

Detonating the air: The legality of the use of thermobaric weapons under international humanitarian law

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Abstract

Thermobaric weapons cause damage and harm through overpressure and thermal effects, but secondary harm may also occur due to fragmentation, the consumption and depletion of ambient oxygen, and the release of toxic gases and smoke. Several international instruments prohibit or regulate weapons that generate asphyxiating or toxic gases, poison or poisoned weapons, chemical weapons, and weapons primarily designed to be incendiary. Thermobaric weapons are, however, primarily designed for blast and are not specifically covered by, or excluded from, the application of these instruments. The general customary law principles of international humanitarian law that determine the legality of the use of all weapons, including thermobaric weapons, prohibit causing superfluous injury and unnecessary

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suffering, and the use of indiscriminate weapons. Thermobaric weapons cause severe suffering but will not be rendered unlawful merely because of this effect. These weapons are also not automatically and inherently indiscriminate when used in their normal or designed circumstances. The use of thermobaric weapons, when directed at a military objective, while considering all feasible precautions to protect civilians and civilian objects and the principle of proportionality, will, as a result, be lawful in most circumstances. However, the use of thermobaric weapons should, in a similar manner to heavy explosive weapons, be avoided in urban or populated areas.

Keywords: international humanitarian law, thermobaric weapons, weapons law, unnecessary suffering, superfluous injury.

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Introduction

In order to secure a strategic and tactical advantage over their actual or potential adversaries, States have progressively developed more formidable and efficient weapons for use during armed conflict.¹ This reality has produced, among many other examples, thermobaric weapons that create wide area pressure, thermal heat and blast.² Thermobaric weapons are particularly suitable, from a military perspective, for use against military objectives located in buildings and hard or deeply buried subterranean structures or those in populated areas and urban environments.³ The enhanced pressure and thermal effects produced by a thermobaric explosion, especially within confined spaces, are devastating and cause severe injuries that are difficult to treat.⁴ However, these weapons also create significant challenges for belligerents as their use in populated areas exposes civilians to terrible harm. Nonetheless, States maintain that thermobaric weapons offer a unique military advantage which cannot be produced by available alternative weapons.

The legality of the use of thermobaric weapons has, in the past, been the subject of some general debate within the media. This speculation has increased during the armed conflict between Russia and Ukraine.⁵ It is, however,

- 1 See William Boothby, *Weapons and the Law of Armed Conflict*, Oxford University Press, Oxford, 2009, p. 1.
- 2 Noah Shachtman, "When a Gun Is More than a Gun", *Wired*, 20 March 2003, available at: www.wired.com/2003/03/when-a-gun-is-more-than-a-gun/ (all internet references were accessed in March 2023).
- 3 Robert Weinheimer and Kristian Vuorio, *The Use of Thermobaric Weapons*, Orac International, January 2022, pp. 22–30; David Andrew, "Munitions—Thermobaric Munitions and Their Medical Effects", *Journal of Military and Veterans' Health*, Vol. 12, No 1, 2003.
- 4 Dave Majumdar, "The American Military's Deadly Thermobaric Arsenal", *The National Interest*, 3 December 2015, available at: <https://nationalinterest.org/blog/the-buzz/the-american-militarys-deadly-thermobaric-arsenal-14505>; Denise Chow, "What Are Vacuum Bombs? Concerns Grow about Russia's Thermobaric Weapons", *NBC News Science*, 2 March 2022; R. Weinheimer and K. Vuorio, above note 3; Matt Montazzoli, *Are Thermobaric Weapons Lawful?*, Lieber Institute, West Point, NY, 23 March 2022.
- 5 Patricia Zengerle, "Ukraine, Rights Groups Say Russia Used Cluster and Vacuum Bombs", *Reuters*, 1 March 2022, available at: www.reuters.com/world/europe/ukraines-ambassador-us-says-russia-used-vacuum-bomb-monday-2022-02-28/; Marianne Hanson, "What Are Thermobaric Weapons? And Why

surprisingly difficult to find a comprehensive review of the legality of thermobaric weapons despite the possibility that the use of these weapons will increase in future conflicts.⁶ The lack of significant engagement on this issue may be due to the complexity of dealing with the numerous forms of thermobaric weapons. Therefore, this article will attempt to accommodate all the forms of thermobaric weapons by focusing on the primary design element that all thermobaric weapons have in common – namely, a thermobaric explosion that produces blast. The basic goals of weapons law will first be assessed, together with the inherent design, nature, use and effects of thermobaric weapons. From this exercise, an additional evaluation will be conducted of any treaty-based provisions and customary international humanitarian law (IHL) rules that potentially apply to, or that may affect, the use of thermobaric weapons. It is submitted that the isolation and assessment of the technical aspects of a specific weapons technology such as thermobaric weapons, along with an examination of that technology’s use and effects, will provide valuable insight and produce broader conclusions on the legality of the use of all means of warfare.

Weapons law

Weapons law, principally by way of treaty law but also through customary IHL, prohibits particular weapons⁷ and related technologies or restricts the conditions in which such weapons may lawfully be employed.⁸ The basic principle of weapons law prohibits harm that is not essential to achieving a legitimate objective of armed conflict. The right of belligerents to adopt means or methods of injuring the enemy is, therefore, not unlimited.⁹ Weapons law incorporates several treaties with specific rules that apply to particular weapons, such as the

Should They Be Banned?”, *The Conversation*, 2 March 2022, available at: <https://theconversation.com/what-are-thermobaric-weapons-and-why-should-they-be-banned-178289>; Colm Ó Mongáin, “The Weapons Used, Feared and Threatened in Ukraine War”, *RTE*, 6 April 2022, available at: www.rte.ie/news/world/2022/0406/1290608-weapons-explainer/.

6 R. Weinheimer and K. Vuorio, above note 3.

7 The term “weapon” refers to an offensive capability (device, weapon, implement, substance, object or piece of equipment), with a destructive, damaging or injurious effect, that is capable of causing, or that is intended or designed, by way of attack, to cause injury or damage when applied to an adversary in an armed conflict or to threaten or intimidate any person. See Samuel Paunila and N. R. Jenzen-Jones, *Explosive Weapon Effects: Final Report*, GICHD, 2017, p. 128; W. Boothby, above note 1, p. 4; Justin McClelland, “The Review of Weapons in Accordance with Article 36 of Additional Protocol I”, *International Review of the Red Cross*, Vol. 85, No. 850, 2003, p. 397; Program on Humanitarian Policy and Conflict Research at Harvard University, *Commentary on the HPCR Manual on International Law Applicable to Air and Missile Warfare*, 2009, Rule 1(ff), para. 1.

8 William Boothby, “Space Weapons and the Law”, *International Law Studies*, Vol. 93, 2017, p. 192; Eitan Barak, *Deadly Metal Rain: The Legality of Flechette Weapons in International Law: A Reappraisal Following Israel’s Use of Flechettes in the Gaza Strip, 2001-2009*, International Humanitarian Law Series Vol. 32, Martinus Nijhoff, Leiden, 2011, p. 53; Sean Watts, “Regulation-Tolerant Weapons, Regulation-Resistant Weapons and the Law of War”, *International Law Studies*, Vol. 91, 2015, pp. 542–543; US Department of Defense (DoD), *Law of War Manual*, Office of General Counsel, 12 June 2015 (DoD Manual), paras 1.3.3.1, 6.2.1.

9 Protocol Additional (I) to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, 1125 UNTS 3, 8 June 1977 (entered into force 7 December 1978) (AP I), Art. 35(1); Convention (IV) Respecting the Laws and Customs of War on Land and Its

banning or regulation of the use of projectiles¹⁰ of a weight below 400 grams that are explosive or charged with fulminating or inflammable substances,¹¹ expanding bullets,¹² asphyxiating, poisonous or other gases,¹³ biological weapons,¹⁴ weapons designed to injure by undetectable fragments,¹⁵ chemical weapons,¹⁶ blinding laser weapons,¹⁷ anti-personnel mines,¹⁸ cluster munitions¹⁹ and nuclear weapons.²⁰ These instruments are typically produced retrospectively, generally after some technological advance in weapons technology has been developed and/or where these weapons have had unacceptable effects during armed conflict.²¹ Numerous States, in consultation with the United Nations, the International Committee of the Red Cross (ICRC) and civil society organizations, have recently acknowledged the devastating humanitarian consequences on civilians that result from the blast and fragmentation effects of explosive weapons. This collaboration resulted in the adoption of a non-binding political declaration whereby States committed to avoid and restrict the use of explosive weapons that may cause indiscriminate effects and civilian harm in populated areas.²² In reality, however, the motivations behind the regulation or prohibition of different weapons are influenced by both humanitarian concerns and the continued

Annex: Regulations Concerning the Laws and Customs of War on Land, The Hague, 18 October 1907 (Hague Regulations), Art. 23(g).

10 A “projectile” refers to a munition propelled under power from a weapon system.

11 St Petersburg Declaration Renouncing the Use, in Time of War, of Explosive Projectiles under 400 Grammes Weight, 138 CTS 297–299, 29 November/11 December 1868 (St Petersburg Declaration); Frits Kalshoven, “Arms, Armaments and International Law”, *Recueil des Cours*, Vol. 191, 1985, pp. 207–208.

