A Demonstrator's Guide to Understanding Riot Munitions

And How to Defend against Them

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Contents

If there's one thing that police officers prefer to hitting people with sticks, it's shooting blunt objects and chemical weapons at people. Arms manufacturers are constantly developing new ways to assault people from a distance—and taxpayers keep buying new toys for their oppressors.

This article offers an overview of less-lethal projectiles—both chemical weapons and impact munitions. The police themselves don't bother distinguishing the two. We'll cover chemical weapons like tear gas and pepper spray. We'll cover impact weapons like baton rounds, rubber bullets, and pepper-balls. We'll cover the systems police use to apply these weapons, including air guns, sprays, grenades, grenade launchers, and shotguns. We'll cover the ways that police mark people for arrest—and the ways they probably don't. Other articles in this series discuss batons and other police weaponry. One of the most useful articles to read in conjunction to this one is our "Protocols for Common Injuries from Police Weapons."

This can be a scary subject. But remember—their goal isn't to strike us with plastic bullets or spray us with chemicals. Their goal is to make us live in fear. They want us to stay home, disconnected, leaving their authority absolute and unchallenged. They fail to achieve goal every time we take the streets together. They fail every time we refuse to let that fear dictate what we do.

In this article, we'll touch briefly on how to protect ourselves via gas masks, armor, shields, and the like. Other articles explore those options in detail. But the chief thing that can protect us against the police is solidarity. We are the ones who must keep each other safe. One shield on the front line of a demonstration can protect many people. One medic willing to treat those in the line of fire can protect many people. A few people who risk jail time to push the police back can protect many people. Our best protection against riot munitions is each other.

Courage is not the absence of fear. It is acting despite fear. Together, we can overcome fear.

> https://twitter.com/hungrybowtie/status/1344916089436655618

On Standardization and Oversight

We have found no evidence that there is any federal or state oversight of what weapons police are permitted to use to quell civil disturbances. According to an anarchist lawyer who specializes in this field, each of roughly 18,000 agencies in the US maintains its own use of force guidelines detailing internal standards regarding what its officers can do to people. We've found no body that certifies the chemistry employed in chemical weapons. Any given chemical weapons manufacturer chooses their own binding agents and chemical additives; it appears there is no easy way to know what chemicals we are being exposed to when police target us with these weapons. While this shouldn't cause us to back down and accede to authoritarianism, it's important to remember that these weapons are only "less lethal" in comparison to live ammunition.

There are only two factors contributing to standardizing these weapons. The first is that weapons that use existing projectile systems (such as 37mm launchers) are more likely to be widely adopted than oddball systems that require entirely new training and weaponry. The second is that manufacturers tend to copy each other's innovations.

While the federal government apparently does not provide oversight, it does occasionally offer advice and suggestions—for example, in this somewhat-outdated 2004 manual of less-lethal weaponry.

Impact Munitions

Police fire a wide range of blunt force projectiles from a variety of weapons. Manufacturers and police departments sometimes call these "Blunt Impact Projectiles" (BIPs) or "Kinetic Impact Projectiles (KIPs). "Rubber bullets" are only one of many variants. They vary in size, force, composition, delivery methods, and lethality.

The sales pitches that manufacturers make to law enforcement agencies emphasize the ability to obtain compliance from subjects via projected force with minimal risk of injury or death. All of the academic studies—not to mention our lived experience—show that neither of these claims is correct: impact munitions regularly maim and kill protestors and they rarely succeed at breaking up demonstrations. They're even less effective at stopping social movements. Often, when one of us loses an eye or suffers a fractured skull, more people come out to the streets.

Some of the more common impact munitions include **baton rounds,** large plastic, foam, gel, or even wooden projectiles that are fired from a multi-launcher or occasionally a shotgun; **rubber bullets,** metal projectiles coated in rubber or PVC; **bean bag rounds,** woven bags filled with either silica or lead, usually fired from shotguns; **pepper-balls,** which are essentially paintballs filled with pepper spray; **FN303 rounds,** a combination of pepper-balls and regular impact munitions; **rubber balls,** which are rubber or plastic or foam pellets packed into grenades to explode like shrapnel or shotgun shot; and, of course, the venerable **gas canister** (bearing chemical agents or smoke), which is not designed to be fired directly at protestors—but regularly is.

Contrary to popular supposition, most modern impact munitions are designed for "direct fire" rather than "skip fire." Direct fire munitions are for shooting directly at individuals, while skip fire projectiles are designed to be skipped off the ground into the crowd. Tear gas canisters are generally intended for skip firing at close range or firing at a 25–30 degree arc into the air for maximum range; they are not rated for direct fire. Some styles of baton rounds that split into multiple projectiles are designed for skip fire to distribute the projectiles more widely, while others are designed to be fired over the heads of protesters in order to rain chemicals down. Full-size wooden baton rounds and some rubber bullets seem to be designed for skip fire as well, but in general, skip fire is less accurate and less common.

Baton rounds, stinger grenades, and beanbags hurt. They injure people. Occasionally, they maim or—even more rarely—kill people. Yet of all the tools used by the police, they are some of the least effective at stopping demonstrations. Unlike a cop within mêlée range, a baton round cannot arrest you. Unlike a cloud of gas, it can't force you to disperse. Ranged impact weapons rely primarily on pain compliance. While this may work on individuals, pain alone usually cannot force a resolute crowd to comply. Standing around getting shot at isn't always the right move. But the effects of impact munitions can be mitigated by protective equipment including shields, armor, helmets, goggles, barricades, and even umbrellas. Impact weapons rely on fear above all—and through mental preparation and mutual support, we can defend ourselves from fear. We can choose not to comply with fear.

All around the world, intimidation is the chief weapon of the mercenaries who serve the ruling class.

Common Injuries

Impact munitions are ostensibly designed to hurt people and cause compliance without causing significant injury. But there's nothing safe about them.

It's been difficult for us to parse the available data to work out which parts are applicable specifically in the United States. The largest study, from 2017, includes information from many other studies around the world. But a good portion of its data—about 41%—describes the use of rubber bullets. Rubber bullets account for a vastly disproportionate number of the serious injuries in the study, and a slightly disproportionate number of deaths. The study found that 3% of people injured with impact munitions die as a result, but that is not a useful number to understand in the context of a demonstration of the US. People do die as a consequence of impact munitions—but it will not be anywhere near 3% of those who are injured by them. We have not been able to confirm whether rubber bullets are currently in use in the US (as they are easily confused with rubber ball ammunition), but if they are, they are not the predominant impact munition in use.

The 2017 study found that the majority of serious injuries and deaths were the result of impacts to the head or neck. A smaller study from 2000 found that the majority of deaths were the result of impacts to the chest (causing ribs to break and puncture the heart or lungs).

After the type of munition fired, the most significant factors determining the severity of injuries are the distance from which it is fired and the speed with which the victim can access medical care. Attacks from within ten feet caused the greatest number of broken bones, for example. Also, street medics save lives.

The most *common* injury from impact weapons is intense bruising. And despite police lacking competence and acting with impunity, it does seem like most impact munitions are aimed where they are supposed to be aimed, at the abdomen or lower, where serious injuries are less likely to occur.

Occasionally, injuries and deaths occur when an officer fires breaching rounds (projectiles designed to break through barriers such as doors) directly at people, presumably by accident.

Three weeks into the George Floyd uprising, the American Academy of Ophthalmology reported at least 20 serious eye injuries at protests caused by impact weapons (including baton rounds, bean bag rounds, and pepper-balls), tear gas canisters, and, in one case, the probe of a Taser. These included seven instances in which people lost an eye as a result of such an incident, with many more people awaiting surgery, unsure if they would keep their eyes. In one case this year, a journalist suffered a serious eye injury after a projectile broke the protective lenses of his gas mask.

Across the world, medical specialists continue to call for the abolition of impact munitions in policing.

Protection

Based on street experience and the analysis of studies, the most vital areas to protect are the head, eyes, neck, and chest. Helmets, gorgets, sports armor breastplates, and impact-resistant goggles, face masks, or gas masks can protect against this, potentially combined with shields. The neck is the most complicated of these areas to protect; most people have never heard the word "gorget,"

let alone imagined wearing one while protesting against the police. Basically, a gorget is an item of neck armor worn by fencers. None of us have ever seen anyone wear one at a demonstration.

We will discuss shields in a later article. Here, suffice it to say that, to protect against impact munitions, a shield must be strong enough to resist penetration of the round, rigid enough to distribute the force of impact across a large surface area, and be backed by foam wherever the wielder's body is in contact with it. Plywood 3/8" thick serves well enough, though 1/2" can hold up to more weaponry. Traffic barrel plastic resists penetration well but distributes the force poorly, though it is substantially lighter than wood. No shield makes you invulnerable.

Most injuries occur below the waist. It appears that the most effectively trained police prefer to shoot demonstrators in the kneecaps. In view of this, it may be worth considering wearing kneepads or more complete sports armor, not so much to avoid permanent injury or death as to remain mobile, effective, and uninjured.

Shields and barricades can help mitigate all of these potential injuries as well.

> https://twitter.com/gravemorgan/status/1295116634583994369

Understanding Ballistics

To understand impact, we have to understand kinetic energy.

Kinetic energy, often called muzzle energy in ballistics, is measured in joules (or in foot-pounds, if you're not feeling metric). It's derived from the velocity of an object and its weight, with velocity being exponentially more important. The formula to determine the kinetic energy of a projectile is $E_k = (1/2)m\mathbf{v}^2$ with E_k representing energy (kinetic), m representing mass, and v representing velocity.

None of us are engineers, but we consulted a couple in the course of writing this article. Basically, we can understand joules measuring the answer to the question "How much did I get hit with?" A baseball thrown at 90 mph might have 120 joules. A baton round might have 240 joules, hitting you twice as hard as that baseball. A .22 rifle might also deliver projectiles with 240 joules, but the baton round is a blunt impact whereas a bullet is designed to penetrate. A 9mm pistol might deliver bullets with 470 joules, an AR-15 with 1850, while a slug from a 12-gauge shotgun could approach 4500. If a 180-pound person fell from a height of 15 feet, they'd have around 4000 joules when they hit the ground. A speeding car? Easily 200,000 joules.

