

Appendix E Improvised Explosive Devices

“Shampoo bottles, bicycle seats, tiffins. A plastic container or an LPG cylinder. A parcel of books. A clock, a teddy bear. In the Kashmir Valley, any one of these innocuous objects can be fatal. They are all commonly used by militants to fashion bombs and improvised explosive devices (IEDs). But the most lethal of all is the remote controlled explosive device, hidden in a ditch, a drainpipe or a parked vehicle.”

- “Lethal Weapons”, *Indian Express Newspaper* (Bombay), August 24, 2000

General

While terrorists will use conventional weapons, such as rocket-propelled grenades and assault rifles to achieve their goals, they also have the ability to assemble and employ a wide variety of lethal improvised explosive devices (IEDs). Explosives are a popular weapon with terrorists and are covered in the al Qaeda training manual. The manual states, “Explosives are believed to be the safest weapon for the Mujahideen. Using explosives allows them to get away from enemy personnel and to avoid being arrested.” It goes on to say that, “In addition, explosives strike the enemy with sheer terror and fright.”¹⁸³

IEDs are a common tool of terror used by non-state actors. These devices have been fabricated in an improvised manner and incorporate highly destructive lethal and dangerous explosives or incendiary chemicals, which are designed to kill or destroy the target. The materials required for these devices are often stolen or misappropriated from military or commercial blasting supplies, or made from fertilizer and other readily available household ingredients.¹⁸⁴ IEDs basically include some type of explosive, fuse, detonators and wires, shrapnel and pieces of metal, and a container to pack the explosives and shrapnel.

The use of IEDs by terrorists is a constant threat. Terrorist groups are continuously developing new techniques and tactics in response to defenses and countermeasures established by their opponents. They will disguise IEDs to hinder recognition and will often booby-trap the devices to detonate if disturbed.

The most simple of the IEDs used is the one initiated by closing of a battery circuit, similar to turning on a battery operated light. When turning on the switch closes the circuit, electricity flows to the light so it can be illuminated. As shown in Figure E-1, a clothespin-triggering device in this IED replaces the light switch and when it is activated, the electricity flows to the charge, thus detonating the explosive.

¹⁸³ Ben N. Venzke and Aimee Ibrahim, *Al Qaeda Tactic/Target Brief* (Alexandria: IntelCenter/Tempest Publishing, 2002), 11.

¹⁸⁴ *Conventional Terrorist Weapons* (New York: United Nations Office for Drug Control and Crime Prevention, 2002), 4; available from http://www.undcp.org/odccp/terrorism_weapons_conventional.html; Internet; accessed 12 November 2002.

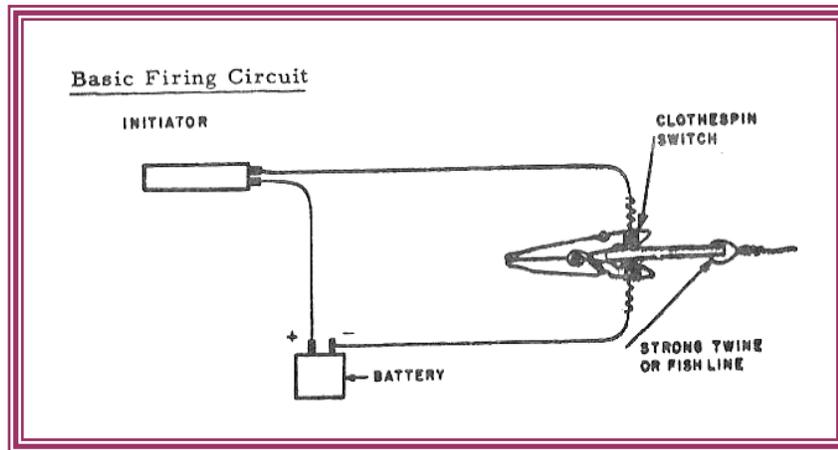


Figure E-1: Basic Firing Circuit (Source: TM 31-210)

