

NEWS & TERRORISM

COMMUNICATING IN A CRISIS

A fact sheet from the National Academies and the Department of Homeland Security

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IED ATTACK IMPROVISED EXPLOSIVE DEVICES

WHAT IS IT?

An **improvised explosive device (IED) attack** is the use of a “homemade” bomb and/or destructive device¹ to destroy, incapacitate, harass, or distract. IEDs are used by criminals, vandals, terrorists, suicide bombers, and insurgents. Because they are improvised, IEDs can come in many forms, ranging from a small pipe bomb to a sophisticated device capable of causing massive damage and loss of life. IEDs can be carried or delivered in a vehicle; carried, placed, or thrown by a person; delivered in a package; or concealed on the roadside. The term IED came into common usage during the Iraq War that began in 2003.

Elements of an IED

IEDs consist of a variety of components that include an initiator, switch, main charge, power source, and a container. IEDs may be surrounded by or packed with additional materials or “enhancements” such as nails, glass, or metal fragments designed to increase the amount of shrapnel propelled by the explosion. Enhancements may also include other elements such as hazardous materials. An IED can be initiated by a variety of methods depending on the intended target.

Materials Used as Explosives in IEDs

Many commonly available materials, such as fertilizer, gunpowder, and hydrogen peroxide, can be used as explosive materials in IEDs (see Table 1). Explosives must contain a fuel and an oxidizer, which provides the oxygen needed to sustain the reaction. A common example is ANFO, a mixture of ammonium nitrate, which acts as the oxidizer, and fuel oil (the fuel source). Concern about the use of explosives created from liquid components that can be transported in a stable form and mixed at the site of attack is the reason that in 2006 the U.S. Department of Homeland Security restricted the amount of liquids that passengers can carry on commercial aircraft.

Table 1. Examples of explosives

	Common uses	Common form	Known IED use
High explosives			
Ammonium nitrate and fuel oil (ANFO)	Mining and blasting ²	Solid	Oklahoma City bombing
Triacetone Triperoxide (TATP)	No common uses; mixed from other materials	Crystalline solid	2005 bombings in London
Semtex, C-4	Primarily military	Plastic solid	Irish Republican Army bombings
Ethylene glycol dinitrate (EGDN)	Component of low-freezing dynamite	Liquid	Millennium Bomber, intended for Los Angeles airport, 1999
Urea nitrate	Fertilizer	Crystalline solid	World Trade Center 1993
Low explosive			
Smokeless powder	Ammunition	Solid	Olympic Park bombings

¹The primary focus in this fact sheet is explosive-based IEDs; it does not address IEDs used for dispersing chemical, radiological, or biological material, also known as “dirty bombs.” See the other fact sheets in this series for information on chemical, radiological, or biological dispersion.

²Ammonium nitrate (without fuel oil) is used as fertilizer.



Examples of Terrorist IED Attacks

Oklahoma City Bombing

On the morning of April 19, 1995, a truck bomb exploded in front of the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma. The bomb was improvised from ammonium nitrate fertilizer and nitromethane, which were put into the back of the truck and left to explode. It was the worst terrorist attack on U.S. soil up to that time, killing 169 people. Timothy McVeigh was convicted and executed for the crime; his accomplice, Terry Nichols, is serving a life sentence in federal prison.

Madrid Train Attacks

Ten explosions rocked through four commuter trains during rush hour on March 11, 2004, in Madrid, Spain. The bombs had been made from bags stuffed with explosives, allegedly the explosive known as Goma-2 ECO, and metal fragments; cell phones with timers were used to initiate the explosive devices. The attack, which was carried out by violent Islamist extremists, killed 191 people, and injured more than 1,800.

July 2005 London Bombings

Fifty-two people were killed and hundreds more injured in a series of coordinated attacks on the London transportation system on the morning of July 7, 2005. The attacks were carried out by four suicide bombers. Authorities had difficulty identifying the explosive used in the IEDs; they believe it was TATP on the basis of finding TATP in the London apartment of the biochemist arrested in Cairo in association with these bombings.