Yet most of us would rather get shot with a baton round than a .22. As one contributor to this text put it, "I'd rather be hit with 200 joules of marshmallows than 200 joules of baton." Joules are far from the whole story about the damage a given projectile can inflict. The surface area it hits you with (the joules per square meter), the angle it hits you, where it hits you, and the object's composition (a wooden baton round will absorb less of its own impact than a gel baton round, for example) all matter more. In one study, it took only 375 joules to break bones when pressure was applied at certain angles, while it took 9920 joules to break the same bones when pressure was applied at other angles.

Because velocity is more important to energy than the weight of the projectile, the energy with which a projectile strikes a target drops off quickly at distance. A faster object will often carry more kinetic energy than a slower, heavier object.

It is useful to start with the energy various weapons can deliver and the impact testing to which various pieces of protective gear are subjected. We've found one military document that

refers to a "internationally recognized lethality limit" of 75 joules. But these factors do not give us enough information to know how a given projectile will affect a given target. While we are testing various impact munitions against various items of protective gear, we'd like to hear any anecdotes or research you can share about the effectiveness of different forms of protection against projectiles.

Baton rounds

- Material composition: plastic, foam, gel, wood
- Delivery methods: mostly 37/40mm launchers, some 12-gauge shotguns
- Velocity: most seem to be around 300 fps (feet per second), with some examples up to 650 fps
- Energy: one example is 244 joules
- Range: depends widely on composition, but an overall advertised range of between 1.5 and 80 meters

Baton rounds come in multiple shapes, sizes, and materials, but they're basically big chunks of painful object. They tend to be large-caliber (37mm and 40mm), so that they impart as much force as possible while remaining too blunt to penetrate skin. Many baton rounds also include some kind of payload, such as chemical agents or marking dye.

Most projectiles that get called "rubber bullets" are probably baton rounds. It's not necessary to correct people pedantically, but for the purpose of this article, we're going to make the distinction and call them baton rounds instead.

The most common materials for baton rounds are plastic, foam, gel, and wood. While there are far too many varieties list at length, and different manufacturers use different materials for different purposes, the general idea seems to be that foam rounds tend to be intended for short-range fire while plastic and wood are intended for longer range applications. Gel rounds are advertised as being useful at short or long range, as are "collapsible head" plastic rounds. Of course, it's hard to imagine the police really thinking through exactly which round they want to use for which tactical purpose, especially in chaotic situations, and it's safe to assume that they are firing all of these at any range they want.

Baton rounds often contain multiple projectiles within each shell that are designed to split apart.

Some baton rounds have rifling built into the shell or into the barrel of the launcher to spin-stabilize the projectile for accuracy. Most appear not to. While every baton round is rated to a different range, most seem to be designed for use between 2 and 40 meters; only a few varieties are designed for up to 80 meters.

Direct fire baton rounds are supposed to be aimed at the navel, thighs, buttocks, or knees—though as previously mentioned, it is a mistake to expect police to limit themselves thus.

Most people struck with baton rounds just come away with a nasty welt. However, baton rounds have maimed and killed people, especially when they strike people's faces. In July, Portland police shot a 26-year-old protestor in the face with a baton round while he had his hands up.

We believe that round to have been a Sage International 37mm KO1 round. The blow fractured his skull, nearly killing him and necessitating surgery.

There are also 12-gauge shotgun baton rounds. Most of these are various rubber projectiles that have fins and look like tiny missiles or rocket ships. One, for example, the stabili-shock, weighs 6 grams and is meant to fire at 426 fps for a total of 51 joules of force. We found one video of someone loading the round wrong and shooting it at three times that velocity. We have seen some evidence of police using these at protests in the US.

Another make is the Lightfield Superstar, a colorful sea urchin of pain. It is a close-quarters weapon, considered safe for direct fire at as close as two meters. We have found no evidence of law enforcement using these in the US.

Baton rounds seem to have been invented by the British for use in their colonial project in Ireland, because the rubber bullets they were using at the time were killing too many people. Plastic baton rounds still killed colonial subjects, but at a slower rate.

Modern baton rounds often contain one or more chemical weapons, including OC (Oleoresin capsicum) and CS (common tear gas) most commonly, though CN (which is more dangerous) is used as well. Some baton rounds also contain marking compounds.

Rubber Balls

- Composition: hard rubber
- Delivery methods: hand-thrown grenades, 37/40mm canisters, 12-gauge shotguns, possibly .68 caliber air guns
- Velocity: variable
- Energy: 30–200 joules when fired from a shotgun, other styles unknown
- Range: widely variable

Rubber balls are fired individually or, more often, packed into shotgun shells, multi-launcher shells, or hand-thrown grenades. They shoot out wildly and injure people unpredictably. Brand names include Stinger, Sting-ball, and Hornet's Nest; they are sometimes generically described as rubber buckshot. We've found a few common calibers of balls: .32 caliber and .60 caliber (which is to say .32" and .6"), are common in grenades and larger canisters, while "rubber buckshot" seems to come in 00 buckshot size: .33". Some shotgun rounds are packed with one to three .68" rubber balls.

According to one manufacturer, rubber ball weapons are considered a weapon of last resort when other less lethal options have failed. This is probably because rubber balls are unpredictable in who they strike and where.

It's possible, though we have not been able to confirm it, that most of what people describe as rubber bullets in the United States are the larger caliber of rubber ball. Combined Tactical Systems Sting-balls are in common use in Portland—they are presumed to be the means by which police broke someone's finger in August. Anecdotally, a lot of them seem to misfire, as demonstrators have found a large number of improperly-deployed canisters.

There is speculation that expired rubber balls lose some elasticity over time and become more hazardous.

Rubber balls are also packed into grenades that for all other purposes function as flash-bang grenades: disorientation devices that use sound and light to distract people. One hand grenade we looked at, the ALS Hornets Nest Sting Grenade, holds 180 .32 caliber balls and produces a flash of 1–2 million candela and a bang of 130 db at five feet.

Rubber balls move very chaotically; grenades detonated on the ground can easily send projectiles towards our faces and eyes.

These grenades are absolutely not safe to handle and should not be caught or thrown back.

Beanbags

- Composition: silica or lead in Kevlar or other fabric
- Delivery method: Mostly 12-gauge shotguns, but also 37/40mm launchers
- Range: 20–35 feet
- Velocity: ~270 fps
- Force: one 12-gauge example was 146 joules

Beanbag rounds are bags full of metal (such as #9 shotgun shot) or silica (sand). On average, they are for closer-range use than baton rounds; they more often used inside buildings—specifically, in jails. Every manufacturer and every round will be different, but most seem to be intended for use between 20–35 feet. Some beanbag rounds are "drag stabilized" with a bit of cloth that hangs off the back to keep it accurate its entire effective distance. They are fired from 37mm and 40mm launchers and 12-gauge shotguns.

Manufacturer's guidelines suggest that it would take 2–3 shots with a beanbag round to incapacitate a target. When they are used in riot situations, they are not usually employed to incapacitate people so much as to inflict a psychological impact on the crowd.

We saw one police officer on a forum telling the story of a man on PCP surviving 34 shots with beanbag rounds (though one round shattered the bones in his hand). Police on internet forums often boast about how they shoot rookies with beanbag rounds to haze them.

We found Safariland beanbag rounds for retail at $30 or available on eBay for $10. Other manufacturers charge around $6–7 per round.

Rubber Bullets

- Composition: rubber- or nylon- or PVC-coated steel, or a hard composition of rubber and silica
- Delivery method: varied

Thus far, our research into rubber bullets has been less conclusive than our research into the other rounds. Historically, rubber bullets for crowd control come in two forms: metal projectiles coated in rubber, as British occupiers used extensively in Northern Ireland, and hard pellets made of a homogenous mixture of roughly 20% rubber and 80% silica, as commonly deployed by the Israeli colonial occupation in Palestine.

We know that the police in the US are shooting people with rubber balls, and there has been some speculation that in 2020, DC police have used the steel-cored variety that have killed so many people over the years.

As metal-cored projectiles were disproportionately responsible for death and maiming in the 2017 study of less-lethal weapons, this warrants further investigation. If you see police fire rubber balls at people, try to grab some. Measure them, cut them open, and send us pictures.

There are also bullet-shaped rubber bullets designed to be fired from 9mm handguns and, presumably, every other common firearm caliber. But as these are fired from regular firearms, they do not seem to have found their way into the police riot control weapon arsenal. So far, the only manufacturer we've tracked down that makes this style of bullet is in Canada: Lamperd Less Lethal. It's safest to assume that the rifles and handgun you see police carrying hold live ammunition.

Pellets and Paintballs

More and more commonly, less lethal munitions are fired from .68" caliber airguns—which is to say, paintball guns. A few styles that we have not confirmed to be in use in the USA are covered above under "rubber bullets." The more common styles are pepper-balls and FN303 rounds.

While both are used as impact munitions, they are unique to their individual platforms, so we'll cover them under "launchers" below. However, fascists have lately adopted the paintball gun as a favored tool for street conflict. Rumors abound that they are using frozen paintballs, but we suspect that they may be using rubber balls.

Frozen paintballs are nearly mythical in the paintball world because local media outlets falsely claim they are favored tool of Halloween vandals. Paintballs frozen in a home freezer for 48 hours do not freeze solid; they only become slightly more brittle and tacky, and they thaw quickly. Paintballs frozen in dry ice are much more solid and potentially dangerous, but unwieldy to shoot. Liquid nitrogen frozen paintballs are as hard as ice, but so brittle they are nearly impossible to load and fire. All cold paintballs become less accurate—as the shell becomes tackier—but sting more.

In parts of the world where access to firearms for self-defense is less ubiquitous, airguns are sometimes used to deliver near-lethal force, firing pellets including solid rubber and rubber- or PVC-coated steel balls such as those covered under rubber bullets above, sometimes referred to as "glass breaker" balls. These projectiles are certainly available to US law enforcement as well as civilians; they can be fired from any paintball launcher.

