabinet, and burn marks on the floor), this damage does not create a Fourth Amendment violation. Rather, the appropriate remedy, if any, for this damage lies in tort. The fact that the flash-bang's detonation caused an injury to one of the officers is irrelevant to the inquiry into whether the device's use violated Fourth Amendment rights.

<u>United States v. Morris</u>, 349 F.3d 1009 (7th Cir. 2003)

Emphasized the dangerous nature of flash-bang devices and has cautioned that the use of such devices in close proximity to suspects may not be reasonable

<u>Boyd v. Benton County</u>, 374 F.3d 773, 777-79 (9th Cir. 2004)

The use of flash bang device is an unconstitutional use of excessive force where police deployed it without either looking or sounding a warning when there were innocent individuals in a room as well as suspected robbers.

<u>Spradley v. State</u>, 933 So.2d 51 (Fla. Dist Ct. App 2d Dist. 2006)

The police had a search warrant and there were no exigent circumstances to enter the home without knocking and announcing. As soon as an officer finished knocking and announcing, the police set off an explosive detonation device and used a battering ram to break down the two doors. The time elapsed was approximately 15 seconds. The appellate court held that since defendant had standing to challenge the violation of Fla. Stat. § 933.09. (The officer may break open any outer door, inner door or window of a house, or any part of a house or anything therein, to execute the warrant, if after due notice of the officer's authority and purpose he or she is refused admittance to said house or access to anything therein.) as his property was damaged.

Under the circumstances, a reasonable, law-abiding person might delay more than a few seconds to respond to the door, to orient themselves, to make certain that the explosive device posed no danger, and to determine that it was safe to invite the person knocking to enter. It seemed particularly unreasonable to expect an occupant to open the door in the seconds within which it is being hit with a large object on the other side. By intentionally detonating the distraction device during the few seconds that the occupants had to go to the front door and open it, the police could not reasonably expect the occupants to accomplish that which was expected of them.

<u>Escobedo v. Bender</u>, 600 F.3d 770 (7th Cir. 2010)

Based on the pre-existing case law, it was clearly established at the time of the incident (2005), that throwing a flash bang device blindly into an apartment where there are accelerants, without a fire extinguisher, and where the individual attempting to be seized is not an unusually dangerous individual, is not the subject of an arrest, and has not threatened to harm anyone but himself, is an unreasonable use of force.

<u>Jackson v. Gerl</u>, 622 F. Supp 2d 738 (Dist. Court WD, 2009)

Detonating a Stinger grenade inside a prison cell could not be considered de minimis (minimal amount of force as described in Hudson v. McMillian). Court was unable to determine if deployment of grenade was in a good-faith effort to maintain discipline or maliciously and sadistically to cause harm.

<u>Rush v. City of Mansfield</u>, (Dist. Court, ND Ohio 2011)

The Court did not accept argument that a “grenade-and-announce” is sufficient to comply with knock-and-announce, particularly where the police combine the grenade with "blinding beams" that prevent their visual identification as police. Grenade-and-announce does not give occupants the opportunity to cooperate "in lieu of having to face an unexpected and threatening intrusion." The grenade is the "unexpected and threatening intrusion” (as discussed in US v. Buchanan).

Although the term “stingball grenade” appears in both literature and case law, a more accurate generic description would actually be rubber ball grenade, as “Stingball” is a registered trade name of Combined Tactical Systems©. A similar product, “Stinger”, is produced by Defense Technologies©. Rubber ball grenades are a type of diversionary devices that are used in crowd control and corrections environments. While this category of munitions is categorized as a diversionary device, there are significant differences from a standard flash bang.

First, rubber ball grenades can only be used one time. A number of flash bang models utilize non-bursting canisters and can be repeatedly reloaded. Second, the composition of the flash bang is steel and utilizes vents to release the blast wave. Unlike flash bangs, rubber ball grenades intentionally propel hard rubber pellets that may cause injury to people in close proximity to the device when it ignites. Additionally, Stingball and Stinger grenades have a rubber exterior and break apart in a fashion similar to that of a military grenade. As a result, there is a risk of causing severe injuries or death from flying projectiles (Ijames, 2005; Sandia National Labs, 2003; Bozeman & Winslow, 2005) as rubber balls tend to ricochet (Heal, 2001). However, even standard flash bangs are not without risk, as fragmentation and fire have been documented in prior studies (Elabs, 2004). Due to the extreme temperatures generated, fire is a legitimate concern and suspects who are too close may have injury patterns that resemble those caused by fireworks (Feier & Mallon, 2010).

Over the years, several companies have launched their own form of rubber ball grenades that generate heat, light, sound and fragmentation. Surprisingly, with applications in both law enforcement and corrections, there was very little literature regarding these devices.