Olympic Park Bombing

In the midst of the 1996 Olympics, an IED composed of “pipe bombs” concealed in a backpack exploded in the Centennial Olympic Park in Atlanta, Georgia, where the games were being hosted. The bomb contained nails to increase its lethality. Two people died and many were injured. Eric Rudolph pleaded guilty in 2005.

WHAT ARE THE EFFECTS?

The extent of damage caused by an IED depends on its size, construction, and placement, and whether it incorporates a high explosive or propellant. Table 2 predicts the damage radius based on the volume or weight of explosive (TNT equivalent) and the type of bomb. Vehicle bombs, also known as vehicle-borne IEDs, can carry significantly more explosive material, and therefore do more damage.

Damage to Structures and to Infrastructure

An explosion in or near a building or public transportation venue may blow out windows; destroy walls; and shut down building systems such as power, ventilation, fire suppression, water/sewage, and others. Exit routes may be disrupted or destroyed, and smoke and dust may travel upward through stairways and elevator shafts, making navigation difficult. Building failure may result in the release of hazardous materials used within a building, such as radioactive material from medical devices, or incorporated within the structure of a building, such as asbestos insulation. An IED attack may cause disruptions in municipal services such as electricity, water, communications, and transportation, which may continue for days to weeks after the attack. Individuals and businesses should have a plan for addressing these interruptions.

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Threat	Threat Description	Explosive Capacity	Building Evacuation Distance	Outdoor Evacuation Distance
	Small Package/letter	1 lb	40 ft	900 ft
	Pipe Bomb	5 lb	70 ft	1,200 ft
	FedEx Package	10 lb	90 ft	1,080 ft
	Vest/Container Bombs	20 lb	110 ft	1,700 ft
	Parcel Package	50 lb	150 ft	1,850 ft
	Compact Car	500 lb	320 ft	1,900 ft
	Full Size Car/Minivan	1,000 lb	400 ft	2,400 ft
	Van/SUV/Pickup Truck	4,000 lb	640 ft	3,800 ft
	Delivery Truck	10,000 lb	860 ft	5,100 ft

Table 2.
Courtesy U.S. Technical Support Working Group (TSWG)

attack, there may be bombings at multiple locations. Rescue efforts can be hampered by the need to respond to more than one site.

Secondary Hazards

The explosion of a bomb can cause secondary explosions if gasoline, natural gas, or other flammable material is ignited. Secondary hazards that result can include fire with possibly toxic smoke, disruption of electric power, ruptured natural gas lines and water mains, and debris. There can be loss of traffic control in the area of the blast with possible traffic accidents involving fleeing citizens.

Immediate Health Effects

Explosions create a high-pressure blast that sends debris flying and lifts people off the ground. The type of injuries and the number of people hurt will vary depending on: the physical environment and the size of the blast; the amount of shielding between victims and the blast; fires, or structural damage that result from the explosion; and whether the explosion occurs in a closed space or an open area. Injuries common to explosions include:

- **Overpressure damage** to the lungs, ears, abdomen, and other pressure-sensitive organs. Blast lung injury, a condition caused by the extreme pressure of an explosion, is the leading cause of illness and death for initial survivors of an explosion.
- **Fragmentation injuries** caused by projectiles thrown by the blast – material from the bomb, shrapnel, or flying debris that penetrates the body and causes damage.
- **Impact injuries** caused when the blast throws a victim into another object, i.e. fractures, amputation, and trauma to the head and neck.
- **Thermal injuries** caused by burns to the skin, mouth, sinus, and lungs.
- Other injuries including exposure to toxic substances, crush injuries, and aggravation of pre-existing conditions (asthma, congestive heart failure, etc.).