12 Hague Declaration (III) Concerning Expanding Bullets, 187 Consol. T. S. 459, 26 Martens Nouveau Recueil (Ser. 2) 1002, 29 July 1899.

13 Hague Declaration (II) on the Use of Projectiles the Object of which Is the Diffusion of Asphyxiating or Deleterious Gases, 187 CTS 453, 29 July 1899 (Hague Declaration II); Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, 94 LNTS 65, 8 February 1928 (Gas Protocol); S. Watts, above note 8, p. 562.

14 Convention on the Prohibition of Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, 26 UST 583, 1015 UNTS 163, 10 April 1972.

15 Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (and Protocols), 1341 UNTS 137, 10 October 1980 (amended 21 December 2001) (CCW), Protocol (I) on Non-Detectable Fragments, Geneva, 10 October 1980 (CCW Protocol I).

16 Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, 1974 UNTS 45, 13 January 1993 (entered into force 29 April 1997) (CWC).

17 CCW, above note 15, Protocol (IV) on Blinding Laser Weapons, 13 October 1995 (entered into force 30 July 1998) (CCW Protocol IV).

18 Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, 2056 UNTS 211, 3 December 1997 (entered into force 1 March 1999) (Ottawa Convention).

19 Convention on Cluster Munitions, 48 ILM 357, 30 May 2008 (entered into force 1 August 2010).

20 Convention on the Prohibition of the Use of Nuclear Weapons, UN Doc. A/RES/60/88, 11 January 2006 (entered into force 22 January 2021).

21 See, in general, S. Watts, above note 8.

22 See the Political Declaration on Strengthening the Protection of Civilians from the Humanitarian Consequences Arising from the Use of Explosive Weapons in Populated Areas, 2022, available at: www.dfa.ie/our-role-policies/international-priorities/peace-and-security/ewipa-consultations/.

military utility, or lack thereof, of the weapon in question under specific tactical conditions based on a cost-benefit analysis.²³

IHL requires States to assess the legality of new weapons under international law. This requirement was first codified in Article 36 of Additional Protocol I to the Geneva Conventions of 1949 (AP I) and has since been incorporated into customary international law, thus binding all States.²⁴ States are required to conduct a preventative legal review of weapons in order to determine whether the acquisition, development, modification or employment of a new weapon would be consistent with, or partially or totally prohibited by, IHL or any other rule of international law.²⁵ Articles 36 and 82 of AP I, read together, require that legal advisers be available during armed conflict to advise military commanders on IHL and “on the appropriate instruction to be given to the armed forces on this subject”.²⁶ It is unclear how many States have systems for the legal review of new weapons, but it is evident that most States currently do not have existing weapons review mechanisms or that these systems are generally inadequate to ensure suitable outcomes.²⁷ Some States Parties²⁸ and non-States Parties²⁹ to AP I conduct weapons reviews; some States claim to comply with the review obligation,³⁰ while some rely on the reviews conducted by other States. Nonetheless, many States while others are pessimistic about the usefulness of these reviews.³¹

23 Margarita Petrova, *Banning Obsolete Weapons or Reshaping Perceptions of Military Utility: Discursive Dynamics in Weapons Prohibitions*, IBEI Working Paper No. 2010/31, 2010, p. 6.

24 See Jean-Marie Henckaerts and Louise Doswald-Beck (eds), *Customary International Humanitarian Law*, Vol. 1: *Rules*, Cambridge University Press, Cambridge, 2005 (ICRC Customary Law Study), Rules 71–86, available at: <https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1>. See also Kathleen Lawand, *A Guide to the Legal Review of New Weapons, Means and Methods of Warfare: Measures to Implement Article 36 of Additional Protocol I of 1977*, ICRC, Geneva, 2006, p. 933 (ICRC Legal Review of New Weapons); Program on Humanitarian Policy and Conflict Research at Harvard University, *HPCR Manual on International Law Applicable to Air and Missile Warfare*, Cambridge University Press, Cambridge, 2013 (HPCR Manual); Michael N. Schmitt and Liis Vihul (eds), *Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations*, Cambridge University Press, Cambridge, 2017 (Tallinn Manual 2.0), Rule 9.

25 See AP I; ICRC Legal Review of New Weapons, above note 24, pp. 931–936, 946–948.

26 ICRC Legal Review of New Weapons, above note 24, p. 933.

27 Natalia Jevglevskaia, *International Law and Weapons Review: Emerging Weapons Technology under the Law of Armed Conflict*, Cambridge University Press, Cambridge, 2021, p. 48; ICRC Legal Review of New Weapons, above note 24, pp. 931–956; Brian Rappert, Richard Moyes, Anna Crowe and Thomas Nash, “The Roles of Civil Society in the Development of Standards around New Weapons and Other Technologies of Warfare”, *International Review of the Red Cross*, Vol. 94, No. 886, 2012, pp. 782–784; Netta Goussac, “Safety Net or Tangled Web: Legal Reviews of AI in Weapons or War-Fighting”, *Humanitarian Law and Policy Blog*, 18 April 2019, available at: <https://blogs.icrc.org/law-and-policy/2019/04/18/safety-net-tangled-web-legal-reviews-ai-weapons-war-fighting/>.

28 Australia, Belgium, Germany, France, the Netherlands, Norway, Sweden, the United Kingdom, Argentina, Denmark, Mexico, Austria, Canada, New Zealand and Switzerland.

29 The United States of America and Israel. See Maya Yaron, “Statement on Lethal Autonomous Weapons Systems (LAWS) Weapon Legal Review”, Group of Experts Meeting on Lethal Autonomous Weapons Systems, 13 April 2016, available at: [https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_-_Informal_Meeting_of_Experts_\(2016\)/2016_LAWS_%2BMX_ChallengestoIHL_Statements_Israel.pdf](https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_-_Informal_Meeting_of_Experts_(2016)/2016_LAWS_%2BMX_ChallengestoIHL_Statements_Israel.pdf).

30 Russia, Italy and Finland.

31 N. Jevglevskaia, above note 27, p. 28.

Article 36 does not establish new rules on the legality of weapons but rather addresses the implementation of existing substantive IHL obligations on States. The review process is not subject to specific rules, and individual States may, therefore, decide on the nature of and process for the review.³² However, the review obligation imposes a duty to conduct a realistic, systematic and multidisciplinary review, wherein States must at least assess the potential of the weapon to cause superfluous injury or unnecessary suffering (SI/US) and widespread, long-term and severe damage to the natural environment, the possible indiscriminate nature of the weapon, and any specific treaty rules or customary law that prohibit or restrict the use of the weapon. As weapons are usually acquired to meet a capability requirement over a substantial period, such a review is also prudent in order to establish, as far as possible, whether any future developments of IHL could affect a weapon's legality.³³ Ultimately, weapons and related technologies that fall outside these prohibitions or restrictions may lawfully be used in armed conflict, provided that the rules applicable to targeting are respected.³⁴ Targeting decisions and associated issues are excluded from the application of weapons law as States cannot practically be expected to predict all the potential uses or abuses of a weapon that may increase the amount of injury and suffering.³⁵

Thermobaric weapons

The assessment of any weapon must consider the weapon's technical characteristics, design and intended use.³⁶ Thermobaric weapons, in general, are classified as enhanced blast weapons.³⁷ More specifically, these weapons are a subcomponent of volumetric weapons – that is, weapons which use oxygen from the air to create a high-temperature explosion.³⁸ Thermobaric weapons may take a variety of forms,³⁹ including devices designed to explode (bombs⁴⁰ and hand grenades⁴¹), projectiles (mortar or artillery shells), and warheads⁴² that are integrated with

32 *Ibid.*, p. 28.

33 28th International Conference of the Red Cross and Red Crescent, Geneva, 2–6 December 2003, Final Goal 2.5.

34 Permanent Court of International Justice, *S. S. Lotus (France v. Turkey)*, Judgment, 1927 PCIJ (Series A) No. 10, 7 September 1927, p. 18.

35 William Hays Parks, "Means and Methods of Warfare", *George Washington International Law Review*, Vol. 38, No. 3, 2006.

36 ICRC Legal Review of New Weapons, above note 24, p. 944.

37 D. Andrew above note 3, p. 9; Lemi Türker, "Thermobaric and Enhanced Blast Explosives (TBX and EBX)", *Defence Technology*, Vol. 12, No. 6, 2016, p. 1.

38 Volumetric weapons include thermobaric and fuel-air explosives; see M. Montazzoli, above note 4.

39 L. Türker, above note 37, p. 423.

40 The KAB-1500LG-OD-E with thermobaric warhead: see "KAB-1500LG-OD-E", *Rosoboronexport*, available at: <http://roe.ru/eng/catalog/aerospace-systems/air-bombs/kab-1500lg-od-e/>.