The IED can be detonated using a number of triggering devices. These can be mechanical, electrical, or remote controlled type devices. For instance, after emplacing the IED, such as in a natural culvert or under a road by digging and then camouflaging the spot, the person waits some distance for the target to arrive. Once the target is within the damage area, the IED is initiated. The damage caused can be phenomenal as even a small amount of explosive can cause an explosion that dislodges a vehicle up to 50 feet in the air, or damage a bridge totally. This same scenario can be applied to a passenger train. More sophisticated assemblies of IEDs can be even more devastating and cause much damage.

Explosive Charges

Although terrorists use manufactured explosive material, it is easy for them to obtain the ingredients required to make improvised explosive material as well. The ingredients can be purchased at local stores with relative ease. Additionally, the instructions for making these type explosives have been published in a wide variety of literature, such as The Anarchists Cookbook¹⁸⁵, for years. They are also available on the Internet. One such site has the recipes to make 27 different low and high order explosives¹⁸⁶ and another site gives instructions for both producing explosives and making the bombs.¹⁸⁷ The following are examples of common types of explosive charges found in IEDs.

- Improvised explosive mixtures: Although there are recipes to make virtually any explosive, the following are some common improvised ones that are used.
 - Ammonium nitrate fertilizer

¹⁸⁵ William Powell, *The Anarchist Cookbook* (Secaucus, NJ: Lyle Stuart, Inc., 1971), 111.

¹⁸⁶ *Improvised Explosives*; available from

http://members.odinsrage.com/white88/18_ImprovisedExplosives.htm; Internet; accessed 11 December 2002.

¹⁸⁷ *Improvised Explosives*, vol. I, version 2.0 (15 May 1990); available from

<http://www.logicsouth.com/~lcoble/password/firearms.html>; Internet; accessed 11 December 2002.

- Black powder
 - Gasoline
 - Match heads
 - Smokeless powder
 - Sodium Chlorate and sugar
- Chemical reactions:
 - Acid bombs, such as nitric and sulfuric acid
 - Caustic bombs, such as Drano toilet bowl cleaner
 - Dry ice
 - Plastic Explosives: This has become the explosive of choice for various international terrorist groups. There are 2 main types used by terrorists:
 - C-4: a white, RDX based explosive produced by the United States. This is the common plastic explosive used by the U.S. military.
 - SEMTEX: an orange, RDX and PETN based explosive produced in the Czech Republic. Intelligence experts estimated the bomb that destroyed Pan Am 103 over Lockerbie, Scotland, in 1988 contained about two-thirds of a pound of Semtex.¹⁸⁸

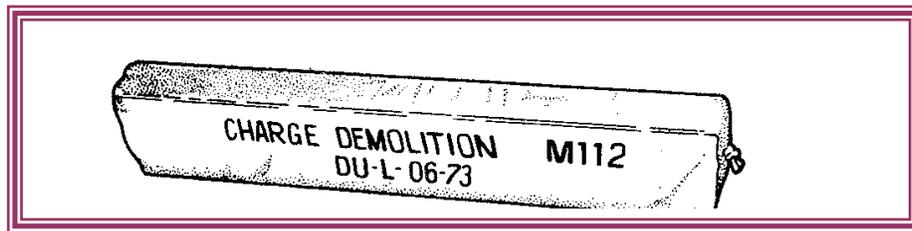


Figure E-2: U.S. Army M112 Block Demolition Charge of C4 (Source: FM 5-25)

- TNT: TNT is the most common military explosive and is used alone or as part of a composite explosive. It is also used as the standard against which other military high explosives are rated.