Delayed Health Effects

Some health effects caused by IEDs, including eye injuries and abdominal injuries, may not be apparent initially, but can cause symptoms and even fatalities hours to months after the event. Psychological effects in attack survivors, first responders, and others are not unusual in the aftermath of a high-casualty event. While most symptoms diminish with time, in some cases assistance and guidance from mental health professionals may be required.

Detecting IEDs

Detection of IEDs presents a real challenge for security screeners, employees, first responders, and military personnel. Training security guards, airport staff, and other personnel to be alert for suspicious behavior and IED indicators is the most common and best defense. Various bomb detection technologies continue to be developed for use in high-risk areas or situations such as airports and high profile events. These technologies include “trace detectors” that identify trace amounts of commonly used explosives in the air, and “millimeter-wave technology” that detects dense objects, hidden under clothes. Explosives-detection dogs, trained to detect and locate chemical explosives, are used in many security scenarios.

WHAT SHOULD PEOPLE DO TO PROTECT THEMSELVES?

The number one way to protect yourself and others from an IED attack is to be alert to your surroundings. Advanced technologies help police and other authorities detect possible dangers, but an even more effective tool is to encourage individuals to be alert for, and to report, anything that is out of the ordinary in their daily routine. Examples include bags or boxes in unusual places, unusual smells, and suspicious behaviors such as someone dressed in a heavy coat in summer.

Steps to Take if You See Something Suspicious

“If you see it, say it!”

It can be difficult to determine when to report something suspicious. People most familiar with a given environment are in the best position to determine whether or not something is out of the ordinary. Use common sense, and follow these guidelines:

- Trust your instincts; if something feels wrong, don't ignore it.
- Do not assume that someone else has already reported it.
- Call local authorities.
- Keep your distance from a suspicious package—do not approach or tamper with it.

When you make a report, be ready to provide your name, your location, a description of what you think is suspicious, and the time you saw it. The responding officer will assess the situation, ensure the area is evacuated and call for appropriate personnel and equipment. Technologies used to assess whether a package contains explosive material may include portable x-ray systems or bomb disposal robots.

Make a Personal Plan for Response

Preparation is key. Every person can take these steps to prepare for an IED attack:

- Learn the emergency procedures at your place of work, any other sites you visit regularly, and any public transportation systems you use. Communication systems may be inoperable in an emergency, and you should be familiar with what steps to take.
- Know how to get out of the area. If you work far from home, plan backups to get home if the usual modes of transit are not operating.
- Know the routes to hospitals in your community.
- Take a first aid course.
- Make a family emergency plan. Remember that family members may be in separate locations at the time of an attack. Use planning tools at ready.gov to prepare yourself and your family.
- Designate an “out-of-area” contact, and make sure that everyone in your family has that person's phone number.
- Have an emergency supply kit at work and at home that includes water and non-perishable food to last at least three days, battery-powered radio, first aid kit, flashlights, and batteries.

WHAT TO DO DURING AN IED ATTACK

If you are at the immediate site of an IED attack, your top priority is to get out of the area. This increases your safety in case a secondary device is present in the area and minimizes your exposure to dust, smoke, and any hazardous substances that may have been released as a result of the blast. This also allows emergency responders to find and assist the most critically injured victims.

If you are in a building:

- Get under a sturdy table or desk if objects are falling around you.
- Exit as quickly as possible, without stopping to retrieve personal possessions or make phone calls. Assist other victims to leave the area if possible. Use stairs instead of elevators. Be aware of weakened floors and stairways, and watch for falling debris as you exit the building.

Once you are out of the building:

- Move away from windows, glass doors, or other potentially hazardous areas.
- Continue moving away from the blast site and look for emergency officials who will direct you to a safe location.
- Be aware that secondary explosions may occur at or near the original bombing site, especially as rescue personnel arrive. Use caution to avoid debris that could be hot, sharp, or cause puncture wounds.

The number one way to protect yourself and others from an IED attack is to be alert to your surroundings.