41 The Russian-produced RG-60TB thermobaric hand grenade.

42 A warhead refers to the portion of the munition that contains detonating explosives, is designed to be fitted to or integrated with an existing delivery system and is intended to cause the damage or destruction of the target. See United Nations, *International Ammunition Technical Guidelines*, 3rd ed.,

existing delivery systems such as shoulder-launched⁴³ or multiple-barrel mobile rocket launchers,⁴⁴ air-delivered laser-guided bombs,⁴⁵ or ground- or air-launched guided⁴⁶ or unguided missiles.⁴⁷

Thermobaric explosives are normally made up of a high-power explosive core and a secondary fuel-rich composition, typically a plastic-bonded explosive composition comprised of a metallic fuel and an oxidizer or nitramine, axially spaced from the core.⁴⁸ The addition of aluminized or other metal particles to the composition creates the so-called “thermobaric effect”.⁴⁹ The thermobaric explosion is initiated by an anaerobic detonation of the explosive core, which distributes a plasma cloud of the fuel-rich composition across the target, whereafter, a secondary aerobic post-combustion ignites and detonates the cloud of fuel, which is now combined with the ambient atmospheric oxygen. Thermobaric weapons create large, powerful combustion zones that burn at extremely high temperatures.⁵⁰ These weapons are optimized to produce a destructive force by generating dynamic negative overpressure⁵¹ and sustained

2021, note 3.176, available at: https://unoda-safeguard.s3.amazonaws.com/iatg/en/V3_IATG_compiled-compressed.pdf.

- 43 The TBG-29V shoulder-launched rocket thermobaric weapon: see “TBG-29V”, *Rosoboronexport*, available at: <http://roe.ru/eng/catalog/land-forces/strelkovoe-oruzhie/grenade-launchers/tbg-29v/>.
- 44 The TOS-1A multiple rocket launcher: see “TOS-1A”, *Rosoboronexport*, available at: <https://roe.ru/eng/catalog/land-forces/missile-systems-multiple-rocket-launchers-mrl-atgm-systems-and-field-artillery-guns/TOS1A/>.
- 45 A “bomb” is generally accepted to be a guided or unguided munition with no method of propulsion. Michel Chossudovsky, “‘Tactical Nuclear Weapons’ against Afghanistan?”, Centre for Research on Globalisation, 5 December 2001, available at: www.nadir.org/nadir/initiativ/agn/free/9-11/globalresearch/cho112c.htm.
- 46 The AGM-114N thermobaric blast fragmentation laser-guided missile for use by rotary and fixed-wing aircraft: see “AGM-114 Hellfire Missile”, *Aeroweb*, available at: www.fi-aeroweb.com/Defense/AGM-114-Hellfire-Missile-System.html.
- 47 The Russian-made Metis-M1 anti-tank missile system, which launches the thermobaric 9M131FM missile: see “Metis-M1”, *Rosoboronexport*, available at: <http://roe.ru/eng/catalog/land-forces/missile-systems-multiple-rocket-launchers-mrl-atgm-systems-and-field-artillery-guns/metis-m1/>.
- 48 Nitramines are a class of organic nitrate explosives. See “Explosives – Nitramines”, *Global Security*, available at: www.globalsecurity.org/military/systems/munitions/explosives-nitramines.htm; Stefan Kolev and Tsvetomir Tsonev, “Aluminized Enhanced Blast Explosive Based on Polysiloxane Binder”, *Propellants, Explosives, Pyrotechnics*, Vol. 47, No. 2, 2022, p. 1; United States, “Thermobaric Explosives and Compositions, and Articles of Manufacture and Methods Regarding the Same”, Patent No. US 7,754,036 B1, 13 July 2010, available at: <https://patents.google.com/patent/US7754036B1/en>; Stanisław Cudziło, Waldemar Trzciński, Józef Paszula, Mateusz Szala and Zbigniew Chylek, “Performance of Magnesium, Mg-Al Alloy and Silicon in Thermobaric Explosives – A Comparison to Aluminium Propellants”, *Propellants, Explosives, Pyrotechnics*, Vol. 45, No. 11, 2020, p. 1.
- 49 Kai Zhong, Liangliang Niu and Chaoyang Zhang, “Atomic Insight into the Thermobaric Effect of Aluminized Explosives”, *FirePhysChem*, Vol. 2, No. 2, 2022, p. 191.
- 50 The European Court of Human Rights (ECtHR), in its judgment in the *Tagayeva* case, commented that the RPO-A Shmel with a thermobaric charge “creates a powerful combustion zone (a sphere of fire 5 to 7 metres in diameter) burning at temperature of about 1800°C; accompanied by an extremely powerful shock wave caused by a complete burning of oxygen in the detonation zone”. ECtHR, *Tagayeva and Others v. Russia*, Appl. Nos 26562/07 *et al.*, 13 April 2017, para. 220.
- 51 Negative overpressure results from the extraordinary blast concussion of the explosion, which creates pressure that is less than atmospheric pressure. Overpressure may also be “positive” when it exceeds atmospheric pressure: see S. Paunila and N. R. Jenzen-Jones, above note 7, p. 122.

mechanical and thermal impulse blast⁵² waves that propagate in all directions.⁵³ The slower explosive thermal heat overpressure exposes the target to longer periods of pressure and thermal heat; as a result, thermobaric explosions produce a higher total energy output over an extended period than conventional explosives and therefore generate more destruction than conventional explosives.⁵⁴ The harmful effects of thermobaric weapons are amplified in confined spaces as the thermobaric explosion may, depending on the structure, expose the target to multiple blast waves.⁵⁵ Thermobaric explosions also cause tertiary and quaternary damage due to the pressure effects generated by the structures around the explosion and from suffocation due to the consumption and depletion of the ambient oxygen, as well as from toxic gases and smoke. These combined attributes make thermobaric weapons extremely effective against buildings, bunkers, trenches and hard or deeply buried subterranean structures.⁵⁶

Most conventional weapons use explosives to propel metal fragments or a shaped-charge jet to destroy targets.⁵⁷ By contrast, thermobaric weapons are typically designed with light casings that may, as an additional effect, cause harm when secondary fragments are formed by shearing or spalling of nearby solid objects affected by the blast.⁵⁸ These weapons are thus highly destructive to human bodies, and their use increases the quantity and severity of injuries to which humans are normally exposed with conventional explosive weapons. The lethal effects of thermobaric explosions are often related to the bronchial trauma caused by the negative pressure; however, soft targets close to the ignition point of the thermobaric explosion are likely to be crushed or obliterated, while those further away will potentially suffer internal injuries as the thermobaric explosion compresses, stretches or disintegrates by overload any tissue interface of varying densities, elasticity and strength.⁵⁹ These explosions may also cause concussions, fractures, lung collapse, air embolisms within blood vessels, ruptured eardrums, displacement of the eyes from their sockets and neurological, biochemical and blood chemistry changes. Treating these “terrible”, appallingly painful and

52 The blast refers to a destructive wave of gases or air produced in the surrounding atmosphere by a detonation.

53 D. Andrew, above note 3, p. 10; Ovidiu-George Iorga *et al.*, “Experimental Techniques for Measuring Overpressure Generated by Thermobaric Devices”, 19th International Seminar on “New Trends in Research of Energetic Materials”, Pardubice, 20–22 April 2016.

54 R. Weinheimer and K. Vuorio, above note 3.

55 D. Andrew, above note 3, p. 9.

56 *Ibid.*, p. 9; O.-G. Iorga *et al.*, above note 53.

57 Richard Moyes, “Spiked”, *Landmine Action Campaign*, No. 13, 2007, p. 10, available at: <https://tinyurl.com/9byw4vhc>.

58 S. Paunila and N. R. Jenzen-Jones, above note 7, p. 118.

59 Such as the lungs, bowel and inner ear. See D. Andrew, above note 3, p. 11; Malcolm Mellor, “Ballistic and Other Implications of Blast”, in James M. Ryan, Norman M. Rich, Richard F. Dale, Graham J. Cooper and Brian T. Morgans (eds), *Ballistic Trauma: Clinical Relevance in Peace and War*, Springer, London, 1997, pp. 47–59.

agonizing⁶⁰ injuries frequently requires computer-assisted tomography that may not always be readily available within the combat zone.⁶¹

The legality of thermobaric weapons

The weaponization and use of thermobaric explosives continue to pose unique challenges when assessing the legality of these weapons. The following section discusses the restrictions that potentially apply to, or that may affect the use of, thermobaric weapons. Such an assessment necessitates a review of the general legal principles with which all weapons must comply, the treaty-based rules concerning the effects of weapons on the natural environment, and the customary and treaty provisions that deal with all weapons and specifically with thermobaric weapons.

Specific regulations and prohibitions

No international instrument specifically addresses the legality of the possession or use of thermobaric weapons. Even so, the debate on the legality of the use of thermobaric weapons may indirectly implicate specific provisions of the Hague Regulations Respecting the Laws and Customs of War on Land annexed to the Hague Convention of 1907 (Hague Regulations),⁶² the 1925 Geneva Gas Protocol,⁶³ the 1980 Protocol on Prohibitions or Restrictions on the Use of Incendiary Weapons (CCW Protocol III) to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (Convention on Conventional Weapons, CCW),⁶⁴ and the 1993 Chemical Weapons Convention (CWC).⁶⁵ It may be prudent here to refer briefly to the prohibition of weapons “the primary effect of which is to injure by fragments which in the human body escape detection by X-rays”, which are covered by Protocol I of the CCW.⁶⁶ Many munitions, including the fuses of some

60 ECtHR, *Tagayeva*, above note 50, para. 220; M. Montazzoli, above note 3; D. Andrew, above note 3, p. 9; Ove Bring, “Regulating Conventional Weapons in the Future: Humanitarian Law or Arms Control?”, *Journal of Peace Research*, Vol. 24, No. 3, 1987, p. 279.