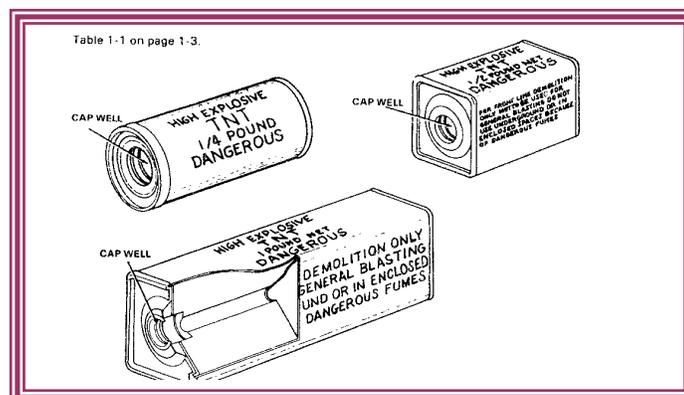


Figure E-3: TNT Block Demolition Charges (Source: FM 5-25)

¹⁸⁸ Earl Lane, "Plastic Explosives Difficult to Detect," *Newsday.com*, 23 July 1996, 1; available from <http://www.newsday.com/news/nytwa96-jet3bomb.0.2501618.story>; Internet; accessed 12 December 2002.

- Dynamite: The most widely used explosive in the world for blasting operations. It has been fairly easy to obtain by both theft and legal purchases in the past.

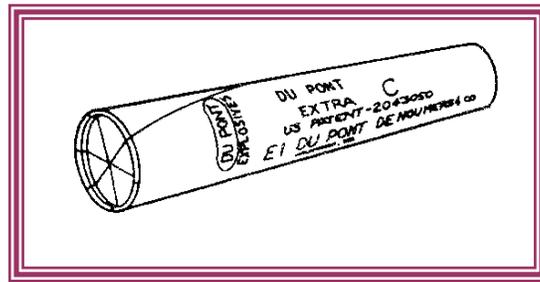


Figure E-4: Commercial Dynamite (Source: FM 5-25)

Common Trigger Devices

As mentioned earlier, some form of trigger is used to detonate the explosive device. These range from very simple homemade devices to highly technical devices. Although not all-inclusive, some examples are listed below.

- Manual wind-up alarm clocks and wristwatches. Delay can be up to 24 hours.

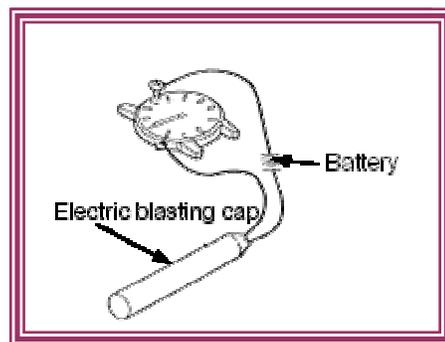


Figure E-5: Wristwatch Device (Source: FM 20-32)

- Pressure release switch that is spring-loaded. These can be as simple as a mousetrap or a commercially produced switch.

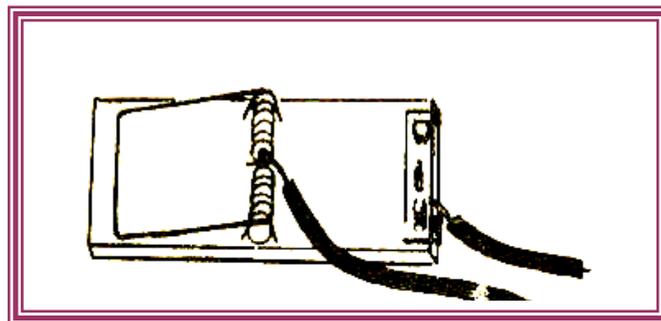


Figure E-6: Mousetrap Switch (Source: TM 31-210)

- Pull switches that actuate when a trip wire is pulled. There are many different forms of these triggers. They can be made easily by stripping the insulation off of wire and looping them together or by inserting a piece of wood between the contact wires on a clothespin.