Methodology

This current study focused on the Stingball brand of rubber ball grenades and focused on the model 9590 from Combined Tactical System (CTS). This brand was chosen as a convenience, as the principle investigator held an instructor certification in this diversionary device, which was required by Alcohol, Tobacco, Firearms and Explosives (ATFE) in order to acquire this category of destructive device.

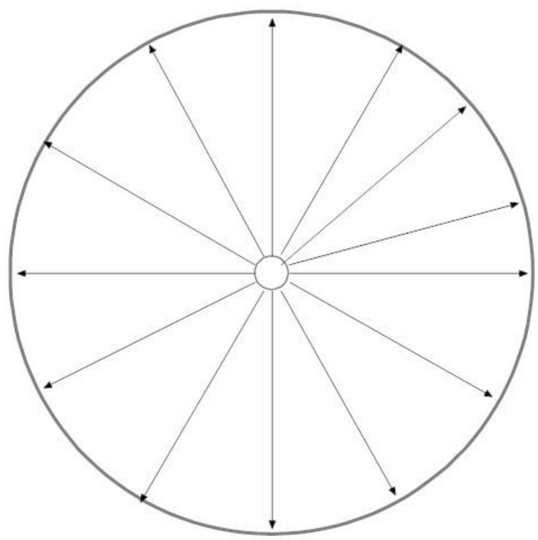
When a Stingball devise is released by the operator, the bouchon disengages and initiates the Model 201 precision delay fuze, which in turn initiates an ejection charge. The fuze then separates and kicks the body of the grenade away and proceeds to deflagrate. This action reduces the likelihood of the heavy fuze being projected as an additional form of shrapnel.

Each Stingball grenade contains approximately 105 rubber balls (.31 caliber) that are released in all directions as a form of less lethal shrapnel. The delay for almost all distraction devices and rubber ball grenades varies from .7 to 2 seconds, with the most common delay being between 1.5 and 2 seconds (Heal, 2001).

In riot situations, Stingballs are considered to be effective diversionary devices, and are most effective when deployed in volleys as more suspects are impacted simultaneously (Heal, 2001). According to Combined Tactical Systems (2009), these devices generate three primary effects: heat (2700° F), light (6-8 million c.d.), and sound (165-180 dB). The environment where the device is deployed can impact these effects where pressure waves and projectiles can be reflected off barriers and other obstructions.

Two initial concerns formed the basis of this analysis. First, the dispersion pattern of the Stingballs is frequently described as 360° of coverage similar to the one shown in Figure 1, illustrating an equidistant and equal dispersion in the delivery of payload. Regardless of initiating source (explosion or deflagration), it is unlikely that universal coverage could be achieved, as some projectiles would be propelled upward.

Figure 1. 360° Diagram Coverage



Second, unlike other less lethal weapons that target “safe” zones of the body (See Mesloh, et al., 2008), the trajectory of the Stingball fragments cannot be controlled by the user and could potentially strike unintended portions of the target's body. This creates a concern for eye safety and soft tissue damage, and the potential that the projectiles may become lethal.

A total of 100 Stingball grenades were detonated to identify the area of Stingball coverage and to perform some type of trajectory analysis. Since there is a dearth of rubber ball grenade literature, a modification of the grounded research approach was employed (Strauss & Corbin, 1990; Galser & Strauss, 1967) to create or modify variables based on observations made during the data collection process.

However, there were two immediate problems: 1) the rubber body of the grenade (when thrown) performed in a similar fashion to a child's "crazy ball" which never bounced in the same manner consecutively, and 2) after several bounces, the separating fuze of the munition created a unique problem by propelling the grenade a considerable distance. After observing a number of deflagrations and noting a substantial variance in the distances travelled, it was determined that this data would also be captured for analysis. It was then measured how far the body traveled away from the bouchon to its point of deflagration.

Because this was a separating fuze munition, the methodology could not control the exact location of the Stingball deflagration. This effect was minimized, however, by placing the grenade at a designated deflagration point and holding it in place with a bang pole (which had to be designed and constructed since none existed for separating fuze munitions).

To document whether 360° coverage was obtained, the research team constructed a 16’x16’x8’ cardboard box comprised of witness panels to measure the number of projectile impacts. The size of the test box was modified numerous times during initial pre-tests, and this size consistently captured the greatest amount of data. An eight foot section of cardboard was replaced with transparent Lexan to allow researchers the ability to view the action in real time or through the review of multiple video recordings.

Figure 2. Observations of Stingball Deployments

The grenade was remotely detonated while attached to the bang pole and cardboard panels were marked where grenade pieces and rubber balls penetrated the surface of the cardboard. The data from each deployment was mapped onto a data collection form and collated for later analysis. Photographs and videos of testing made it possible to reconstruct the results of each deployment.