61 Anna Wildegger-Gaissmaier, “Aspects of Thermobaric Weaponry”, *ADF Health*, Vol. 4, No. 1, 2003; Lisanne van Gennip, Frederike Haverkamp, Mans Muhrbeck, Andreas Wladis and Edward Tan, “Using the Red Cross Wound Classification to Predict Treatment Needs in Children With Conflict-Related Limb Injuries: A Retrospective Database Study”, *World Journal of Emergency Surgery*, Vol. 15, No. 52, 2020.

62 Hague Regulations, above note 9, Art. 23(a).

63 Gas Protocol, above note 13.

64 CCW, above note 15; *Review Conference of the State Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects: Final Document*, UN Doc. CCW/CONF.I/16 (Part I), Geneva, 1996; David Keye and Steven A. Solomon, “The Second Review Conference of the 1980 Convention on Certain Conventional Weapons”, *American Journal of International Law*, Vol. 96, No. 4, 2002.

65 CWC, above note 16.

66 *Ibid.*

thermobaric weapons, are constructed of non-metallic parts that produce fragments which may not be detectable by X-rays. The incorporation of these parts in thermobaric weapons will not in itself result in their prohibition under Protocol I, however, since the injuries caused by these fragments are incidental to the primary effect of the weapon.

Poisonous and asphyxiating gases and toxic chemicals

The 1899 Hague Peace Conference, in its efforts to prohibit destruction not absolutely demanded by the necessities of war, adopted a declaration whereby States are required to “abstain from the use of projectiles the sole objective of which is the diffusion of asphyxiating or deleterious gases”, since these weapons were regarded as equal to “barbarity, treachery and cruelty”.⁶⁷ The 1907 Hague Regulations, in turn, specify that “it is especially forbidden [t]o employ poison or poisoned weapons”.⁶⁸ The Geneva Gas Protocol prohibits “the use in war of all asphyxiating, poisonous, and other gases” as well as “bacteriological methods of warfare”.⁶⁹ The determination of whether a specific weapon has been designed to cause asphyxiation, and is therefore subject to the Gas Protocol, is a question of fact.⁷⁰ During the *Nuclear Weapons* case, the United Kingdom and United States submitted to the International Court of Justice (ICJ) that the prohibition against gas warfare applies to weapons designed to injure or cause death by the effect of such poison, which would exclude those weapons that incidentally poison. The subsequent ICJ *Nuclear Weapons* Advisory Opinion states that the terms “poison” or “poisoned” must be interpreted in their ordinary sense to include weapons whose primary or exclusive effect is to poison or asphyxiate.⁷¹ Poison must, therefore, be the “intended” injury mechanism.⁷²

A thermobaric explosion produces pressure and thermal effects but also consumes and depletes the ambient oxygen and, further, generates toxic gases and smoke.⁷³ Thermobaric explosions, therefore, have the potential to cause choking, suffocation and poisoning from processes that cause burns, chemical reactions on or in the human body, and infections due to contamination.⁷⁴ The removal of oxygen from the surrounding area will be

67 Hague Declaration (IV,2) concerning Asphyxiating Gases, The Hague, 29 July 1899.

68 Hague Regulations, above note 9, Art. 23(a).

69 Gas Protocol, above note 13.

70 James Malony Spaight, *Air Power and War Rights*, Longmans, Green, London and New York, 1947, pp. 191–192.

71 ICJ, *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, 8 July 1996 (*Nuclear Weapons* Advisory Opinion), para. 55; written statements in the *Nuclear Weapons* case by the United Kingdom, para. 97, and the United States, para. 100, cited in ICRC Customary Law Study, above note 24, p. 253; DoD Manual, above note 8, para. 6.8.1.1.32.

72 ICRC Customary Law Study, above note 24, p. 253.

73 R. Weinheimer and K. Vuorio, above note 3.

74 James Fry, “Contextualized Legal Reviews for the Methods and Means of Warfare: Cave Combat and International Humanitarian Law”, *Columbia Journal of Transnational Law*, Vol. 44, No. 2, 2006, p. 458; O.-G. Iorga *et al.*, above note 53.

enhanced where thermobaric weapons are employed in confined spaces, such as caves.⁷⁵ However, thermobaric weapons are not primarily designed to asphyxiate or poison. When present, these effects are regarded as secondary or additional effects. This conclusion excludes the use of thermobaric weapons from the application of the above declarations and treaties.

The Chemical Weapons Convention

The CWC defines chemical weapons to include “[m]unitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices”. Toxic chemicals are further defined as “[a]ny chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals”.⁷⁶ However, these chemicals are not prohibited by the CWC if they are not intended for purposes that are proscribed by the Convention.⁷⁷ The Rome Statute of the International Criminal Court (ICC) describes the employment of “asphyxiating, poisonous or other gases, and all analogous liquids, materials or devices” as “serious violations” of IHL applicable to international armed conflict, and such violations are regarded as war crimes subject to the jurisdiction of the ICC.⁷⁸

The composition of the fuel mixtures in thermobaric weapons includes toxic chemical substances and chemical agents, which are selected based on exothermicity (the release of heat during a chemical reaction).⁷⁹ The presence of these substances may create a toxic environment as harmful as most other chemical agents if a secondary aerobic post-combustion ignition failure of the aerosolized explosive cloud occurs.⁸⁰ However, the mere fact that a thermobaric weapon contains chemicals does not, in itself, render it a prohibited chemical weapon in terms of the CWC,⁸¹ as thermobaric weapons are not primarily designed to produce harm by poisoning. There are also no reports that highlight any failures during the secondary combustion processes or other reliability concerns of thermobaric weapons that may render their use illegal.

75 D. Andrew, above note 3.

76 CWC, above note 16, Arts II(1)(b), II(2).

77 Matthew Aiesi, “The Jus in Bello of White Phosphorus: Getting the Law Correct”, *LawFare*, 26 November 2019, available at: www.lawfareblog.com/jus-bello-white-phosphorus-getting-law-correct.

78 Rome Statute of the International Criminal Court, 2187 UNTS 90, 17 July 1998 (Rome Statute), Art. 8(2)(b)(xviii).

79 Edward Sheridan, George Hugus, Filippo Bellomo, Daniela Martorana and Ryan McCoy, “Thermal Enhanced Blast Warhead”, Patent No. US 8,250,986 B1, 28 August 2009.

80 Defense Intelligence Agency, “Fuel-Air and Enhanced-Blast Explosive Technology – Foreign”, April 1993 (document obtained by Human Rights Watch under the US Freedom of Information Act).

81 Ian J. MacLeod and A. P. V. Rogers, “The Use of White Phosphorus and the Law of War”, *Yearbook of International Humanitarian Law*, Vol. 10, 2007.

The Convention on Conventional Weapons

The CCW creates an enabling framework, by way of individually ratified additional protocols, for the progressive banning of certain conventional weapons that are excessively injurious or that have indiscriminate effects.⁸² The CCW now includes comprehensive bans or restrictions on the use of particular weapons, including CCW Protocol III, which restricts the use of incendiaries. The ICRC Customary Law Study includes two rules on incendiary weapons that may, by analogy, be applied to the use of thermobaric weapons.⁸³ The implications of these two rules will be discussed hereunder with reference to the prohibition against causing SI/US and as it relates to indiscriminate weapons.

Incendiary weapons typically contain a solid, liquid or gel incendiary substance.⁸⁴ They are defined in CCW Protocol III as “any weapon or munition which is primarily designed to set fire to objects or to cause burn injury to persons through the action of flame, heat, or a combination thereof, produced by a chemical reaction of a substance delivered on the target”.⁸⁵ The high temperatures produced by incendiary weapons cause thermal and respiratory burns and secondary fires. The definition in Protocol III of incendiaries incorporates examples of qualifying weapons,⁸⁶ but it excludes, as incendiary weapons, those weapons “which may have incidental incendiary effects”⁸⁷ and those “designed to combine penetration, blast or fragmentation effects with an additional incendiary effect”.⁸⁸

A prohibition on the anti-personnel use of incendiaries was considered but not adopted by delegates to the CCW negotiations that produced Protocol III,⁸⁹ as the burn injuries caused by incendiary weapons were, in principle, not considered worse than injuries inflicted by other weapons.⁹⁰ The position on the anti-personnel use of incendiaries is unlikely to change, and it is thus improbable that a protocol prohibiting the use of these weapons will be adopted in the future.⁹¹ CCW Protocol III, accordingly, prohibits attacks using incendiary weapons directed at civilians or civilian objects “in all circumstances” but allows for the

82 CCW Protocol IV, above note 17.

83 ICRC Customary Law Study, above note 24, Rules 84–85.

84 Examples are white and red phosphorus, thermite and a jellied fuel mixture: S. Paunila and N. R. Jenzen-Jones, above note 7, p. 119.