Anti-fascists leaking far-right communication logs in Portland in 2020 revealed that at least one far-right militia member discussed using frozen paintballs but noted their lack of accuracy. He suggested instead using glass breaker balls, as detailed above.

There are also self-defense rounds for airguns that use a D-shaped round like First Strike. First Strike is a style of paintball round fired from a magazine instead of a hopper, designed for greater accuracy. The same system has been adapted to shoot rubber projectiles with enough force to be deadly. We've seen no evidence of their use by police, besides the Pepperball VXR rounds covered under pepper-balls, below, and the FN303 rounds.

Barricade Rounds

Barricade rounds are projectiles that are designed to penetrate barriers as tough as glass windows (12-gauge), hollow-core doors (37mm), or thin wallboard or plywood (40mm) and release chemical agents from their nosecone upon impact with said barrier. They are not as effective at breaking through double-pane windows or getting past heavy drapes. The rounds are not meant to be fired at people; they have killed multiple people who were struck directly by them.[1]

They carry OC, CS, CN, or inert liquid or powder. The liquid-carried ones are heavier and penetrate barricades more effectively, while powder carriers are more effective at dispersing gas. Liquid rounds come with red dye that mark where they hit.

Launchers and Dispersal Methods

Police have access to a wide variety of tools they use to project force at a distance. The most common of these include .68 caliber airguns (essentially, paintball guns), 12-gauge shotguns (referred to and usually marked as less-lethal shotguns, but effectively interchangeable with any other 12-guage shotgun), grenades, and 37 or 40mm "multi-launchers," which are functionally grenade launchers. They also disperse chemicals with sprays, hoses, and smoke candles.

These weapons are not particularly inaccurate, manufacturers' promises notwithstanding. Studies show that when the operators of less-lethal weapons are under stress, their vertical accuracy past 30 meters is significantly compromised. Other factors include fatigue, the weight of the launcher itself, which is significant when loaded, and the recoil of the rounds, which tend to "pull" the round up when fired. These minor differences multiply in effect over distance. What would be a one-inch variance at close range can become a difference of several feet at a longer range. This means that even if an officer chooses to aim a crowd control weapon at someone's lower body, he could easily hit his target in the head—or hit someone else entirely. There is not a surefire way to shoot any weapon into a crowd of people and be certain to hit your intended target.

.68 Caliber Air-Powered Guns

Police use what amount to paintball guns to launch chemical agents, impact munitions, and marking rounds at people. These are .68 caliber air-powered rifles and handguns. At one time, these were used almost exclusively to shoot pepper-balls and paintballs at protestors, but it wasn't long before one manufacturer added impact munitions to the projectiles by forgoing a round ball and making fin-stabilized projectiles that contain both chemical agents and enough metal to hurt.

There seem to be two primary manufacturers of .68 caliber "less lethal" weapons and ammunition: Pepperball and FN Herstal. We will focus on each one's flagship rifle as an example, but police might be armed with older models of these weapons, the pistol versions of these weapons,

[1] Defense Technology's barricade rounds, called "Ferret" rounds, come in 12-gauge (with 2.5" shells), 37mm, and 40mm. The 12-gauge rounds have a velocity of 1000 fps and an effective range of 50–100 meters. The 37mm reputedly has a velocity of 450 fps an effective range of 50–200 yards (though we question this 200 yard claim—it seems like a typographical error). The 40mm variety has a velocity of 325 fps (liquid) or 375 fps (powder) and an effective range of 54 yards.

or systems from other companies entirely. The pistol version of the Pepperball system seems to be even less accurate than other options.

There are also a large number of "riot ball"-style munitions designed to be fired from air rifles/paintball guns (including .68 caliber and .50 caliber), though we have not collected evidence of their use in the United States. These might be anything from solid rubber balls to PVC- or nylon-coated steel pellets to D-shaped projectiles that use "First Strike" paintball guns for increased accuracy.

There is a lot of anecdotal information about paintball players suffering eye damage from ordinary paintballs. These smaller projectiles may be especially dangerous in demonstrations. That's a good reason to wear goggles.

Of the two weapon systems known to be employed by US law enforcement, the FN303 seems to be substantially more dangerous in terms of pain, injury, and death, while the Pepperball system is more tactically versatile.

FN303

- Effective range: 50 m
- Maximum range: 100 m
- Caliber: .68
- Magazine capacity: 15
- Weight: 5 pounds
- Velocity: 295–300 fps
- Energy: 35 Joules
- List price: $1699
- Ammunition list price: $2.85-$4.65/round (paint rounds are cheaper, chemical weapon rounds more expensive)

The FN303 is a gun that uses compressed air to fire rounds at targets. While the actual barrel is small, firing a .68" projectile like other paintball and pepper-ball guns, the FN303 looks a bit like a grenade launcher from some angles because the compressed air tank sits above the barrel and can be mistaken for a larger barrel itself. It fires polystyrene projectiles that are fin-stabilized for accuracy. Each projectile has a front section containing tiny pellets of bismuth and a rear section containing the payload. Bismuth is essentially a non-toxic alternative to lead. The front section is designed to deliver trauma without skin penetration; but tests on ballistic gel imply that it often penetrates skin regardless, and protestors in Portland have found that the rounds can penetrate bicycle helmets. Bismuth pellets can penetrate skin and stay embedded for weeks until manually removed.

The FN303 has a 10" barrel (shorter than a rifle) and a 15-round drum magazine. The air tank can fire up to 110 shots before it needs refilling. The safety is inside the trigger guard. The entire device can be removed from its stock and mounted underbarrel on a rifle, although fortunately,

we have not seen any evidence of civilian police doing so. It is also available in a pistol format, with a six-round magazine that contains a disposable carbon dioxide cartridge that powers the gun.

Each FN303 projectile weighs 8.5 grams. There are five versions on the market, each color-coded. White projectiles contain inert powder and are used for training; clear projectiles have no rear payload and are only used to hurt people; orange projectiles contain PAVA powder (synthetic pepper spray—see below); pink projectiles contain a pink, water-soluble, washable paint for marking targets; yellow projectiles contain a yellow, latex-based, indelible paint for marking targets that cannot as easily be washed off. The projectiles have a shelf life of three years when kept in their original, foil-lined packaging.

In 2004, a Boston police officer used an FN303 to shoot and kill Victoria Snelgrove. The officer was allegedly aiming at someone else in the crowd. The pellet entered her eye, breaking through bone and injuring her brain. She died of her injuries a few hours later. Studies indicate that an individual FN303 loses accuracy after a few hundred rounds have been fired through it; the FN303 was the weapon used in the aforementioned study showing how inaccurate less lethal weapons are in the hands of an operator in a stressful situation. The city of Boston discontinued the use of the FN303 as a result, as did several other cities. Boston apparently melted theirs down to make manhole covers. As of this writing, Portland police continue to employ the FN303, as many other departments around the country presumably do.

In Luxembourg, in 2009, police using FN303s for the first time shot and broke a journalist's finger.

In 2020, Portland police shot a National Geographic filmmaker with an FN303 round; it broke the plastic lens on his Czech M10 gas mask, lacerating his eye and necessitating surgery. Weeks later, the bismuth pellets were still embedded in the skin of his face, looking like small blackheads that he has been removing himself with a needle.

Pepperball VKS

- Effective range of pepper-balls: 20 m
- Effective range of VXR projectiles: 50 m
- Caliber: .68
- Magazine capacity: 10–15 rounds in magazine, 180 rounds in hopper
- Weight: 6.2 pounds without hopper
- Energy: Adjustable between 10–28 joules
- Velocity: 280–425 fps
- List price: around $1200
- Ammunition list price: unknown

The Pepperball VKS (Variable Kinetic System) is essentially a paintball gun designed to look and function like an AR-15 and to fire paintballs full of pepper spray or other rounds. The user can

switch between feeding them via a rifle-style magazine (which can hold pepper-balls or shaped rounds) or a paintball-style hopper (that holds only pepper-balls) by rotating the barrel. They can also use two different compressed air sources: the stock itself is a compressed 13ci HPA air canister or a remote air line can connect to any compressed air tank. Online forums suggest a wide range of how many shots one can get from a 13ci tank, estimating between 80–250. The AR-style safety switch has three modes: (S) Safety, (F) Fire, and (D) Disassemble. A velocity adjustment screw sits above the trigger on the right side. The VKS comes in black-and-yellow, black-and-orange, and all black.

The manufacturer's guidelines say that the weapon is not to be fired at the head, face, eyes, ears, throat, or spine.

Police departments use pepper-balls for direct impact as well as area saturation. A Denver PD trainer says that the police use pepper-balls to saturate an area that would otherwise be dangerous to approach, to draw suspects out from hiding or cover.

The rifle fires two types of ammunition: round pepper-balls, loaded from the hopper or magazine, which are accurate up to 20 meters, and the newer form of ammunition, VXR-shaped projectiles, which are only loaded from the magazine. The VXR projectiles are accurate up to 50 meters, as they are fin-stabilized.

This rifle can fire projectiles at speeds of up to 425 fps. For comparison, most paintball fields limit guns to 280fps for safety.

Each round is color-coded. The shelf life of ammunition is 3 years.

Pepper-balls: 280–350 fps, 12–15 joules, 20 meter accuracy, 50 meters+ area saturation

- White and red: LIVE, 0.5% PAVA (synthetic pepper spray)
- Black and red: LIVE-X, 5% PAVA
- White and blue: CS, 2.5% CS (tear gas)
- Blue and red: CS/PAVA, 1.25% CS and 1.25% PAVA
- White and purple: Inert, used for training or just to hurt people
- Solid green: marking, contains paint for identification
- Solid white/beige: glass breaker, designed to shatter glass and then itself shatter, not designed for use on people or animals
- Clear: water-filled, used for training or just to hurt people
- Also clear: UV marking, used to mark people with ink that can only be detected under UV light

VXR rounds: 280–425 fps, 12–28 joules, 50 meter accuracy, 130 meter+ area saturation

- Red and orange-red: VXR Live, .25% PAVA
- Red and black: VXR Live-X, 2.5% PAVA

- Blue and black: VXR CS, 1.25% CS
- Blue and red: VXR CS/PAVA, 0.625% CS Powder and 0.625% PAVA Powder
- Purple: VXR inert powder, used for training or just to hurt people
- White and black: VXR inert liquid, used for training; might containing marking paint—documentation is unclear
- Dark blue and black: VXR marking, contains paint for identification
- Also white and black: VXR UV marking, used to mark people with ink that can only be detected under UV light

12-Gauge Shotgun

A large number of less-lethal projectiles are fired from 12-gauge shotguns. Beanbag rounds are the most common, but rubber ball rounds exist, as do baton rounds, as do muzzle blasts—a means of dispersing chemical agents directly from the barrel of the gun, shooting a cloud of dust 10–15 feet or so.