Figure E-7: Pull-Loop Switch (Source: TM 31-210)

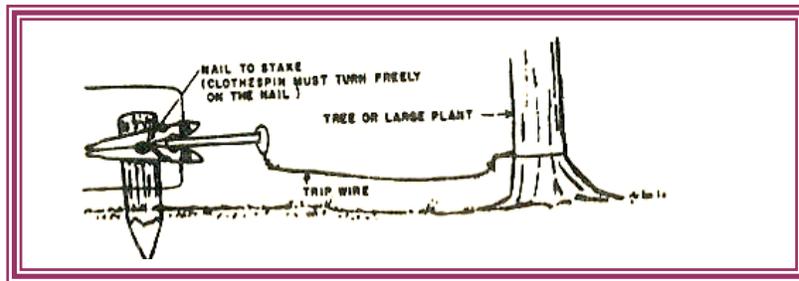


Figure E-8: Clothespin Switch (Source: TM 31-210)

- Pressure switches that actuate when weight is applied.

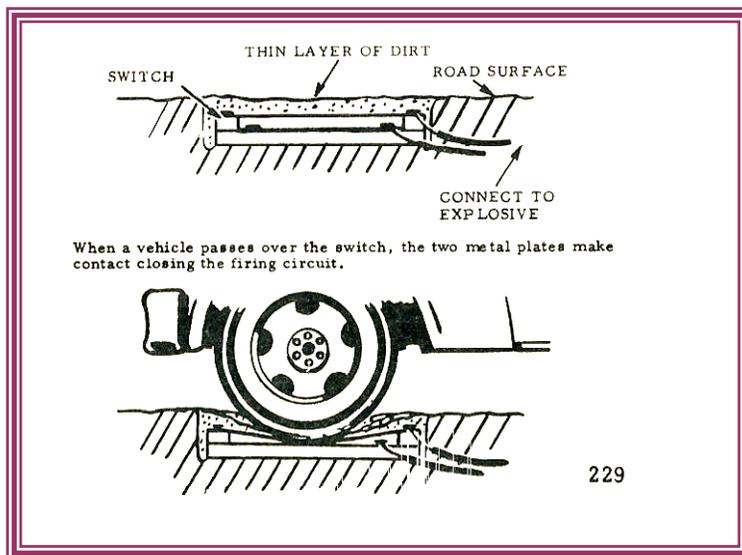


Figure E-9: Pressure Switch (Source: TM 31-210)

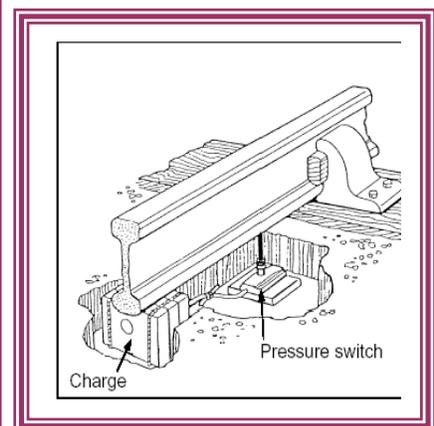


Figure E-10: Pressure Switch (Source: FM 20-32)

- Metal Ball Switch: This switch will activate the device when it is tipped. It also can be used as an anti-disturbance type system that actuates the explosive device when it is disturbed.

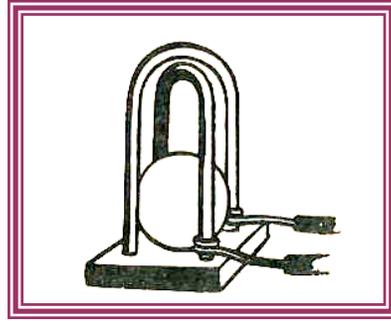


Figure E-11: Metal Ball Switch (*Source* TM 31-210)

- Wire command detonation.