In addition to rubber ball projectiles, the amount and type of shrapnel was documented. To collect the various components, each grenade was initiated within a metal shipping container that served as a test chamber. After each deployment, the container was swept out and its contents inventoried prior to the next test.

Findings

In order to measure the effect of the separating fuze, a total of ten Stingball grenades were deployed from a standard point inside the testing area and the distance measured between where the Stingball pin was pulled to the location that the device deflagrated.

Table 1. Distance Grenade Travelled

Trial	Distance
1	33 inches
2	107 inches
3	128 inches
4	65 inches
5	58 inches
6	91 inches
7	88 inches
8	203 inches
9	22 inches
10	37 inches

The shortest distance was only 22 inches (1.83 ft) and the furthest distance was 203 inches (16.92 ft). It was found that the average distance that the grenade body traveled from the fixed initiation point was 83.2 inches (6.93 ft). Consequently, if the user somehow managed to accurately deliver the grenade (after it bounced several times erratically), the action of the separating fuze would propel it almost an additional seven feet prior to deflagration.

As stated, Stingball grenades are comprised of a fuze mechanism, a hard rubber outer body, and a number of .31 caliber rubber balls that are held inside the outer body. The rubber balls are dispersed in all directions upon deflagration and serve as a diversion in addition to the light and sound effects. It was discovered during testing, however, that far more projectiles were released than just rubber balls. The entire body of the grenade had the possibility of becoming shrapnel. Consequently, the variance in the number of possible projectiles per grenade made predictive modeling impossible.

Eleven (11) grenades were deflagrated inside a metal test chamber and pieces were collected. The number of rubber balls varied considerably from grenade to grenade (103-117) with an average of 110 balls. The body of the grenade broke into a wide range of pieces (7-93) with an average of 35 pieces.

Table 2. Summary of Rubber Balls and Components

	Range	Median	Standard Deviation
Rubber Balls	103 - 117	109.7	4.9
Grenade Body Pieces	7 - 93	35.2	25.4
Total Projectiles	110 - 210	144.9	29.3

As shown in Figure 3, some grenade bodies remained somewhat intact, while others nearly disintegrated creating a shower of shrapnel. As the number of rubber balls and the fragmentation of each Stingball varied, the number of projectiles varied substantially from grenade to grenade (110-210; m = 145; s.d. = 29.3).

Figure 3. Different Fragmentation in Two Stingball Grenades

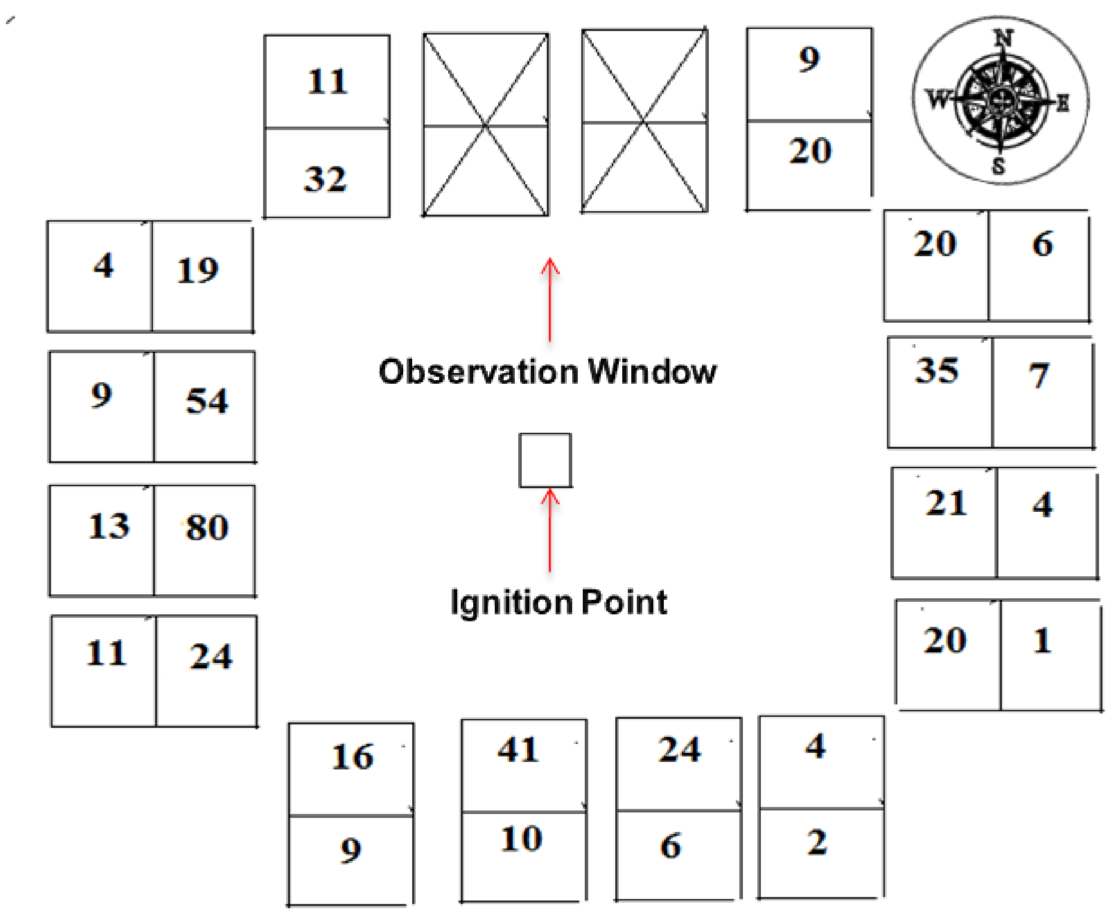
Some grenades fragmented into a few large pieces while others fragmented into dozens of smaller pieces. The researchers categorized shrapnel from the grenades into three size groupings, 0-20mm, 21-40mm and greater then 40mm. As shown in Table 3, the majority of the shrapnel fell into the smallest category.