Note that the title "riot shotgun" does not apply to dedicated less-lethal shotguns but instead describes shotguns that are designed for defensive fighting, in contrast to a hunting shotgun for hunting or a tactical shotgun for offensive combat.

We have not found evidence that there is any oversight in the US that requires police departments to use dedicated less-lethal shotguns, though most departments do. Dedicated less-lethal shotguns are generally designated by the use of bright orange, red, or other color furniture (i.e., the outer parts of a firearm) on the stock and/or the fore end (the part you pump on a pump-action shotgun). While some models of shotgun are sold specifically for less-lethal use, many departments retrofit existing models to color-code them instead. This makes it hard to offer specifics about what shotguns are in use.

Most police shotguns are pump-action shotguns, as these enable them to fire a wider variety of ammunition. A semi-automatic shotgun usually uses the blowback from the shell to chamber the next shell, and that amount of force is irregular if different types of ammunition are used, causing feeding problems and jamming.

Most police shotguns appear to have either 14" or 18" barrels. It is illegal for a civilian to own a 14" barrel shotgun without filing federal paperwork for a short-barreled shotgun. Most pump-action shotguns hold between 4 and 8 shells. One less-lethal 18" shotgun we found held 6+1: that is, six shells in the magazine tube and one chambered.

However, we have received reports on the ground of police using full-length hunting shotguns, presumably with barrel lengths of 26 or 28 inches. One comrade in Cleveland reports that these were being carried primarily for intimidation purposes, while the same department fired actual less-lethal rounds out of 18" barrel shotguns instead. The longer the barrel of a firearm, the more accurate it will be, but also the faster the projectile will go and more powerful the impact will likely be.[2]

[2] One chart we found compares a 22-inch barrel with a 28-inch barrel, noting that a round will fire at 1304 fps from the 22-inch and 1331 fps from the 28-inch, but this may not map to the difference in velocity of a beanbag round.

Barricade rounds can be launched from a 12-gauge shotgun. They are not designed for firing directly at people. Despite this, since they are loaded into less-lethal shotguns, officers have killed multiple people with direct shots, presumably unintentionally. Relatedly, "breaching rounds" are designed to destroy locks and doors. These are shotgun rounds generally comprised of small metal shot, or metal powder, often lead, suspended in a medium like wax. The idea is that the round maintains rigidity until impact, expels energy into a hinge, lock, or doorframe, then fragments into a powder after impact.

With both barricade rounds and breaching rounds, the injuries result from the initial impact, which can transfer a lethal amount of energy into a target.

Several manufacturers of police munitions sell "grenade launching cups" that attach to the muzzle of 12-gauge shotguns, enabling police to launch grenades that are ordinarily thrown by hand. These are used by attaching the cup to the end of the barrel and loading special launching cartridges into the gun.

37mm and 40mm Launchers

The majority of riot munitions—including tear gas canisters, muzzle blasts, baton rounds, flashbangs, and marking rounds—are fired from devices designed as grenade launchers. For the purpose of disambiguation, we're going to refer to them as "multi-launchers," as some sites call them, because they fire a wide range of devices, not just grenades. These are also sometimes called "riot guns" or "less-lethal launchers," but "riot gun" is often used in the US to describe lethal "riot shotguns."

There are two common calibers of multi-launchers, 37mm and 40mm. Traditionally, 40mm launchers are seen as "military" and 37mm launchers as "civilian," but the police employ both and the differences between the two seem to be minor. It can be legal for a civilian in the United States to own a 37mm launcher so long as the munitions they use with it are not anti-personnel; flares and fireworks are legal, while baton rounds are not. There are also 38mm munitions, and most 37mm less-lethal launchers we've seen are advertised as firing 38mm munitions as well. 38mm munitions might be more common outside the United States.

All 40mm grenades used in protest situations seem to fit the "40x46mm" NATO standard for low-velocity grenades, which is the standard used for handheld launchers, unlike the 40x53mm high-velocity grenades that are generally fired from mounted and crew-served weapons (i.e., guns that are designed to be operated by two or more people at a time). The ammunition is not interchangeable between these systems.

Many multi-launcher projectiles are fired with black powder, rather than more modern gunpowder, which causes sparks and smoke. This is done because these projectiles are more fragile than most modern ammunition. Some are available in "smokeless" models that, presumably, use EC smokeless powder, a slightly more modern variant of black powder that produces less smoke.

When people report with shock that police who work at public schools have "grenade launchers," this likely means multi-launchers. The police probably don't plan to fire live grenades at students; rather, they plan to poison them with chemical weapons that are explicitly banned for use in war by the Geneva Convention.

Pistol-style launchers exist, but are generally designed only for muzzle blasts.

Full-size launchers are usually either breech-loaded single-shot guns (in which the barrel hinges away from the handle and a single round is inserted) or drum-fed versions that look

like gigantic revolvers. These revolvers are usually advanced by a pump action, rather than a trigger as in a conventional revolver. These tend to hold between 4 to 6 rounds, depending on the model. Some are rifled to spin projectiles for better accuracy. Internationally, many have wooden stocks and look more like traditional rifles, while most of what we've seen in the US are "tactical" style guns with pistol grips in addition to stocks as well as vertical fore grips—a style that is not legal for civilians without special permission.

Launchers can also be mounted under the barrel of a rifle, rather than operating as standalone devices. This style is in common use in military situations but does not seem to be common among law enforcement.

Canisters and Grenades

For the purpose of this article, we are distinguishing "canisters," designed to be fired from launchers, from "grenades" that are designed to be thrown by hand. In reality, there is no such clear distinction. Some weapons are designed to be thrown or rolled by hand, while others are designed to be loaded into multi-launchers—but some are designed for both.

Grenades are often used to disperse chemical agents and/or impact munitions, particularly rubber balls. Other grenades are "distraction devices," generally referred to as flash-bangs. Many combine these functions.

We've found at least three body styles for police grenades. There is the ball grenade, which looks like a classic baseball-style military grenade, designed to be thrown or rolled. These often contain rubber ball impact munitions, possibly paired with chemical weapons, while others are traditional pyrotechnic tear gas grenades. There are the "low roll" body grenades, which are cylinders with large hex-shaped ends that minimize the distance the grenade will roll. Then there are the regular canister grenades, which appear to be the most common style. These can be of any diameter, but 37/38m, 40mm, 45mm, and 60mm seem to be the most common.

Gas grenades and canisters can disperse chemical agents through a number of methods. The most common is the classic pyrotechnic dispersal, which works by creating a fire inside the canister that releases the chemical agent as smoke. These canisters are very hot and can spark and start other fires.

Another dispersal method, used more often by OC canisters than CS canisters, is aerosol dispersal (sometimes called "flameless expulsion"). Releasing something more akin to a mist than a smoke, these are more commonly used indoors, where pyrotechnic canisters would be less convenient. As best as we are able to determine, these are generally not used as much outside because they produce less dense concentrations of chemical agents.

Finally, there are instantaneous blast canisters, which explode all at once and release their payload as a powder. These are designed for inside or outside use, but as the dust is easily dispersed by wind, they are intended primarily for use against dense crowds of people, when pyrotechnic grenades are less effective, either owing to throwback potential or the risk of starting unintentional fires. These canisters are easily identified after the fact because they are split open along the sides.

Gas dispersal canisters are often designed to separate into a number of sub-munitions, like the "triple chaser" from Defense Technology that splits into three smaller tear gas canisters. This is done to make it more work for us to throw them back or douse them with water.

https://twitter.com/comradecamera/status/1352152555933978627

Less-lethal grenades are generally equipped with fuses like any military grenade: the user pulls a pin, which makes it possible to release a lever that is gripped in the hand. Once the lever is released, the fuse is ignited. While fuses could be of varying length, we have found two second delays to be common: a 1.5-second delay before the fuse is ignited, then .5 seconds for the fuse itself. On at least some models, the fuse assembly ejects itself before the payload is ignited so that it does not become a projectile.

Some grenades come with additional safety clips that prevent the fuse from being pulled while the grenade is being carried. Some come with water-resistant bodies for high-humidity environments. Some, particularly flash-bangs, are reloadable. People have reported seeing police combing the area after protests and picking up certain spent munitions. It's possible they are doing this to conceal the use of some particularly egregious weapons (such as DM gas), but it's also possible they are recovering reloadable grenades.

Grenades can also be "command initiated" instead of lit by a fuse. This system seems to be more common in tactical situations, such as house raids, rather than at demonstrations that are more dynamic. This system involves attaching a tube to the grenade to allow for instantaneous, remote detonation.

Sprays and Foggers

In addition to firing canisters that release chemicals as smoke, police also spray people directly with chemicals with handheld devices. The two chemicals we've found in our research are OC (pepper spray) and CS (a tear gas), but almost any chemical agent can be aerosolized and sprayed. Depending on the manufacturer, the chemical irritant, and the spray pattern, these can employ any number of propellants, such as compressed air, nitrogen, or the refrigeration chemical ominously named 134a. There are numerous spray patterns, from the simple "stream" pattern to cones, fog (or "vapor"), and even foam.

Chemical sprays, unlike pyrotechnic dispersal methods that disperse a powdered irritant, generally aerosolize a liquid form of the chemical. This can be water-based or oil-based; consequently, chemical weapon protection should be rated against oil-borne particulates (P100 filters instead of N100 filters). Foggers use a liquid formulation as well, but aerosolize this liquid pyrotechnically (the way a fog machine does) rather than by using an aerosol gas.