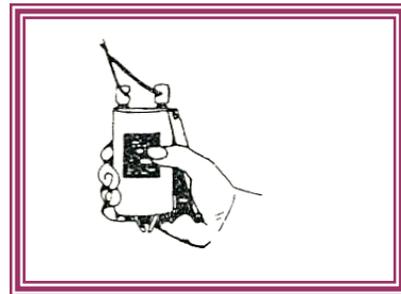


Figure E-12: Hand-held Detonation Device (*Source*: FM 20-32)

- Barometric Sensor: Bombs can be triggered using a barometric sensor that detonates once it reaches a specific altitude. The bomb on Pan Am Flight 103 had a detonator with a barometric sensor with a timer delay and triggered only after the aircraft had reached a specific altitude and flew at that altitude for a set length of time.¹⁸⁹
- Alarm equipment, such as motion detectors, infrared detectors, and heat detectors. Trigger devices were found in Chechnya that could discern the body heat of a person from background clutter over 20 feet away.¹⁹⁰
- LED digital wristwatch.¹⁹¹
- Radio control systems similar to those used for models. These have been used by the IRA to detonate bombs against the British.¹⁹²
- Hand-held radar guns.¹⁹³

¹⁸⁹ Christopher Wain, “Lessons from Lockerbie,” *BBC News*, 21 December 1998, 1; available from http://news.bbc.co.uk/1/hi/special_report/1998/12/98/lockerbie/235632.stm; Internet; accessed 12 December 2002.

¹⁹⁰ Ed Wagamon, “Tactical Combat in Chechnya: Mines & Booby Traps: The Number One Killer” (Part 1 of 2), *How They Fight: Armies of the World*, NGIC-1122-0062-01, vol 4-01 (August 2001): 35.

¹⁹¹ *Ibid*, 35.

¹⁹² Bruce Hoffman, *Inside Terrorism* (New York: Columbia University Press, 1998), 180.

¹⁹³ *Ibid*, 181.

- Radio command detonation, such as battery-powered garage door openers, cell phones, and paging systems.¹⁹⁴

Types of IEDs

The different types of IEDs vary based on the type explosive used, method of assembly, and also the method of detonation. As this is restricted only by human ingenuity, the types of IEDs are infinite. The Technical Support Working Group, which is an interagency group focusing on counter terrorism, categorizes IEDs based on their size and explosive capacity. The following table from *Jane's Unconventional Weapons Response Handbook* shows the categories.

| Threat | Explosives Capacity (TNT Equivalent) |
|---|---|
| <i>Firebomb or incendiary device</i> | Less than 1 lb (0.5 kg) |
| <i>Postal explosive device</i> | 1-5 lb (0.5 – 2.5 kg) |
| <i>Pipe bomb</i> | 1-5 lb (0.5 – 2.5 kg) |
| <i>Man-portable explosive device</i> | 5-50 lb (2.5 - 25 kg) |
| <i>Compact sedan</i> | 500 lb (225 kg) |
| <i>Full-size sedan</i> | 1,000 lb (455 kg) |
| <i>Passenger or cargo van</i> | 4,000 lb (1,815 kg) |
| <i>Small moving van or delivery truck</i> | 10,000 lb (4,535 kg) |
| <i>Large moving van or water truck</i> | 30,000 lb (13,605 kg) |
| <i>Semi-trailer</i> | 60,000 lb (27,210 kg) |

Source: John P. Sullivan, et al., *Jane's Unconventional Weapons Response Handbook* (Alexandria, VA: Jane's Information Group, 2002), 53.

Table E-1: Explosive Capacity

Although not all inclusive, some of the common IEDs a military organization will encounter are shown below:

- Pipe Bombs. This is the most common type of terrorist bomb. Steel, iron, aluminum or copper pipes that are widely available in the market are used and low-velocity explosives are tightly capped inside. These are often wrapped with nails to cause more damage.