If You are a Business Owner

Be aware. Many commercial products can be used to construct IEDs. Here are some simple steps you can take to avoid unwittingly enabling an attack:

- Recognize hazardous chemicals in your product inventory.
- Check your inventory and report missing or stolen products.
- Ask for customer identification and maintain a log of large purchases.
- Know your customers and report suspicious or unusual purchases to authorities.
- Watch for suspicious behavior, which can include:
 - Nervousness.
 - Vague knowledge of a product's proper use.
 - Purchasing unusual quantities of a product.
 - Large cash purchases.
 - In storage facilities, customers utilizing a facility at unusual hours; odors, liquids, or fumes coming from a storage unit; discarded chemical containers.

The image shows two overlapping advisory materials from the FBI-DHS Private Sector Advisory program. The top document is titled "Hazardous Chemicals?" and lists various chemicals such as Acetone, Hydrogen Peroxide, Ammonia, Benzene, Methyl Ethyl Ketone, and Hexane. The bottom document is titled "Suspicious Behavior?" and lists common examples like nervous customer attitudes, vague product knowledge, unusual quantities, refusal to provide identification, insistence on in-store pickup for bulk purchases, and large cash purchases. It also includes a section on "How Can You Help?" with a checklist of actions like understanding products, reporting suspicious behavior, and being alert to unusual activities.

FBI-DHS offers advisory materials for the private sector.

- Limit your use of phones and other communications devices as much as possible, because communications systems may become overloaded.

If you become trapped:

- Cover your nose and mouth with anything you have on hand to limit inhalation of dust or other hazardous materials. Dense-weave cotton material can act as a good filter.
- Avoid unnecessary movement so you don't kick up dust.
- Signal your location to rescuers by using a flashlight or whistle, or by tapping on a pipe or wall.
- Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust and drain your energy.

If you are nearby, but not at the immediate site of an attack:

- Assess the environment around you before taking any action.
- Avoid being lured closer to see what is happening because the risks from secondary attacks or hazardous materials could be extremely high.
- Listen for, and follow, instructions from local authorities and building personnel. If no information is immediately available from local officials, stay away from windows and doors and move to an inner area of a building until directed differently by authorities.

If you are in a train, on the subway, or on a bus:

- In general, it is best to remain inside the train car unless you are in immediate danger.
- Use the communication system on the train car to receive instructions.
- If you are in danger and must leave the car, be aware of hazards on the tracks or in the tunnel and move with caution to the nearest station or point where you can contact emergency personnel.
- Open windows or doors if possible and if it is safe to do so, because it can reduce the severity and number of injuries from a secondary explosion.

Caring for the injured:

- First aid you provide may save lives. The most likely help you may need to provide is to control bleeding. Apply direct pressure to the bleeding site.
- Nearby hospitals may be overwhelmed with victims. If you need to transport victims who are not severely injured, go to a hospital that is further from the bombing site.

ADDITIONAL INFORMATION

U.S. Department of Homeland Security – <http://www.dhs.gov> and <http://www.ready.gov>

Federal Bureau of Investigation – <http://www.fbi.gov>

Federal Emergency Management Agency – <http://www.fema.gov>

U.S. Department of Health and Human Services – <http://www.hhs.gov/emergency>

Centers for Disease Control and Prevention – <http://emergency.cdc.gov>

Bureau of Alcohol, Tobacco, Firearms, and Explosives – <http://www.atf.gov>

Technical Support Working Group, Improvised Device Defeat Subgroup – <http://www.tswg.gov>

Local and state government websites often contain information regarding emergency preparedness and response to mass casualty events, including IED attacks.

This report brief was prepared by the National Academy of Engineering and the National Research Council of the National Academies in cooperation with the U.S. Department of Homeland Security. For more information, contact Randy Atkins at 202-334-1508, atkins@nae.edu, or visit www.nae.edu/factsheets.

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