Chemical sprays come in a range of different concentrations and it would be difficult to anticipate which is ones law enforcement are utilizing without research. To make matters more complicated, the strength of OC (the most common sprayed irritant) is notoriously difficult to identify. Manufacturers' claims are not regulated, and there are many different types of capsaicinoids that might be present in a given variant of OC gas. There is probably internal consistency within each manufacturer's line of weapons, but that's about it. One manufacturer's 2% spray might be more powerful than another's 4% spray. Those numbers are almost meaningless on their own.

Small handheld canisters with a button on top seem to be accurate from 10–12 feet, while larger canisters with a trigger assembly seem to be accurate up to 15–20 feet, although this differs from manufacturer to manufacturer. Many spray systems also contain visible or UV reactive dyes to

mark targets. UV dye is particularly common in civilian self-defense spray, while police in Seattle and other cities are known to use visible dye to mark demonstrators for arrest.

There are larger canisters that operate on the same principles as the smaller ones. These often look more like full-size fire extinguishers. Then there are backpack devices with separate spray nozzles and tanks—the "Ghostbusters" variety, as some have called them. These can operate with either powder or liquid chemicals; at least one model has an effective range of 45 feet. Portland police have been seen to conceal backpack chemical foggers inside an unmarked black backpack with a spray nozzle attached to a hose protruding from the bottom.

> https://twitter.com/PredatorFiles/status/1287725556453187590

There are also devices that look like a cross between a fog machine and a leaf blower that are gas-powered and are designed to fill large areas with poison. Like the backpack foggers, these are generally designed for use in prisons, not at demonstrations. As we've seen recently, however, riot police will often use any weapon available to them.

Finally, chemical weapons are sometimes mixed with water and dispersed through fire hoses or water cannons. None of us had seen this method in use in the United States until the 2020 protests in Portland. Chemical burns on a nearby tree were consistent with chlorine poisoning, which could be the result of expired chemistry. This means of chemical weapon dispersal has been used in Hong Kong, Thailand, and Turkey; it is presumably possible in any country that uses water cannons against demonstrators.

Candles

A hundred years ago, when chemical warfare was first emerging, some poisonous gasses were dispersed by "candles," which would burn and release gas. Functionally, this is the same thing as a modern tear gas grenade, which uses pyrotechnics to disperse chemical powder; the phrase "tear gas candle" could be used to describe any pyrotechnic tear gas canister.

Yet in the summer of 2020, we saw either police or federal agents walking through the streets of Portland holding a burning object at the end of a stick. This looked, for all the world, like a censor at a Catholic mass with smoke pouring out of it.

We don't know for certain whether this was a chemical agent (probably) or inert smoke, but it feels noteworthy that the only tear gas we've come across that was designed for dispersal in "candles" like this is DM gas, the vomit gas that protestors believe is in use in Portland. This would mark a major escalation in the form of chemical warfare employed against protestors.

Chemical Weapons

As with all many other less-lethal weapons, the distinctions between categories of chemicals are actually quite blurry.

Conventional parlance divides chemical weapons in two categories: tear gas and pepper spray. While these distinctions exist, they're not clear-cut. If we imagine "tear gas" as clouds of smoke or dust and "pepper spray" as chemical sprays, this is really a question of methods of dispersal, not the actual chemicals being used.

We will discuss seven different chemicals herein. Although something like fifteen varieties have been developed, we will focus on the most common ones that are either known to be used against demonstrators or at least widely suspected of being used thus. Of those seven, five of them are usually dispersed as gas, while two usually appear as a chemical spray. But it's possible for almost any chemical to be dispersed by almost any means, and we have seen quite a bit of crossover.

The five tear gasses, in brief, are:

- CS gas, far and away the most common tear gas;
- CN gas, an outdated tear gas that is more toxic and less effective, but is still in production and commercially available;
- CR gas, which is sometimes called "fire gas," known for being incredibly hard to decontaminate—this makes your skin burn even worse than other gasses, and is in suspected use but not listed as commercially available;
- DM gas (or Adamsite), the nearly-mythical "vomit gas" that the police are suspected of using, though there is not yet hard evidence of its use;
- and MPK gas, which to our knowledge is only used in Russia but might be of interest to some readers.

The two pepper spray chemicals are:

- OC, the common "pepper spray" that is made from chile peppers; and
- PAVA, a synthetic form of OC that appears to act in very similar ways.

We will largely conflate these two throughout this article, as we've had a hard time identifying any significant distinction between them.

The first self-defense sprays were actually filled with CN gas, but OC is generally more effective at disabling a target. There are sprays filled with CS, CN, and OC. There are also tear gas munitions filled with OC and PAVA.

For the ostensible purposes of crowd control, OC (or PAVA) is the most effective tear gas agent. It is the fastest acting, the most debilitating, and the least toxic, and its victims recover faster. CS gas is in second place; it is more traditionally used, and the most widely available.

By any measure, no other tear gas agent besides OC or CS has any use even from a statist point of view except to punish and poison people. They are outdated and cruel technologies. We don't say that in order to ask for sympathy or to appeal to the moral judgment of the state, but simply to point out that the cruelty is the point.

Tactical Considerations

Chemical weapons are used for a number of tactical purposes. As we've found with impact munitions, police employ them in many ways that they were never designed to be used. In general, tear gas is designed to control the movement of crowds, or to disperse crowds. Tear gas

clouds are meant to discourage people from occupying particular areas. Police can use tear gas to direct a crowd much the same way that lines of riot police can: most people will avoid the gas and will move in the direction of clear air. The same crowd control effect can be done, on a smaller scale, with pepper-balls and the focused remote deployment of chemical weapons.

Sprays tend to be used closer up. Outside of demonstrations, they are used to subdue individuals. Inside of demonstrations, they are often used indiscriminately, to disperse, intimidate, or incapacitate a crowd.

Tear gas and other chemical weapons are specifically *not* designed for punishment: they are not designed to be deployed against a trapped crowd or a restrained individual. Police use them this way regularly, of course.

To prevent the police from accomplishing their crowd control goals, we simply refuse to be crowd-controlled. This can necessitate a certain amount of advance preparation.

To mitigate the effects of chemical weapons, personal protective equipment is in order. Our guide to gas masks and goggles gets into this in detail, but the short version is:

- Wear long sleeves and long pants, minimizing the amount of exposed skin;
- avoid wearing contact lenses;
- avoid makeup and moisturizers and other skin creams, especially fat-based creams;
- wear a gas mask, or a half-mask respirator with goggles, or a wet bandanna and goggles and keep moving.

Umbrellas can block chemical sprays. On the day Trump was inaugurated president, in the fabled "umbrella charge," a single umbrella protected dozens of anarchists as they escaped from a police kettle, eight felonies, and a years-long court case.

In light or moderate chemical weapon attacks, it's usually sufficient for a few people to deactivate or throw back the canisters while medics and others treat those affected by sprays. It's also possible to keep moving, so long as this doesn't interfere the goals of the demonstrators.

Unfortunately, the heavy use of chemical weapons will tend to thin out a protest of people who are less prepared. Having wet bandannas (stored in individual ziplock bags) or other PPE available for distribution can be useful to enable the crowd to stay around longer.

Throwing Back Tear Gas Canisters

> "It is never polite to throw back the tear gas… But sometimes love Sometimes real love Is fucking rude."
>
> Andrea Gibson, "Etiquette Leash"

Protestors regularly return tear gas canisters to those who have deployed them. Since tear gas is pyrotechnically deployed, most canisters are quite hot—hot enough to start fires or burn your skin. Anyone hoping to handle gas canisters should wear insulated work gloves made from fire-resistant material. Cheap hardware store gloves are not adequate; canisters have burned protestors through them. Synthetic materials, if not specifically designed to be fire-resistant, can melt into a person's skin. Leather work gloves are often the simplest and best choice, though those who choose not to wear leather should be able to find heat-resistant synthetics.

People have also employed lacrosse sticks and hockey sticks to return tear gas canisters without touching them.

https://twitter.com/plsnotmike/status/1286951807168598018

https://twitter.com/MrOlmos/status/1285110589606334465

Police may employ pepper spray without putting on gas masks, but if they are going to gas an entire area, they will almost always put on masks or rotate in a new line of officers wearing protective gear. This is important: it means that if you keep an eye on the police, you should be able to tell in advance when they are preparing to gas you. It follows that, if anyone must be subjected to tear gas, it should be the people who are best equipped for it—the ones who deployed it in the first place. Of course, we're not lawyers, and laws about which burning objects one is allowed to throw at the police likely vary by locality.

You should only throw canisters when you are aware of your surroundings and have an open space behind you. Before you throw a canister, take note of which direction the wind is blowing and where people are likely to need to go shortly, as well as where they currently are.

https://twitter.com/Gian_Neon/status/1268060951846281216

Neutralizing Tear Gas Canisters

In recent years, protestors around the world have been learning to neutralize gas canisters rather than simply tossing them back. These methods have the advantage of being a bit less confrontational.

Since most canisters are pyrotechnically deployed, it's enough to simply put out the fire inside the canister. One rudimentary method, which does not require touching the canister at all, is to put a road cone over the canister and then pour water in through the hole at the top of the cone until it is doused.

https://twitter.com/hkfp/status/1158399008261464064

A more refined method involves picking up the canister with gloved hands and putting it in a large water bottle or a bucket of water. In Chile and some other parts of the world where communities in revolt have honed their practices, extinguishing canisters has become a distinct role in street protests. People playing this role bring a water jug with a wide mouth, containing a little baking soda, dish soap, and/or vegetable oil—3 tablespoons of each to 1 liter of water. When a canister arrives, they drop it in the jug, and shake the jug while covering the top with one hand just enough to keep the gas from getting out. If you try this, don't seal the bottle—you don't want it to explode.

https://twitter.com/crimethinc/status/1265808184519864320

Failing all else, if you aren't prepared to neutralize the canister, it could be enough to simply cover it with something like a cooking pot or an orange road barrel. Some gas will leak out, but this will diminish its ability to hurt people.