85 CCW, above note 15, Protocol (III) on Prohibitions or Restrictions on the Use of Incendiary Weapons, 10 October 1980 (CCW Protocol III), Art. 1.

86 Flame throwers, fougasses, shells, rockets, grenades, mines, bombs and other containers of incendiary substances.

87 Such as illuminants, tracers, smoke or signalling systems.

88 CCW Protocol III, above note 85, Art. 1(b)(ii): “armour-piercing projectiles, fragmentation shells, explosive bombs and similar combined-effects munitions in which the incendiary effect is not specifically designed to cause burn injury to persons, but to be used against military objectives, such as armoured vehicles, aircraft and installations or facilities”.

89 W. Boothby, above note 1, p. 201.

90 *Ibid.*, p. 201.

91 *Ibid.*, above note 1, p. 201 fn. 57.

direct and deliberate use of incendiary weapons against an adversary, with some limits on the manner of delivery to a military objective.⁹²

It is reasonable to conclude, on initial scrutiny, that thermobaric weapons may violate CCW Protocol III. However, further investigation creates some doubt, specifically as the definition of incendiary weapons in Protocol III is excessively narrow (the definition also does not adequately deal with multi-purpose incendiary weapons). The focus in the definition is on the purpose for which a weapon is designed, as opposed to the impact of the weapon.⁹³ The definitional boundaries, therefore, limit the regulation of specific weapons based on how the developer, manufacturer and/or user describes the design purpose of the weapon. The phrase “primarily designed” indicates that the weapon’s primary design purpose must be directed at setting fire or causing burn injury. However, thermobaric weapons have no increased fire-starting capability compared to other high-explosive munitions.⁹⁴

The European Court of Human Rights (ECtHR) commented in the *Tagayeva* case that experiments to establish the effects of an RPO-A Shmel thermobaric rocket demolished buildings but produced no fires.⁹⁵ The applicants in *Tagayeva* argued that “thermobaric weapons were governed by the more restrictive legal regime of incendiary weapons”.⁹⁶ The Chamber, in its reasoning and based on expert evidence, highlighted the differences between conventional high-explosive, incendiary, fuel-air explosive and thermobaric munitions.⁹⁷ The Chamber found that “incendiary weapons, devices or bombs are designed to start fires or destroy sensitive equipment, using materials such as napalm, thermite, chlorine trifluoride, or white phosphorus”. Incendiary weapons “deflagrate”, while thermobaric weapons “detonate”. The Chamber therefore concluded that incendiary weapons are “primarily intended to provide sufficient heat and fuel to ignite, and possibly sustain, a fire at the target”. In contrast, thermobaric weapons are designed to “create a gross overpressure, combined with very high temperatures, such that the target suffers severe physical damage almost instantaneously”.⁹⁸

Thermobaric weapons are accordingly not primarily designed to cause fire or burns, even though they will likely or frequently produce “incendiary effects” that are substantial but “incidental” or secondary.⁹⁹ Some thermobaric munitions, such as the BLU-118/B penetrating warhead and its successor, the BLU-121/B hardened

92 CCW Protocol III, above note 85, Art. 2; Human Rights Watch, “Strengthening the Humanitarian Protections of Protocol III on Incendiary Weapons: Memorandum to Convention on Conventional Weapons, Delegates”, 22 August 2011, available at: www.hrw.org/news/2011/08/22/strengthening-humanitarian-protections-protocol-iii-incendiary-weapons.

93 Human Rights Watch and International Human Rights Clinic, *From Condemnation to Concrete Action: A Five-Year Review of Incendiary Weapons*, 6 November 2015, p. 5, available at: www.hrw.org/news/2015/11/05/condemnation-concrete-action-five-year-review-incendiary-weapons.

94 HPCR Manual, above note 24, p. 75.

95 ECtHR, *Tagayeva*, above note 50, para. 220.

96 *Ibid.*, para. 596.

97 *Ibid.*, para. 220.

98 *Ibid.*, para. 472.

99 W. Boothby, above note 1, p. 245; M. Montazzoli, above note 3.

steel warhead with a thermobaric explosive fill, are designed to achieve substantial penetration and significant blast effects for use against hard or deeply buried military objectives, such as tunnels and blast doors.¹⁰⁰ These weapons, as a result, have “additional incendiary” and “combined penetration, blast and fragmentation effects” and, as a result, escape regulation under CCW Protocol III on both counts.¹⁰¹

The definitional limitations of incendiary weapons in CCW Protocol III may, in part, be addressed by an amendment with less emphasis on the purpose for which the weapons are primarily designed. This articulation would then focus on how such weapons cause injuries through heat, and the indiscriminate effect thereof on humans. Such an effects-based modification to the definition will not be remarkable as a definition with a similar focus has already been included in Protocol I of the CCW,¹⁰² which focuses on the effect that the weapon has on humans (injury by fragments which cannot be detected by X-rays) rather than its design or purpose.¹⁰³ An effects-based definition in Protocol III would potentially implicate thermobaric weapons due to the suffering caused by the fire and heat, but no such amendment to the definition is foreseen. Ultimately, thermobaric weapons may incidentally start fires, and the use of these weapons should either be avoided or undertaken with extreme caution in civilian populated areas.

Environmental effects

Another IHL limitation that is generally applicable to the means of warfare relates to the effects of weapons on the environment, which is, in principle, considered to be a civilian object. A distinct part of the natural environment may qualify as a military objective where it, by its nature, location, purpose or use, makes an effective contribution to military action, and its total or partial destruction, capture or neutralization, in the circumstances ruling at the time, must offer a definite military advantage.¹⁰⁴ The ICJ confirmed that “[t]he environment is not an abstraction but represents the living space, the quality of life and the very health of human beings, including generations unborn”.¹⁰⁵ The 1994 *San Remo Manual on International Law Applicable to Armed Conflicts at Sea* (San Remo Manual) defines “damage to or the destruction of the natural environment” as “collateral

100 Frits Kalshoven and Liesbeth Zegveld, *Constraints on the Waging of War: An Introduction to International Humanitarian Law*, Cambridge University Press, Cambridge, 2011, p. 163; Adam Hebert, “Initial Shipment of 10 BLU-118B Warheads Expected Soon: DoD Readies ‘Thermobaric’, Cave-Clearing Bomb for Enduring Freedom”, *Inside the Air Force*, Vol. 13, No. 1, 2002, pp. 10–11.

101 CCW Protocol III, above note 85, Art. 1(b)(ii).

102 CCW Protocol I, above note 15.

103 Human Rights Watch and International Human Rights Clinic, above note 93.

104 AP I, Art. 52(2); ICRC Customary Law Study, above note 24, Rule 8. See also ICRC, *Guidelines on the Protection of the Natural Environment in Armed Conflict: Rules and Recommendations Relating to the Protection of the Natural Environment Under International Humanitarian Law, with Commentary*, Geneva, 2020 (ICRC Environmental Guidelines), p. 49.

105 Nuclear Weapons Advisory Opinion, above note 71, para. 29.

casualties” or “collateral damage”, which is prohibited where such damage cannot be justified by military necessity.¹⁰⁶

CCW Protocol III states that “[i]t is prohibited to make forests or other kinds of plant cover the object of attack by incendiary weapons except when such natural elements are used to cover, conceal or camouflage combatants or other military objectives, or are themselves military objectives”.¹⁰⁷ However, as stated above, thermobaric weapons do not qualify as incendiary weapons and are, as a result, excluded from the application of Protocol III. The 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD Convention) prohibits “military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party”.¹⁰⁸ The ENMOD Convention prohibits the conversion of the environment itself into a weapon to cause harm to an adversary, but it applies only to situations where the destruction, damage or injury is caused to another State Party.

AP I provides that “[i]t is prohibited to employ methods or means of warfare which are intended, or may be expected, to cause widespread, long-term and severe damage to the natural environment”.¹⁰⁹ AP I also requires that the natural environment should be protected during armed conflict “against widespread, long-term and severe damage”, and that this protection includes a prohibition against methods or means of warfare which may “prejudice the health or survival of the population” due to damage to the natural environment.¹¹⁰ AP I applies to weapons that have extreme effects on the environment, and the thresholds of “widespread”, “long-term” and “severe” are cumulative as all these requirements must exist for the rule to be breached. The language of the Rome Statute also uses similar terminology where it prohibits intentional attacks that may cause damage to the natural environment, which would be “excessive in relation to the concrete and direct overall military advantage anticipated”.¹¹¹ These prohibitions are considered to be customary international law.¹¹² At the Diplomatic Conference that adopted AP I, some States considered the phrase “long-term” to refer to damage that extends over decades. The Commentary to AP I also states that the threshold would probably be breached only where the damage would likely threaten the “continued survival of the civilian population or would risk causing it major health problems”.¹¹³ It is thus reasonable to conclude that the use of thermobaric weapons, in accordance

106 Louise Doswald-Beck (ed.), *San Remo Manual on International Law Applicable to Armed Conflicts at Sea*, Cambridge University Press, Cambridge, 1995 (San Remo Manual), para 13(c), 44.