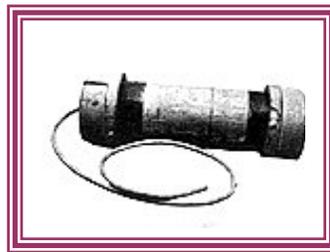


Figure E-13: Pipe Bomb
(Source: BATF)

¹⁹⁴ Ed Wagamon, "Tactical Combat in Chechnya: Mines & Booby Traps: The Number One Killer" (Part 1 of 2), *How They Fight: Armies of the World*, NGIC-1122-0062-01, vol 4-01 (August 2001): 34.

- Incendiary Devices. The Molotov cocktail was initially used by the Russian resistance against German armored vehicles in WWII. They are very easy to make, yet cause sever damage. The device normally consists of a glass bottle, which contains a very volatile fuel, such as gasoline or diesel. A cloth fuse is inserted through the bottle opening and is ignited before the bottle is thrown at the target.

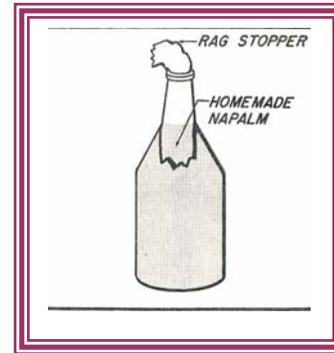


Figure E-14: Molotov Cocktail (Source: TM 31-201-1)

- Vehicle Devices. In addition to the IEDs, a vehicle can be modified to conceal and deliver large quantities of explosives to a target. The motive behind such incidents is to cause many casualties and gross property damage. This type of weapon is termed a VBIED (vehicle borne improvised explosive device). Factors encouraging VBIED use include:
 - Mobility.
 - Benign, non-threatening means of delivery and concealment.
 - Capacity to conceal large quantities of explosives.
 - Fragmentation and blast enhancement.
 - Penetration of target's perimeter not required (within reason).
 - Minimal technology, logistics, and financing are needed to assemble a large explosive device proven to cause major personnel casualties and gross property damage.
 - Suicide driver is nearly impossible to stop.

Such devices can also be remotely controlled for detonation. The near-simultaneous use of multiple VBIEDs against geographically dispersed targets has the potential to create mass casualties and panic.

- Other devices: The design of IEDs is only limited to the ingenuity of the person making them. A few examples of other type devices are shown below.

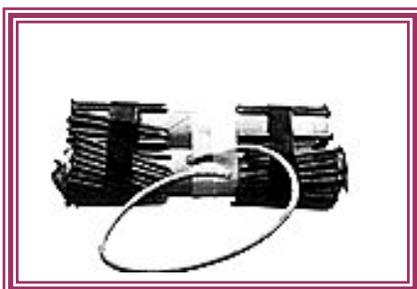


Figure E-15: Dynamite/Nail Bomb (Source: BATF)

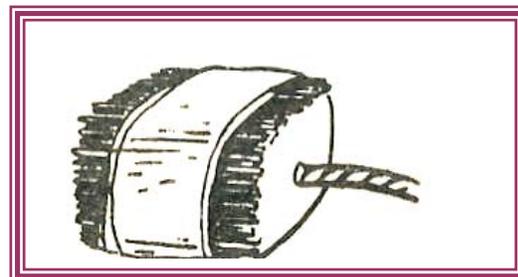


Figure E-16: Nail Grenade (Source: TM 31-210)

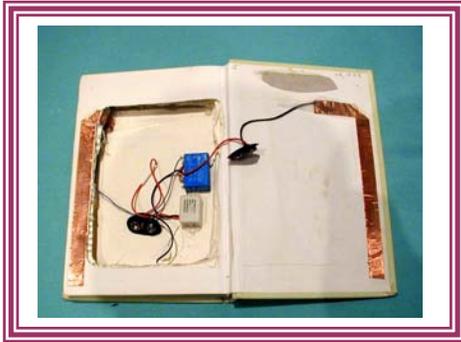


Figure E-17: Bomb Book (Source: File Photo)



Figure E-18: Plastic milk containers filled with explosives (Source: File Photo)

- Projected IEDs. These are improvised devices that launch some form of projectile at the intended target. These fall into 3 categories: Explosively formed projectiles (commonly called platter charges or disk charges); shoulder fired rocket launchers; and improvised mortars.
 - Platter charges. These are designed with some form of explosive material placed on one side of a flat metal plate. When the device is detonated, the metal plate is launched at the target and can penetrate armor and concrete.