Being Prepared for What Chemical Weapons Do

In theory, riot control agents are designed to be as uncomfortable and debilitating as possible without causing permanent damage. They irritate the lungs, eyes, and skin. They are lachrymatory agents, causing your eyes to water. Your nose might run. You might have trouble breathing. You might be unable to open your eyes. Some chemical weapons take effect almost immediately; others can affect you minutes after exposure. Some continue to irritate you long after you move to fresh air; others dissipate faster. Some are more toxic than others; some can cause permanent damage. We'll discuss the specific effects of each chemical separately. But in short: sometimes exposure to riot control agents can be painful and debilitating, especially when you're directly exposed to them without protection. In other cases, they may be simply irritating.

Shortness of breath is a specific and common problem resulting from exposure to chemical weapons. When this is combined with the shock of getting gassed, the overall stress of the situation, and irritated lungs, some people may feel as though they are going to pass out.

If you are experiencing this, try to get out of the area where the gas is deployed, sit up or stand with good posture to open your lungs, and try to breathe deeply. Even if your breathing is still restricted, the additional oxygen will lower your ambient stress level, enabling you to address some of the effects of anxiety and decreasing your heart rate. If you see other people who appear to be on the verge of passing out, try to get them to somewhere safe outside of the area of deployment and encourage them to breathe as deeply as possible.

The other thing that chemical weapons are intended to do is intimidate us. They are used to keep us out of the streets, to keep us from accomplishing our goals. If you are still building your experience in the streets, we recommend that you speak with coolheaded people who have considerable experience in public order situations about what to expect and how to handle the stress of chemical weapons attacks. If you are experiencing large-scale police violence for the first time, and you have the option, it can be a good idea to pace yourself, leaving a stressful situation when it becomes overwhelming, in order to slowly, steadily build a skillset for dealing with it levelheadedly. If you are aiming for longevity as a participant in social movements, it's better to err on the side of caution at first than to ask too much of yourself, have a bad experience, and withdraw from the struggle.

Some of us have been hit by everything under the sun over the years and survived. The fact that we have and the experience of being among comrades who have persisted in spite of intense police violence have both done a lot to demystify the weaponry of the police.

For Those Who Are Particularly Vulnerable

Asthmatics and others with breathing difficulties should be particularly careful about exposure to chemical weapons. This could mean bringing a gas mask or being prepared to leave the area as soon as you see police preparing to deploy gas. It appears that asthmatics account for most of the deaths caused by these chemical agents. To be clear, while these agents do occasionally kill people, being gassed as an asthmatic is rarely fatal.

According to Sven-Eric Jordt, Ph.D., a tear gas researcher, children are particularly vulnerable to tear gas because of their smaller lungs, which have a very different surface-to-volume ratio than adults. This has not stopped federal officers from employing tear gas against migrant children at the US border.

Immunity

Rumors abound about immunity to CS or OC, particularly in military circles.

Some people do appear to be naturally immune to CS gas, or at least more tolerant of it. It is indeed possible to build up the mental capacity to continue to function despite the pain and other effects. But there is no evidence that it is possible to develop a physiological immunity to CS or OC. In fact, on the contrary, repeat exposure to CS gas is known to cause sensitization—the opposite of tolerance.

US soldiers are exposed to CS gas during basic training as part of "mask confidence training," aimed at demonstrating the effectiveness of their gas masks. During these trainings, it appears that some small portion of the population (perhaps 2–5%, according to speculation we've seen) is naturally resistant to the effects of CS. On one forum, we read that a soldier who was highly tolerant of CS gas let someone pepper spray him, erroneously believing that pepper spray (OC) is the same thing. It turned out that he was not immune to pepper spray.

The other common rumor within the ranks is that drill sergeants develop immunity to the gas as a consequence of repeated exposure. What is likely happening, instead, is either that the officers who display some naturally occurring tolerance of CS are put in charge of the CS exposure chamber, or that these instructors have developed a mental, rather than physiological, tolerance for the pain and discomfort that the gas causes.

In any case, it is ill-advised to routinely expose yourself to CS gas in hopes of building up a mental tolerance to it. Exposure to CS gas can cause a number of long-term health problems. Nor is there any evidence that eating hot peppers or the like can increase your tolerance of it.

Some police academies apparently teach racist myths about pepper spray, suggesting without evidence that Latin American and East Asian people are more tolerant of pepper spray—and therefore, it is implied, need to be sprayed longer—because of exposure to spicy food. This is just the latest in centuries of white supremacist pseudoscience justifying cruelty.

How to Treat the Effects of Chemical Agents

Depending on the agent, most of the effects of chemical agents will clear up after about 30 minutes of fresh air. Avoid rubbing your eyes. If you have contacts in, remove them as soon as possible.

Rinse your eyes with water—or, ideally, have someone else rinse your eyes. The best way to rinse someone's eyes is to take a sports-style squirt water bottle and spray water into their open eyes. Bring a bottle for this purpose and use it only for flushes; do not drink from it, lest you contaminate it with saliva. You can open someone's eyes with your thumb and forefinger; wear clean gloves, if you have them. It is enough to open their eyes just a little bit. Start rinsing from the inside of the eye, near the nose, and work your way to the outside. Do one eye at a time. Ask them to blink; remind them to not touch their face. Repeat as many times as necessary.

Spray the water from the sports bottle with some force: the goal is to flush the chemicals off the eye. Rinsing your eyes will not immediately alleviate the burning, but it will enable you to begin to recover.

To get tear gas and other contaminates off your skin, wash with soap and water. If the gas has dried as a powder on you (which is especially possible with expired tear gas), brush the powder off your skin and clothes before rinsing. While it's been suggested that water "activates" the

powder form of chemical irritants, experience has shown that removing it with water, or soap and water, is effective.

When you meet people after being gassed, if you are still wearing the same clothes or have remnants of the gas in your hair, warn them. You may not be affected by traces of gas that could still provoke a significant reaction in them, especially if they have asthma or similar conditions. This can also be a concern if you are entering enclosed spaces with others. Treat the risk of exposing others to tear gas secondhand as a consent issue.

When you have exited the conflict area after exposure, take off your outer clothes and double bag them until you have a chance to wash them. Shower, scrubbing your skin vigorously with soap. Be careful when you wash the chemicals out of your hair: if any get into your eyes, your genitals, or open wounds, it will hurt.

To deal with your clothes, wash them thoroughly, possibly through multiple cycles. Run the washing machine without anything in it afterwards to wash the inside of the washing machine itself. Drying your clothes outside on a line is preferable, so that any lingering effects can dissipate.

Tear Gas and COVID-19

Tear gas makes your nose run, and bodily fluids are effective vectors for COVID-19 infection. Concerned with minimizing the spread of a deadly disease, some medics who would otherwise be administering assistance to those exposed to chemical weapons have begun advocating that people treat themselves for chemical weapons exposure if they are able to. Failing this, you should wear gloves, eye protection, and a mask of your own when you are treating a person for chemical weapons exposure. Take care to clean and decontaminate as soon as you can.

Decontamination Wipes

Law enforcement use Sudecon wipes for decontaminating people from pepper spray and tear gas. Medics we've spoken to report that they haven't seen a side-by-side comparison, but believe that Sudecon wipes might work at least as well as soap and water on skin.

Rosehip Medic Collective in Portland, Oregon has published a recipe for DIY decontamination wipes that were in wide use in the chemical-soaked streets there during summer 2020.

Begin with:

- 1 gallon warm water
- 9 cups white sugar
- 2 tablespoons citric acid

Mix this well, then combine it with 21 fluid ounces of baby shampoo and mix it gently. Soak high quality paper towels in the mixture, and pack them into ziplock bags a few of them at a time. These should keep for a few days, or a few months in a refrigerator.

Medics in Portland have been manufacturing these with the help of a small rolling machine to distribute the moisture more evenly; they hope it will enable the wipes to keep longer. It also helps the medics to manufacture them more quickly.

Other Remedies

People use many different remedies and treatments for chemical weapons—everything from milk to antacids and herbal concoctions. Based on our conversations with street medics and doctors, we recommend just using water for flushing out eyes and soap and water for washing skin. Why? After all, the doctor we spoke to pointed out that it doesn't usually hurt, medically speaking, to use milk to flush out someone's eyes.

We advocate for water because it's readily available and it's less likely to cause allergic reactions. We recommend it because it isn't gross—getting arrested soaked in milk isn't a pleasant experience—and because it doesn't leave telltale white residue like antacid does, which appears more visibly on darker skin and has been used (for example, by police in the Ferguson uprising) to mark suspects for arrest. Perhaps most importantly, we recommend it because it demystifies chemical weapons.

The idea that we need some sort of special remedy to treat exposure to chemical weapons adds to their mystique and the fear they can inspire. But there's nothing arcane about these irritants. Wash them off and get to fresh air. Even if you disagree with us that water is best, please do not interrupt experienced street medics who are applying water eye flushes. That is not helpful behavior.

There is an outdated protest technique (referred to as MOFIBA) that uses mineral oil to cleanse the skin of contaminants, but it has largely gone out of use because, if administered wrong (whether as a consequence of inexperience or of being applied in a tumultuous situation), it can do more harm than good. We won't detail it here. Soap and water are effective for cleaning the skin. Decontamination wipes are good—possibly better—if you have them available, but they are not necessary.

Additional care can sometimes be useful, both medically and emotionally. As one street medic put it, they rub arnica lotion onto handcuff bruises because when someone shows you the bruising caused by police handcuffs, they're showing you the physical evidence that they were assaulted and kidnapped. When you examine those bruises and apply a lotion, you're showing that what happened to them matters and that the consequences are worth treating with care. The arnica lotion likely helps with the bruising, but the act of showing care matters too.

Some protestors in Chile have taken to spraying a room-temperature tea (made by boiling laurel leaves) into the eyes of those who are suffering from pepper-spray, and it seems to be effective. This is not a mechanical flushing of the eyes, but rather applied with a squirt bottle as an aftercare treatment to alleviate burning and to calm the person.