Table 3. Shrapnel Sizes

Trial	0-20mm	21-40mm	40<mm
1	5	8	5
2	29	11	5
3	1	3	3
4	9	9	3
5	17	14	5
6	15	5	5
7	62	24	7
8	31	11	5
9	7	0	3
10	33	9	9
11	13	1	3

According to multiple vendors (including the vendor used in this study), Stingball grenades were advertised to provide 360° coverage of the area upon deflagration. However, our observations did not support this claim. Ten (10) grenades were tested for this variable. Each grenade was centered in the 16' x 16' x 8' cardboard box and manually initiated. After each deflagration, the research team counted and marked each area of impact (defined as piece of the grenade or rubber pellet that struck the cardboard witness panels). Table 4 shows the number of times a section of the test chamber was impacted (with separate scores for the top and bottom half of each witness panel).

Table 4. Summary of Ten Stingball Test Results



Of the ten grenades deployed, there were a total of 512 impacts on the witness panels. Of this number, 80% (410) struck above 4' or higher, while 20% (102) fell at 4' or below. Additionally, one individual panel showed the most activity with 93 rubber ball hits (80 hits on the lower panel, 13 hits on the upper), making up 18% of the coverage. The west wall seemed to have the most activity, receiving 42% of the rubber balls impacts. The pattern of the grenades tended to travel in this direction for each deployment while other quadrants of the test box received considerably fewer impacts. Since all of the grenades were initiated from a fixed position, it was possible to identify this distribution which would have appeared random had the grenade landed haphazardly. It was theorized that the grenade's design caused it to break apart along specific seams on its body and release the rubber balls in that direction.

Conclusion

Evaluation of the Stingball grenade identified a number of factors that potentially impact its deployment in law enforcement and corrections. Two factors were identified that negatively affect the accurate placement of the grenade. The first was the fact that the rubber exterior causes the grenade to bounce unpredictably. The second factor was that the separating fuze moves the device an average of seven feet prior to deflagration. These factors may not be consistent with the application visualized by existing case law, and greatly limit the type of applications in which the Stingball grenade could be deployed.

It was also found that the grenade body broke into various size fragments that each became additional pieces of shrapnel. While the small mass of the rubber balls tended to pose a minimal risk, the larger (and harder) components of the grenade appear more problematic. A number of these components passed completely through the panels used for the experiments, and became imbedded in the wall of the research lab.

Finally, while Stingball coverage may encompass a 360° area, that coverage tends to focus the payload in specific “hot spots”, based upon the orientation of the grenade at the time of deflagration. Coverage is further impacted by the number of rubber balls which varies from grenade to grenade. However, coverage issues may be overcome by deploying in volleys (as suggested by Heal, 1990) and projecting additional projectiles into the target area.

Key Terms

Bouchon –modern fuze system in hand grenades and flash bangs usually consisting of a safety pin, safety "spoon," and percussion ignition device

Deflagrate- subsonic (slow) expansion or explosion (from low explosives such as black powder, flash powder, etc.)

Detonate- supersonic (fast) expansion or explosion (from high explosives such as TNT, PETN, etc.)

Flash bang- A diversionary device which, when ignited, emits a loud bang and bright flash; also known a flash/sound device, distraction device, diversionary device

Fuse- pyrotechnic initiator for a device

Fuze- mechanical initiator for a device

Rubber ball grenade- a less than lethal device which uses an explosion, or other method, to propel or fling pellets or other similar objects which intend to cause pain but without serious injury

Stingball grenade- proprietary name (by Combined Tactical Systems©) for a type of rubber ball grenade

Separating fuze munition- fuze assembly separates from the body, which contains the explosive charge to prevent fragmentation of the fuze

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