Red Army Brigade Ambush Alfred Herrhausen, 30 November 1989

The Red Army Brigade, primarily a German domestic terrorist group, targeted politicians and influential businessmen for murder. As head of Deutsche Bank, Germany's largest bank, Alfred Herrhausen was the most influential businessman in the country. The Red Army Brigade vowed to kill Herrhausen by the end of November 1989

Herrhausen was chauffeured to work each morning in an armored Mercedes, with bodyguards in a lead and a follow car. The Red Army Brigade learned his routine, which was to take substantially the same route to and from work at approximately the same time each day. That route went through a park, which made for an excellent surveillance and attack site. RAB members, in workers' clothes, dug a small hole across the road, set up an infrared beam on one side and a reflector on the other.

On 30 November 1989, Alfred Herrhausen headed for work in his usual motorcade, along his usual route, at his usual time. A RAB lookout signaled the triggerman that Herrhausen's motorcade was approaching the kill zone. The triggerman allowed the first car through, then activated the infrared beam. When Herrhausen's car broke the beam, a timer delay caused a plate charge hidden on the back of a bicycle to detonate, sending it through the rear door of Herrhausen's armored car. It severed his legs and he bled to death.

- Shoulder fired rockets. These are very similar to military rocket launchers, such as the RPG. However, they are less accurate and have a shorter range.
- Improvised mortars. A mortar system can be built using propane cylinders as the launch tube. Add a simple elevation system and detonator and a complete improvised mortar system can be obtained.

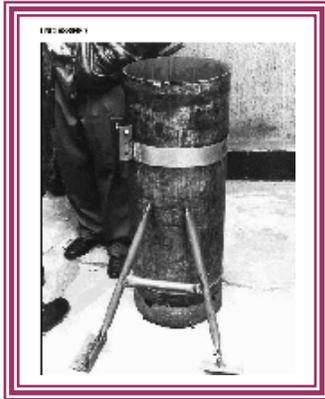


Figure E-19: Improvised Mortar System (Source: File Photo)

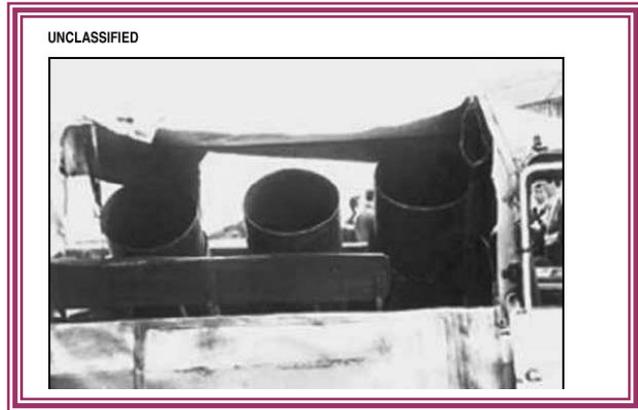


Figure E-20: Multi-tube Battery Mounted in Truck (Source: File Photo)

Commercial Product Modification

Terrorists also show great skill and creativity in their ability to weaponize commercial off the shelf products. Given the right components, something as benign as a cell phone can be turned into a weapon that becomes easy to conceal and to employ. In Figure E-21, the cell phone has been converted to a four-barreled gun.