Some protestors in Hong Kong have carried spray bottles containing three teaspoons of baking soda for every 8.5 ounces of water. While the efficacy of this has not been directly studied, it lines up with the findings of a 2003 study to the effect that CS molecules are unstable and basic fluids like baking soda might accelerate that process of molecular breakdown.

> https://twitter.com/nicole_froelich/status/1231084763412357121

The Geneva Protocol

Perhaps you've heard that the use of tear gas in war is a war crime, banned by the Geneva Protocol (which is distinct from and predates the Geneva Conventions). This is true. It's not just

that tear gas was accidentally swept up in a broad agreement not to employ chemical weapons, either. It's in there explicitly by name.

In 1925, after the chemical horrors of the First World War, 38 countries signed the Geneva Protocol banning the use of chemical weapons. Most of the signatory countries assumed that this included tear gas and chemical herbicides dropped indiscriminately in remarkable quantities. The United States government decided not to share this interpretation. Throughout the 1960s, the US made extensive use of tear gas and herbicide (Agent Orange) in Vietnam.

Today, the Geneva Protocol makes it clear that tear gas is specifically prohibited.

Heads of state don't want anyone else dropping chemicals on their civilians—but if that's what it takes to maintain order internally, they're all for it. So yes, international law explicitly forbids the use of tear gas in war, describing it as a war crime. But governments agree that it is fine to use it on us.

Types of Chemical Agent

We'll review the properties and effects of the more common chemical agents here.

CS Gas

CS gas (2-chlorobenzalmalononitrile, $C_{10}H_5ClN_2$) is the most common tear gas agent. Two US scientists, Corson and Stoughton, were the first to synthesize it; they named it after themselves. It was not weaponized into tear gas until the 1950s.

CS gas is found primarily in tear gas canisters, but it also appears in sprays, or laced throughout impact weapons.

CS gas is perceived to be substantially less toxic than CN gas, while being more effective at disabling people. It's probably more toxic, and less disabling, than OC.

We know that CS can cause heart and liver issues. We know that intense exposure can cause chemical burns and scarring. But there is more.

In terms of immediate lethality, it is speculated that CS could kill in an enclosed space; protesters blamed several deaths in Tahrir Square during the uprising on CS. But this has not been confirmed. CS gas does seem to be less immediately capable of killing than other chemical agents. Its long-term effects, however, are troubling.

Most toxicity reports on CS are over fifty years old; new studies are somewhat rare. The US military is increasingly finding links between CS gas and persistent lung problems by studying the incidence of lung problems before and after soldiers are exposed to the CS gas chamber.

CS gas is clastogenic—that is, it can change your chromosomes. This primarily affects people who are capable of menstruation. Science has been slow to study these effects, but a large number of stories describe miscarriages, excessive bleeding, cramps, blood clots, and seizures after exposure to CS gas.

CS gas (unlike OC and the Russian tear gas MPK) is not generally considered as effective against dogs, bears, and some other mammals owing to different tear duct structure and some resistance from fur. It certainly causes discomfort, and studies have shown it is capable of killing dogs. Anecdotal reports from Turkey describe it killing birds by the thousands and blinding street cats.

As with all chemical weapons, the police do not use CS in a "pure" form—and the other chemicals it is adulterated with can also be toxic. We believe that the liquid/spray version, at least the one that the UK police use, employs methyl isobutyl ketone (MIBK) as a solvent. MIBK is itself toxic and can cause liver and kidney problems.

At least at the siege in Waco, the US government used CS aerosolized along with the solvent Dichloromethane, which has a sweet odor. It is carcinogenic.

Some comrades reported that at least some of the gas used during the G20 protests in Pittsburgh in 2009 smelled vaguely like banana candy.

CN Gas

Phenacyl chloride is a common chemical used in organic chemistry. When it is weaponized as a tear gas, it is called CN gas (2-Chloroacetophenone). It was first developed as a tear gas during the First and Second World Wars, though it is not known to have been used during them.

CN gas is commercially available through any number of police weapon manufacturers, although there is no reason why it should be, considering that it is substantially more toxic and substantially less effective than CS gas. It is less common than CS or OC, but can be found in tear gas canisters, sprays, and laced throughout impact weapons.

CN gas was the active ingredient of "Mace," the first brand of self-defense spray, before OC was developed.

CN gas has killed at least five people via heart damage or asphyxia. It has also caused contact dermatitis—sometimes permanently—in an unknowable number of police officers whose chemical weapons have accidentally leaked onto them. If it can injure police in that manner, it can injure us as well.

CR Gas

CR gas (dibenzoxazepine) is a tear gas agent that is suspected but not confirmed to be in use in the United States. It was developed in the UK in the 1960s and earns its nickname "fire gas" for its capacity to not just hurt your lungs and eyes, but to make your whole body feel like you've been thrown into a patch of nettles. It is said to smell sweet.

CR gas is allegedly 6–10 times more potent than CS gas, and while all the documentation we've found says that it is "less toxic" than CS, it is known to be capable of killing people by asphyxiation or pulmonary edema (liquid filling the lungs).

One of the worst things about CR gas is that it is substantially harder to decontaminate than other riot control agents. It can persist on surfaces for up to 60 days.

We have not found any manufacturers who advertise any products that contain CR gas.

Some protestors in Portland conjecture they might have been exposed to CR gas because some gas they were exposed to reacted particularly strongly to their sweat. The theory is that federal agents, tired of gas-masked protestors, utilized a weapon that causes suffering even to those who are masked. These federal agents might have access to old stores of CR gas, or perhaps do not need to go through public-facing commercial channels the way local police generally do.

However, CS gas (and perhaps especially expired CS gas, which might cause larger flakes that persist longer on the skin) also reacts to sweat to cause burning, and can be dispersed through

sweet-smelling solvents. Chemists and others are currently trying to work out whether CR or DM have been in use in Portland.

DM Gas

DM gas (Adamsite, Diphenylaminechlorarsine) is another largely outdated and particularly vicious tear gas agent. Chemists in both Germany and the US developed it independently in the 1910s. It was originally burned in "candles" to disperse the gas.

DM gas is particularly ineffective as a riot control agent, as its effects take 5–10 minutes to set in. It would only be useful for inflicting punishment—for which purpose it would likely be effective, as its effects can easily last 12 hours. It starts like other tear gasses, with irritation to the eyes and lungs, but this develops into nausea, headache, and persistent vomiting.

DM gas was most notoriously used in the United States against the "Bonus Army," a demonstration of 45,000 veterans of the First World War and their allies in DC in 1932. Eyewitnesses say that the gas suffocated two young children, though historians have been unable to confirm this.

Some people conjecture that DM gas was in use by federal agents in Portland in the summer of 2020, but it remains unproven. There were rumors describing green smoke that might have been DM gas, and reports that some tear gas had made people vomit. So far, no one has been able to prove or disprove this, though some green gas utilized in Portland has been identified as HC gas.

Pepper Spray: OC

OC (oleoresin capsicum) is the only organically derived riot control agent we are aware of. It's derived from capsaicin, the active component of chili peppers.

As far as the ostensible purpose of riot control agents go, OC seems to be the most effective: it is substantially more irritating and incapacitating than CS or CN gas, with a faster onset time than either, while apparently inflicting substantially fewer long-term adverse health effects on those exposed to it.

OC was first introduced as pepper spray, but has increasingly found its way into tear gas variants as well, appearing in tear gas grenades (both slow-burning and instant clouds of dust) and laced throughout impact weapons.

Lest we paint too rosy a picture of OC, it, too, can kill people—specifically, those who are exposed to a great deal of it, such as when police torture restrained arrestees with it, which is a common enough procedure. In particular, it can kill asthmatics by blocking off their lungs to air by "severe acute bronchospasm."

OC in spray form is often suspended in propylene glycol, which is comparatively harmless by itself.

PAVA

PAVA (Nonivamide, pelargonic acid vanillylamide) is a (usually) synthetic form of OC that is more common in Britain, where it is the most common form of pepper spray, than in the United States. The only use of it we've identified in the US so far is in pepper-balls and FN303 rounds.

PAVA does appear naturally, but manufacturers generally synthesize it. It is more heat-stable than OC. It is edible in the same way that OC is. We have yet to find any particular differentiation between the toxicity of PAVA and OC.

Most PAVA spray is suspended in aqueous ethanol. This is sometimes called PAVA 1. In other cases, it is suspended in a mixture of mono propylene glycol, ethanol, and water referred to as PAVA 2. PAVA 1 is flammable, while PAVA 2 is not. Neither are made of chemicals we know to be particularly toxic.

MPK

Western readers are unlikely to ever be exposed to MPK (N-nonanoylmorpholine), a tear gas used in Russia that is reported to be effective against dogs and people who are too intoxicated to be easily incapacitated by other chemical weapons. It is not as strong as other chemicals, so it is generally mixed with CS or CN gas. It is presumably less toxic than the chemicals it is mixed with, as it is reportedly sometimes used as a food additive as well.

Smoke

Many canisters the police employ are just smoke grenades. Police use smoke grenades to mark areas with colored smoke, to hide their own positions and actions, to cause panic in the crowd, and, possibly, to refract lasers pointed their way (we are unsure of the efficacy of this, as there is a great deal of mixed information about lasers). Most chemical weapons manufacturers also offer smoke grenade versions of their various canisters and grenades.

Many military-style smoke grenades, called HC or HCE grenades, contain Hexachloroethane. Hexachloroethane is toxic through skin absorption, depressing the central nervous system; it is presumed to be a carcinogen. In mid-2020, federal agents in Portland, Oregon used outdated grenades containing HC. According to one researcher, HC is no longer manufactured in the USA, but is harvested as a byproduct of other chemical processes. While it is toxic, it seems considerably safer than the other chemical weapons police employ.

"Saf-smoke" grenades, the style manufactured by Defense Technologies, are advertised as less dangerous. The actual contents of Saf-smoke and other competing brands of smoke grenade are proprietary and not immediately available for review.

Flash-bangs

These devices, which manufacturers call "distraction devices" or "disorientation devices," are more commonly known as flash-bangs or stun grenades. They produce an intense flash of light and a loud bang as well as some concussive force. The light (upwards of 8 million candelas—as bright as eight million candles) blinds viewers for approximately five seconds and causes severe afterimages. The volume is around 160–180 decibels, substantially louder than any gunshot you are likely to ever hear; this deafens those in the vicinity, disrupting the fluid in the inner ear and sometimes causing dizziness.