107 CCW Protocol III, above note 85, Art. 2(4).

108 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, 31 UST 333, 1108 UNTS 151, 10 December 1976, Art. 1.

109 AP I, Art. 35(3).

110 *Ibid.*, Art. 55(1).

111 Rome Statute, above note 78, Art. 8(2)(b)(iv).

112 ICRC Customary Law Study, above note 24, Rule 45; HPCR Manual, above note 24, Rule 89.

113 Yves Sandoz, Christophe Swinarski and Bruno Zimmermann (eds), *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, ICRC, Geneva, 1987, para. 1454.

with their primary design purpose, will not achieve the cumulative threshold requirements set in AP I.¹¹⁴ The provisions of the ENMOD Convention and AP I, with regard to the effects of these weapons on the environment, are thus likely to be of peripheral or no relevance to thermobaric weapons.

General principles of international humanitarian law: The right to choose methods or means of warfare

There is, at present, no specific treaty that prohibits blast weapons, and none that are specifically focused on thermobaric weapons. States are, therefore, allowed to develop and use thermobaric weapons, provided they comply with other applicable rules of IHL. It is thus also necessary to consider the customary rules of IHL,¹¹⁵ with specific reference to the prohibition against causing SI/US and the further prohibition against the use of indiscriminate weapons.¹¹⁶ The application of these “primary” principles is associated with and influenced by “further” principles such as military necessity, humanity,¹¹⁷ distinction¹¹⁸ and proportionality.¹¹⁹

The prohibition against superfluous injury or unnecessary suffering

Military necessity dictates that a belligerent is allowed to employ only the measures necessary and lawful to expeditiously and effectively achieve the complete submission of the adversary with the minimum possible loss of resources.¹²⁰ The 1863 Lieber Code, accordingly, states that “[m]ilitary necessity does not admit of cruelty – that is, the infliction of suffering for the sake of suffering”;¹²¹ there are, therefore, limits to military necessity, as the infliction of suffering for the sake of suffering or revenge is regarded as an “intolerable encroachment of humanity”.¹²² The preamble to the St Petersburg Declaration¹²³ thereafter provided the initial articulation of military necessity and the prohibition against SI/US by confirming the existence of a threshold beyond which further suffering would be unnecessary and useless.¹²⁴ The preamble specifically states that “the progress of civilisation

114 See ICRC Environmental Guidelines, above note 104.

115 ICRC Customary Law Study, above note 24. see also HPCR Manual, above note 24; Michael N. Schmitt (ed.), *Tallinn Manual on the International Law Applicable to Cyber Warfare*, Cambridge University Press, Cambridge, 2013; Tallinn Manual 2.0, above note 24.

116 Christopher Greenwood, “Historical Development and Legal Basis”, in Dieter Fleck and Michael Bothe (eds), *The Handbook of International Humanitarian Law*, Oxford University Press, Oxford, 2008, p. 11.

117 See ICJ, *Corfu Channel Case (United Kingdom v Albania)*, [1949] ICJ 4, 1949, p. 22.

118 ICRC Customary Law Study, above note 24, Rules 70, 71.

119 Nuclear Weapons Advisory Opinion, above note 71; Tallinn Manual 2.0, above note 24, Rule 20, para. 75.

120 William Fenrick, “New Developments in the Law Concerning the Use of Conventional Weapons in Armed Conflict”, *Canadian Yearbook of International Law*, Vol. 19, 1981, p. 230.

121 *Instructions for the Government of Armies of the United States in the Field*, US Army General Order No. 100, 24 April 1863 (Lieber Code), Art. 16.

122 *Ibid.*, Arts 5, 6; F. Kalshoven and L. Zegveld, above note 100, p. 203.

123 St Petersburg Declaration, above note 11.

124 Frits Kalshoven, *Reflections on the Law of War*, International Humanitarian Law Series, Martinus Nijhoff, Leiden, 2007, Preamble; Robert Kolb and Momchil Milanov, “The 1868 St Petersburg Declaration on

should have the effect of alleviating as much as possible the calamities of war”, and, in addition, that the only legitimate object which States should pursue during armed conflict is to weaken the military forces of the adversary by disabling “the greatest possible number of men”. The only legitimate objective during armed conflict is, as a result, limited to rendering a belligerent *hors de combat* in order to “weaken the military forces of the enemy” and eventually subdue the adversary’s will to continue with the hostilities.¹²⁵ It would therefore be “contrary to the laws of humanity” to employ weapons that unnecessarily aggravate suffering or that would render the death of belligerents “inevitable”.¹²⁶ Thermobaric explosions, especially in confined spaces, distribute and fill the entire lethal area with a fuel mixture, potentially resulting in the “inevitable death” of everyone within the blast zone.¹²⁷ However, the notion of “inevitable death” may no longer be relevant in contemporary IHL as the principle was not incorporated into the language of AP I.¹²⁸

Numerous subsequent IHL instruments and treaties have refined and confirmed the prohibition against causing SI/US.¹²⁹ The 1874 non-binding Brussels Declaration,¹³⁰ and later, in treaty form, the Hague Regulations of 1899 and 1907,¹³¹ and AP I, confirm that the parties to an armed conflict do not possess unlimited power to adopt any means of warfare.¹³² The Hague Regulations and AP I specifically prohibit, as a cardinal principle of IHL,¹³³ the employment of means and methods of warfare that are calculated to cause SI/US beyond that which is required to accomplish the destruction of material or rendering combatants *hors de combat*.¹³⁴ The phrase “calculated to cause” implies an element of deliberate design and, therefore, weapons that incidentally, unintentionally or accidentally inflict superfluous injury would probably not

Explosive Projectiles: A Reappraisal”, *Journal of the History of International Law*, Vol. 20, No. 4, 2019, p. 520; Hans-Peter Gasser, “A Look at the Declaration of St Petersburg of 1868”, *International Review of the Red Cross*, Vol. 33, No. 297, 1993, p. 513.

125 R. Kolb and M. Milanov, above note 124, p. 518.

126 St. Petersburg Declaration, above note 11.

127 *Ibid.*, Preamble; R. Kolb and M. Milanov, above note 124, p. 155.

128 R. Kolb and M. Milanov, above note 124, p. 528. See, in general, Emily Crawford, “The Enduring Legacy of the St Petersburg Declaration: Distinction, Military Necessity, and the Prohibition of Causing Unnecessary Suffering and Superfluous Injury in IHL”, *Journal of the History of International Law*, Vol. 20, No. 4, 2019.

129 Nuclear Weapons Advisory Opinion, above note 71; ICRC Customary Law Study, above note 24, p. 237; Henri Meyrowitz, “The Principle of Superfluous Injury of Unnecessary Suffering”, *International Review of the Red Cross*, Vol. 34, No. 299, 1994, p. 103.

130 Project of an International Declaration Concerning the Laws and Customs of War, Conference of Brussels, 27 August 1874 (Brussels Declaration), Art. 12.

131 Convention (II) with Respect to the Laws and Customs of War on Land and Its Annex: Regulations Concerning the Laws and Customs of War on Land, The Hague, 29 July 1899, Art. 22; Hague Regulations, above note 9, Art. 22.

132 St. Petersburg Declaration, above note 11, preambular paras 3–6; Brussels Declaration, above note 138, Art. 13(e); Hague Regulations, above note 9, Art. 22; ICRC Customary Law Study, above note 24, Rule 17; AP I, Art. 35(1); Gary Solis, *The Law of Armed Conflict: International Humanitarian Law in War*, Cambridge University Press, Cambridge, 2011, pp. 269–272.

133 Nuclear Weapons Advisory Opinion, above note 71, paras 74–87.

134 Hague Regulations, above note 9, Art. 23(e): “It is especially prohibited ... [t]o employ arms, projectiles, or material of a nature to cause superfluous injury”; AP I, Art. 35(2): “It is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering.”

violate this principle. AP I, however, uses different terms where it states that it is “prohibited to employ weapons, projectiles and materials and methods of warfare of a nature to cause superfluous injury or unnecessary suffering”.¹³⁵ The 1913 Manual of the Laws of Naval War,¹³⁶ the CCW,¹³⁷ the CWC¹³⁸ and the 1997 Ottawa Convention on Anti-Personnel Mines¹³⁹ also confirm the principle prohibiting SI/US.