Figure E-21: Four-barreled Cell Phone Gun (Source: File Photo)

Covert Firearms

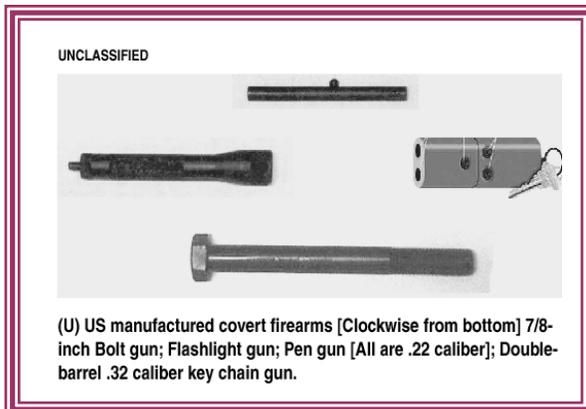


Figure E-22: US Manufactured Firearms (Source: File Photo)

Covert firearms can be developed or secretly obtained through black market channels. With the right amount of cash and good connections a terrorist can find or produce many dangerous and unexpected weapons for their arsenals of terror.

Evacuation Distance Tables

There is no question that U.S. forces are susceptible to the threat posed by IEDs. When confronted with these type devices, trained personnel should only disable them. Friendly personnel should be evacuated to a safe distance to preclude casualties in case the IED is detonated. The table below is representative of a card distributed by the Department of Defense that provides recommended evacuation distances based on the type IED.



| THREAT | THREAT DESCRIPTION | EXPLOSIVES CAPACITY ¹ (TNT EQUIVALENT) | BUILDING EVACUATION DISTANCE ² | OUTDOOR EVACUATION DISTANCE ³ |
|---|---------------------------------------|--|---|--|
|  | PIPE BOMB | 5 LBS/ 2.3 KG | 70 FT/ 21 M | 850 FT/ 259 M |
|  | BRIEFCASE/ SUITCASE BOMB | 50 LBS/ 23 KG | 150 FT/ 46 M | 1,850 FT/ 564 M |
|  | COMPACT SEDAN | 500 LBS/ 227 KG | 320 FT/ 98 M | 1,500 FT/ 457 M |
|  | SEDAN | 1,000 LBS/ 454 KG | 400 FT/ 122 M | 1,750 FT/ 534 M |
|  | PASSENGER/ CARGO VAN | 4,000 LBS/ 1,814 KG | 640 FT/ 195 M | 2,750 FT/ 838 M |
|  | SMALL MOVING VAN/DELIVERY TRUCK | 10,000 LBS/ 4,536 KG | 860 FT/ 263 M | 3,750 FT/ 1,143 M |

This card supersedes any previous undated versions 11/99



| THREAT | THREAT DESCRIPTION | EXPLOSIVES CAPACITY ¹ (TNT EQUIVALENT) | BUILDING EVACUATION DISTANCE ² | OUTDOOR EVACUATION DISTANCE ³ |
|---|----------------------------|--|---|--|
|  | MOVING VAN/ WATER TRUCK | 30,000 LBS/ 13,608 KG | 1,240 FT/ 375M | 6,500 FT/ 1,982 M |
|  | SEMI-TRAILER | 60,000 LBS/ 27,216 KG | 1,570 FT/ 475 M | 7,000 FT/ 2,134 M |



All personnel must evacuate (both inside of buildings and out).

Building Evacuation Distance

Outdoor Evacuation Distance

Threat

All personnel must either seek shelter inside a building (with some risk) away from windows and exterior walls, or move beyond the Outdoor Evacuation Distance.

Preferred area (beyond this line) for evacuation of people in buildings and mandatory for people outdoors.

¹ Based on maximum volume or weight of explosive (TNT equivalent) that could reasonably fit in a suitcase or vehicle.

² Governed by the ability of an unstrengthened building to withstand severe damage or collapse.

³ Governed by the greater of fragment throw distance or glass breakage/falling glass hazard distance. Note that pipe and briefcase bombs assume cased charges which throw fragments farther than vehicle bombs.

Table E-2: Explosive Device Evacuation Distances (Source: DOD)