Police occasionally use these in conjunction with baton charges or other impact weapons when they wish to knock demonstrators off guard. But at the end of the day, like so many police tactics,

these are methods to intimidate people into complying, not methods that directly force people to comply.

Flash-bang grenades are generally made of solid steel or aluminum, designed not to fragment as a result of their detonation. Many of them are reloadable or refillable.

Some flash-bang grenades are "aerial warning/signaling" munitions designed to be fired into the air to explode over a crowd. These can come with or without chemical payloads; each round has a different range, ranging from 50 to 300 meters. There are versions for 12-gauge shotguns as well.

At least one manufacturer says that there should be a clear area of 5–6 feet around the site where a flash-bang will detonate; still, police regularly throw, fire, and roll these into crowds. While some are packed with rubber ball munitions, most are designed not to cause harm via impact. Yet they can maim or kill people, usually through burning. They've also been known to start fires, particularly when deployed indoors.

Collecting Spent Munitions

Since there is so little oversight and so little information available about the weapons that taxpayers pay for police to shoot us with, protestors have taken to documenting spent shell casings to see what is being fired at them. Collecting spent munitions can contribute to useful pattern analysis. Some cities have people who are willing to come pick up munitions for this purpose. If your city doesn't have anyone pursuing this, consider taking it on yourself.

The National Lawyers Guild is interested in knowing what people are being shot with; they are collecting information. So are we. Please contact us with photos and information.

Police in Portland seem to be convinced—or are trying to convince people—that picking up spent munitions is a crime and they have threatened to fire more munitions at anyone caught doing it. They have not managed to figure out exactly what crime it is, and we are not currently aware of anyone facing charges for doing so.

Police munitions are often found unexploded or unfired. It's unclear to us if this is because these cartridges are firing without deploying properly, if they're jamming the gun and being ejected unspent, or if police are simply dropping munitions on the ground by accident.

When opening a bag of spent munitions, it is possible to experience secondary effects from gas residue. Consider storing them double bagged in ziplock bags. Only handle them in open-air environments while wearing gloves and protective clothing.

Marking

The police sometimes attempt to mark those participating in demonstrations or suspected of crimes in hopes of arresting them later. In some cases, they may simply use marking to frighten us by making us believe that they will come looking for us, in hopes of limiting what we choose to do in the streets. We know of far more times that the police have used marking than times that this marking was later used to identify people for arrest or was presented as evidence in court. We would love to hear from anyone with more information about marking, whether through experience or research.

There are reports of police using pepper-ball rounds for marking at least as far back as the 2003 protests in Miami against the Free Trade Area of the Americas ministerial and the Iraq War protests of the same era.

We've been able to identify at least seven means by which police mark people:

- Malodorants
- Temporary powder
- Washable paint
- Indelible paint
- UV dye
- DNA marking

It is probable that colored, visible dye is used as well. These are often paired with other effects, such as 12-gauge beanbag rounds loaded with florescent green powder or FN303 rounds that add paint or dye to impact weaponry. We have also received reports that police in Portland have shined green laser pointers from the rooftops to mark protestors as targets for impact weapons or arrest.

There appears to be only one malodorant round on the market, the 40mm BIP Malodorant from Security Devices International, Inc. It is intended to mark people by smell and also to serve as a crowd deterrent. The smell was described by Fox News as "egg salad meets trash" and is said to disperse fairly quickly. None of us have heard of it being used at demonstrations.

Marking powder, paint, or dye can be applied via any means that chemicals are administered. Paintball guns, shotguns, and multi-launchers all have marking rounds available, and we've heard reports of police adding paint or dye to their water cannons.

We have yet to find information on the exact makeup of the paint or dye commonly included in marking rounds. Some manufacturers divide their products into "washable," "indelible," and "UV" or into "powder" and "liquid." Security Devices International, Inc., for example, claims that their liquid marking round leaves a "semi-permanent stain" that "remains on the target and clothing up to 24 hours." The data sheet for that particular round refers to its contents as a proprietary blend of inert materials. Other companies are no more forthcoming.

Removing Paint

The easiest way to deal with a mark on your clothes that identifies you as a suspect is to get rid of the clothes. You should make this decision according to how important they are to you and what you fear you might be arrested for. A court case is usually more expensive than a windbreaker. You may also be able to leave an item of clothing somewhere—for example, in a bush or trash can—and come back later to see if you can recover it.

Washable paint and chalk should be the easiest to remove. It should wash off of skin with water, or soap and water and scrubbing. One way to remove water-based paint from clothes is to let the paint dry, then scrape off as much as you can with a butter knife or the back of a spoon; then hand-wash the item, passing warm water through the fabric from behind the stain, blotting

it with a rag or paper towel; then mix half-detergent and half-water and rub that into the stain. Then rinse, and repeat the last step until the stain is gone or you are no longer drawing paint out of the clothes. In a worst-case scenario, try using small amounts of acetone (nail polish remover) or rubbing alcohol—but be advised, this might damage the item.

Oil-based paint, which might be used in the "indelible" paint, can be removed from skin by mixing olive oil and dish soap, lathering up your skin, and rinsing it off, repeating as necessary. You can remove oil-based paint from clothes by putting your clothes inside out on a stack of rags or paper towels and then pouring turpentine or another paint thinner onto the fabric from behind the stain, blotting it with rags. Once no more paint comes out that way, rub dishwater detergent into the stain and then leave the clothing in hot, soapy water overnight. Rinse it thoroughly in the morning, then throw your clothes into a washing machine.

UV ink can also be removed from both skin and clothes. In some ways, it may be easier to clean than other inks because it doesn't really dry except under UV light (we are unsure if the UV light in sunlight will cause it to dry). Most UV ink appears to be alcohol-soluble, so using rubbing alcohol or even hairspray should help remove it from skin. Other recommendations we have seen include washing with diluted bleach water or scrubbing your skin with an abrasive mixture of sugar and dishwashing liquid. Still other people maintain that hot soapy water and plenty of abrasion will do. You could try washing your clothes repeatedly in hot water, checking with a UV flashlight as you go.

There are cheap, small flashlights available that come with both regular and UV LEDs. Usually, they are used by employees working door security to look for hand stamps—or by people who are checking their bedding for bedbugs.

DNA marking

There's paint, there's invisible ink, and then there's… DNA marking. Actually, there are two different things that are called DNA marking. The first is a chemical weapon, usually a spray, that contains a unique blend of different metals and other materials, acting as a sort of chemical fingerprint that can be identified later. This type of tagging uses the word DNA only as advertising jargon. Each can, or shipment of cans, might contain its own unique fingerprint, though we have not been able to confirm this.

The other style of DNA marking uses DNA, literally. This DNA marking is a system that marks a target with synthetic DNA that can live on clothes or skin for several weeks. Both systems of DNA tagging work the same way: if someone is identified later by way of these tags, this can provide concrete evidence in court connecting them to potential criminal behavior.

There is every reason to believe that police are using one or both of these methods, though it is hard to know which one and precisely when they are using it. The 40mm DNA Forensic Marking round, for example, made by Security Devices International, Inc, uses a "botanical encrypted taggant in water" which we believe refers to actual synthetic DNA.

All the DNA marking materials that we've been able to find seem to be suspended in UV ink for dispersal, although we know of no reason that they would have to be.

As of this writing, we have not heard of any arrests or court cases related to the 2020 uprising that involved DNA marking. Most after-the-fact felony arrests of protestors seem to hinge instead of livestream footage and social media posts. This does not mean that it is not in use or that it will not be used in the future.

On Twitter, Minneapolis police have openly discussed using DNA marking spray, although they have not specifically claimed to have used it on protestors. It's possible that they were conflating "UV marking" with "DNA tagging."

Removing DNA marking

Since all available evidence suggests that DNA marking is carried in a UV dye, it seems probable that it can be removed in a similar way as one goes about removing UV dye. Most manufacturers claim that the marking lasts for "days," or "several washes," although at least one claims it lasts for "weeks."

One manufacturer, Security Devices International (SDI), claims that it lasts 3–5 days on a person but 2–5 years on clothing.

Rumors from Portland suggest that the synthetic DNA is degraded by UV light. Some people have suggested that any clothes that one might not want to destroy or throw away—for example, body armor—should be left in the sun for several hours, with someone turning them regularly to make sure all parts of the items are exposed. Sunlight is bad for the plastic polymers of armor, especially soft bulletproof vests, so this might not be recommended for some materials. People also suggest using alcohol or hydrogen peroxide to break the DNA tag down, but this might degrade the material as well, especially in the case of hydrogen peroxide.

It all depends on how important it is to destroy the evidence that you were in a particular crowd at a particular time. Depending on the severity of the risk, you might replace all of your affected clothes and spend considerable time washing and exfoliating—or you could simply wash everything a couple times, take a few showers, and check yourself with a UV light.

SelectaDNA

Perhaps the first company to develop synthetic DNA marking for police use was SelectaDNA in the UK. SelectaDNA sells DNA spray, gel, and other devices directly to consumers for the purpose of home security. They also sell less-lethal .68 caliber air-powered weapons, a rifle and a pistol, to shoot DNA marking rounds at rioters. Both of these guns have an effective range of 30–40 meters and use 8-round magazines and a 20-round disposable CO2 cartridge. They are semi-automatic and can fire six rounds in a second. Each comes equipped with a camera. It's unclear if the SelectaDNA pellets can be fired by other .68 caliber air guns.

Each pack of 16 pellets is uniquely coded. In theory, this means that police can do more than argue "this person was at the demonstration where we shot everyone with green paint, you can tell by the green paint"—they can claim "this is someone I shot with one of these 16 pellets, as registered on the timestamp of my rifle camera."

The synthetic strands of DNA are carried by a UV ink substrate. It can be detected on a suspect with a UV light or smelled by specially-trained dogs. Presumably, the dogs are smelling the UV ink, not the DNA itself.

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