The San Remo Manual states that it “is forbidden to employ methods or means of warfare which are of a nature to cause superfluous injury or unnecessary suffering”.¹⁴⁰ The 1993 Statute of the International Criminal Tribunal for the former Yugoslavia (ICTY)¹⁴¹ provides that the Tribunal possesses the jurisdiction to prosecute persons violating, among other things, the prohibitions against poisonous weapons or other weapons calculated to cause unnecessary suffering. The ICJ, in its Nuclear Weapons Advisory Opinion, commented that the Martens Clause “has proved to be an effective means of addressing the rapid evolution of military technology”, with specific reference to weapons that cause unnecessary suffering and “harm greater than that unavoidable to achieve legitimate military objectives”.¹⁴² Article 8(2)(b)(xx) of the Rome Statute specifically states that the use of means and methods of warfare that cause SI/US or which are inherently indiscriminate qualifies as a war crime in international armed conflicts.¹⁴³ However, the purpose of this provision has effectively been defeated as States Parties have failed to adopt the required annex listing those means and methods of warfare that would cause the harm described in Article 8(2)(b)(xx). Rule 70 of the ICRC Customary Law Study expresses the customary rule that the “use of means and methods of warfare of a nature to cause superfluous injury or unnecessary suffering is prohibited”.¹⁴⁴

The prohibition against SI/US has arguably become increasingly irrelevant as the application of the principle in practice and the determination of any violations thereof are vague and complicated.¹⁴⁵ It is not possible to measure by medical means what the threshold of SI/US is, and there is, as a result, no agreed-upon objective standard to determine or define SI/US.¹⁴⁶ These limitations have resulted in disagreements regarding the exact scope, significance and operational limits

135 *Ibid.*, Art. 35(2) (emphasis added).

136 Manual of the Laws of Naval War, Oxford, 9 August 1913, Art. 16(2).

137 CCW, above note 15, Preamble; CCW, above note 15, Protocol (II) on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices, 3 May 1996, Art. 3(3).

138 By implication as the CWC, in its preamble, “reaffirms principles and objectives of and obligations assumed under the Geneva Protocol of 1925”.

139 Ottawa Convention, above note 18, Preamble.

140 San Remo Manual, above note 106, para. 42(a).

141 Statute of the International Criminal Tribunal for the former Yugoslavia, UN Doc. S/RES/827, 25 May 1993, Art. 3(a).

142 Nuclear Weapons Advisory Opinion, above note 71, para. 238.

143 Rome Statute, above note 78, Art. 8(2)(b)(xx).

144 ICRC Customary Law Study, above note 24, pp. 237–244; Nuclear Weapons Advisory Opinion, above note 71, para. 78.

145 Elvira Rosert, “The Prohibition of Unnecessary Suffering in International Humanitarian Law: Norm Erosion, Contestation, and Permissive Effects”, paper presented at the 12th Pan-European Conference on International Relations, Prague, 12–15 September 2018.

146 G. Solis, above note 132, p. 272.

imposed by the prohibition against SI/US.¹⁴⁷ States have nonetheless included specific weapons in their military manuals that are considered to violate the prohibition against SI/US. These manuals list chemical, biological and bacteriological weapons, weapons that injure by non-detectable fragments, dum-dum bullets, hollow-point weapons or other projectiles with expanding heads, poison, anti-personnel mines, blinding laser weapons, and explosive traps when used in the form of an apparently harmless portable object.¹⁴⁸ The existence of such a list may seem counter-intuitive as the purpose, or use, of all weapons may, by design or chance, cause severe injury, suffering and death.¹⁴⁹ However, IHL prohibits only those weapons that cause superfluous injury or suffering that is unnecessary. The terms “superfluous” and “unnecessary” indicate that the use of a less harmful alternative weapon should be employed where such a weapon is available. Rule 85 of the ICRC Customary Law Study refers to incendiary weapons, but this rule may be applied to the use of thermobaric weapons by analogy. Rule 85 prohibits the “anti-personnel” use of incendiary weapons “unless it is not feasible to use a less harmful weapon to render a person *hors de combat*”.¹⁵⁰ This rule may be interpreted as “a specific application” of the prohibition against SI/US,¹⁵¹ as the use of incendiary weapons and, by analogy, thermobaric weapons amounts to the infliction of additional and unnecessary suffering where a less harmful weapon is available that could render the adversary *hors de combat*.¹⁵² The phrase “less harmful” has been interpreted to mean “less painful” or “less long-lasting”.¹⁵³ This interpretation, however, adds little to the debate on the legality of the use of thermobaric weapons as IHL, in general, requires that a less harmful available weapon to achieve the military purpose must be used, failing which the use of the weapon would amount to the infliction of SI/US.¹⁵⁴

The accepted test to determine whether a weapon violates the prohibition against SI/US aims to establish whether a weapon, when used for its intended purpose and with reasonable foresight, will result in increased suffering that

147 Y. Sandoz, C. Swinarski and B. Zimmermann (eds), above note 113, p. 403.

148 Australia, *The Law of Armed Conflict: Commanders' Guide*, Australian Defence Force Publication, Operations Series, ADFP 37 Supplement 1 – Interim Edition, 7 March 1994, paras 306, 308, 309; Australia, *The Manual of the Law of Armed Conflict*, Australian Defence Doctrine Publication 04.6, Australian Defence Headquarters, 11 May 2006, para. 4.20; France, *Fiche didactique relative au droit des conflits armes*, annexed to Directive No. 147 of the Ministry of Defence, 4 January 2000, p. 6; France, *Manuel de droit des conflits armes*, Ministry of Defence, Office of the Law of Armed Conflict, 2001, p. 54; Germany, *ZDv 15/1: Humanitäres Völkerrecht in bewaffneten Konflikten – Grundsätze*, DSK VV230120023, Federal Ministry of Defence, June 1996, para. 305.

149 Yoram Dinstein, *The Conduct of Hostilities under the Law of International Armed Conflict*, Cambridge University Press, Cambridge, 2004, p. 62.

150 ICRC Customary Law Study, above note 24, Rule 85.

151 Jean-Marie Henckaerts, “Customary International Humanitarian Law: A Rejoinder to Judge Aldrich”, *British Yearbook of International Law*, Vol. 76, No. 1, 2005, p. 531.

152 W. Boothby, above note 1, p. 201.

153 George Aldrich, “Customary International Humanitarian Law: An Interpretation on Behalf of the International Committee of the Red Cross”, *British Yearbook of International Law*, Vol. 76, No. 1, 2005, p. 521.

154 ICRC Customary Law Study, above note 24, Rule 85.

serves no military purpose and is also substantially disproportional or excessive compared to that caused by available lawful alternative weapons which are sufficiently effective in achieving the intended military advantage.¹⁵⁵ The ICRC interprets this test to focus on the design-dependent nature of the foreseeable injury caused by the weapon and whether such injury is more than what is necessary to render a combatant *hors de combat*.¹⁵⁶ It would thus, by necessary implication, be unlawful to use a weapon if it is of a nature to occasion additional injury or suffering for which there is no corresponding military purpose. The emphasis is therefore not on the subjective bodily sensation of the victim but on the presence or lack of military advantage from the use of the weapon. The practical application of the prohibition against SI/US with regard to thermobaric weapons thus requires some deliberation on alternative methods for securing a military advantage or achieving a military purpose for which thermobaric weapons would ordinarily be used.¹⁵⁷

Each weapon should be assessed based on its individual effects and its expected average injury and suffering.¹⁵⁸ Thermobaric weapons, when used as intended, may indeed cause severe injuries and extreme suffering, but when evaluated in isolation, the increased lethal effects will not render these weapons unlawful.¹⁵⁹ The purpose for which thermobaric weapons were developed was, and still is, to achieve a specific military advantage, especially when these weapons are employed to defeat hard targets and subterranean objectives – States have concluded that the heat and pressure effects of thermobaric explosions cannot be obtained using an available alternative current inventory weapon without substantial collateral damage and suffering.¹⁶⁰ As a result, a ban on the use of thermobaric weapons would contradict prevailing military judgement on the military advantages that these weapons offer. Some States may also, in the absence of an express treaty law prohibition concerning a particular weapon, challenge the illegality of a particular weapon based on the prohibition against SI/US alone.¹⁶¹ It is, accordingly, inappropriate to assume that the use of thermobaric weapons would inevitably breach the prohibition against SI/US.

155 Isabelle Daoust, Robin Coupland and Rikke Ishoey, “New Wars, New Weapons? The Obligation Of States to Assess the Legality of Means and Methods of Warfare”, *International Review of the Red Cross*, Vol. 84, No. 846, 2002, p. 354; W. Boothby, above note 1, p. 51; David Turns, “Weapons in the ICRC Study on Customary International Humanitarian Law”, *Journal of Conflict and Security Law*, Vol. 11, No. 2, 2006; W. Fenrick, above note 120, p. 500; W. Hays Parks, above note 35, p. 536; William Boothby and Wolff Heintschel von Heinegg, *Nuclear Weapons Law: Where Are We Now?*, Cambridge University Press, Cambridge, 2022, p. 155.

156 HPCR Manual, above note 24, fn. 116.

157 See W. Boothby and W. von Heinegg, above note 156, p. 155.

158 W. Boothby, above note 1, p. 225.

159 Y. Dinstein, above note 149, p. 65; W. Boothby, above note 1, p. 234.

160 National Research Council of the National Academies, *Advanced Energetic Materials*, National Academies Press, Washington, DC, 2004, p. vii; Eddie Lopez, “Will Thermobaric weapons Overwhelm the Military Health System?”, US Army College, 2018, available at: <https://warroom.armywarcollege.edu/articles/will-thermobaric-weapons-overwhelm-the-military-health-system/>; Richard Wallwork, “Artillery in Urban Operations: Reflections on Experiences in Chechnya”, master’s thesis, Faculty of the US Army Command and General Staff College, Fort Leavenworth, KS, 2004, p. 86.

161 HPCR Manual, above note 24, p. 59; Y. Dinstein, above note 149, p. 61.

The prohibition against indiscriminate and disproportionate attacks and indiscriminate weapons

The question of whether one method of harming humans with the use of a particular weapon, such as a thermobaric weapon, is inherently more inhumane and thus unacceptable, as opposed to the harm caused by another weapon such as a conventional explosive weapon, is subject to interpretation and may not, therefore, produce a definitive answer. The more proximate question is whether a weapon with a wide blast radius and effects is inherently indiscriminate. It is important to acknowledge the basic distinction between an indiscriminate weapon and an indiscriminate attack, even though the attack and the weapon used to prosecute the attack cannot be practically separated. Indiscriminate attacks do not refer to weapons that are, *per se*, unlawful, as the focus is on the unlawful use of the weapon.¹⁶² Indiscriminate attacks may conceivably be realized with the use of most weapons where the rules of targeting are not respected.¹⁶³ It must also be noted, however, that the determination of the legality of any weapon may include a presumption that the weapon operator will comply with the law of targeting.¹⁶⁴ The potential indiscriminate nature of thermobaric weapons, as opposed to the assessment of indiscriminate attacks, thus offers a more appropriate opportunity to logically assess the legality of these weapons.

Article 51(4) of AP I, which deals with indiscriminate attacks, includes reference to weapons that are unlawful by nature because they are incapable of compliance with the principle of distinction or the prohibition against SI/US.¹⁶⁵ There is no accepted definition of what constitutes a weapon that is “by nature indiscriminate”,¹⁶⁶ but AP I records that indiscriminate weapons are those which cannot, due to their nature, be directed at a specific military objective, or the effects of which cannot be limited as required by AP I, and which, under these circumstances, are of a nature to strike civilians, civilian objects and military objectives without distinction.¹⁶⁷ This rule is mainly concerned with the lawfulness of the weapon since its focus is on the inherent characteristics of the weapon as opposed to the indiscriminate nature of the particular attack, which is

162 AP I, Art. 51(5).

163 R. Weinheimer and K. Vuorio, above note 3.

164 Lauren Sanders and Damian Copeland, “Developing an Approach to the Legal review of Autonomous Weapons”, *ILA Reporter*, 27 November 2020, available at: <https://ilareporter.org.au/2020/11/developing-an-approach-to-the-legal-review-of-autonomous-weapon-systems-lauren-sanders-and-damian-copeland/>.

165 AP I, Art. 51(4): “Indiscriminate attacks are prohibited. Indiscriminate attacks are: ... b) those which employ a method or means of combat which cannot be directed at a specific military objective; or c) those which employ a method or means of combat the effects of which cannot be limited as required by this Protocol.”

166 ICRC Customary Law Study, above note 24, Rule 71.

167 AP I, Art. 51(4)(b)–(c); William Boothby, *Conflict Law: The Influence of New Weapons Technology, Human Rights and Emerging Actors*, TMC Asser Press, The Hague, 2014, pp. 159–160; Meron Rappaport, “IDF Commander: We Fired More than a Million Cluster Bombs in Lebanon”, *Haaretz*, 12 September 2006, available at: www.haaretz.com/2006-09-12/ty-article/idf-commander-we-fired-more-than-a-million-cluster-bombs-in-lebanon/0000017f-e033-df7c-a5ff-e27b47270000; Claude Pilloud *et al.*, *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, ICRC, Geneva, 1986, paras 1957, 1962–1966.

related to the actual activities of the user of the weapon. The rule prohibiting indiscriminate weapons has acquired customary international law status,¹⁶⁸ with corresponding prohibitions in the Rome Statute¹⁶⁹ and the military manuals of many States.

The potential classification of a thermobaric weapon as indiscriminate must, accordingly, consider the weapon's ability to engage a specific military objective and the likelihood of limiting its effects to the intended military objective. The technical performance of the specific type of thermobaric weapon under consideration is thus, by necessary implication, significant in determining whether the weapon's normal and intended use may cause it to be indiscriminate. The ICRC lists specific factors to be considered during this assessment, including the accuracy and reliability of the weapon's targeting mechanism, the effective area covered by the weapon (the extent and degree of damage and injury likely to be caused by its blast effect), whether the foreseeable effects of the use of the weapon can be limited or directed to the intended target, and whether the weapon or its effects can be controlled in time or space (the period and area over which the damaging/injurious effects will persist after the use of the weapon).¹⁷⁰ It has been argued that cluster munitions, depleted uranium munitions and anti-personnel mines cause excessive collateral damage compared to the anticipated military advantage. Thermobaric weapons have not been the subject of similar criticism.¹⁷¹

The AP I¹⁷² requirement that a weapon must be capable of being directed against a specific military objective does not require "terminal"¹⁷³ or precision guidance.¹⁷⁴ In fact, there is no explicit obligation in treaty or customary IHL that requires the use of precision-guided weapons even when such weapons are available.¹⁷⁵ However, this may change with technological advances relating to increased precision and shifting public opinion on precision attack capabilities. Variants of thermobaric weapons have been designed to be attached to unguided delivery systems,¹⁷⁶ while others are designed for precision targeting purposes. The Russian TOS-1A, for example, is a dedicated carrier of thermobaric weapons designed to deliver multiple munitions over a long distance to a wide area with

168 ICRC Customary Law Study, above note 24, Rule 71. See also Rome Statute, above note 78, Art. 8(2)(b)(xx).

169 Rome Statute, above note 78, Art. 8(2)(b)(xx).

170 ICRC Legal Review of New Weapons, above note 24, p. 946.

171 HPCR Manual, above note 24, p. 59.

172 AP I, Art. 51(4)(b).

173 The guidance applied to a guided missile between mid-course guidance and arrival in the vicinity of the target: see DoD Manual, above note 8, p. 194, read with p. 258, section 5.1.1.6.

174 HPCR Manual, above note 24, p. 61; Michael N. Schmitt, "Precision Attack and International Humanitarian Law", *International Review of the Red Cross*, Vol. 87, No. 859, 2005, p. 451; Robert Mandel, "The Wartime Utility of Precision Versus Brute Force in Weaponry", *Armed Forces and Society*, Vol. 30, No. 2, 2004, p. 171; Mark Gunzinger and Bryan Clark, *Sustaining America's Precision Strike Advantage*, Center for Strategic and Budgetary Assessments, Washington, DC, 2015, p. 7.

175 HPCR Manual, above note 24, p. 83.

176 The Russian-made Metis-M1 anti-tank missile, which launches the thermobaric 9M131FM missile, and the TOS-1A multiple rocket launcher.

dispersed effects. In contrast, the AGM-114N Metal Augmented Charge Hellfire missile, fitted with a thermobaric warhead, is designed for extreme precision.¹⁷⁷ State practice also confirms that the use of unguided bombs is in itself not indiscriminate by nature as these weapons can, depending on the area of application (uninhabited areas) or their methods of delivery in general, be successfully directed at a military objective without harming civilians or civilian objects.¹⁷⁸ In addition, the ICRC database of customary international law reveals no evidence that any State has expressly declared thermobaric weapons to be inherently indiscriminate.¹⁷⁹ As a result, all forms of thermobaric weapons are not automatically or inherently indiscriminate.

The ICTY, in the *Martić* judgment, made a weapon-specific determination regarding the self-propelled M-87 Orkan, which the Trial Chamber considered to be “an indiscriminate weapon”.¹⁸⁰ The Orkan is comparable to the TOS-1A, as both of these weapon systems are multiple rocket launcher systems designed to deliver various warheads. They are both designed as area weapons with a large fragmentation or blast radius, and they also allow for the delivery of multiple warheads and firings. Their munitions may impact or detonate anywhere within a wide area, especially where they are employed from a long firing range, as environmental conditions and their propulsion during flight may also result in an additional element of variation. However, the Orkan in the *Martić* case was deployed from its maximum range with warheads containing a payload of numerous fragmentation bomblets (cluster munitions) to produce a large dispersion pattern, as opposed to the TOS-01, which delivers a thermobaric warhead.¹⁸¹ The Trial Chamber heard expert evidence that it was not appropriate to employ the Orkan system as an indirect-fire weapon with a warhead containing cluster munitions in an urban environment. The conclusion was that it would have been more appropriate, under the circumstances, to employ an alternative weapon with “appropriate precision, and appropriate destructive force”, such as a precision-guided munition.¹⁸² The Trial Chamber, and later the Appeals Chamber,¹⁸³ therefore found that the Orkan is a “non-guided high dispersion weapon” that was predictably (“beyond doubt”) incapable of hitting specific targets.¹⁸⁴ The TOS-01, in turn, is described by its manufacturer as being

177 US Army, *2012 US Army Weapons Systems Handbook*, 2012, pp. 132–133, available at: <https://man.fas.org/dod-101/sys/land/wsh2012/132.pdf>.

178 HPCR Manual, above note 24, p. 61.

179 M. Montazzoli, above note 3.

180 ICTY, *Prosecutor v. Milan Martić*, Case No. IT-95-11-T, Judgment, 12 June 2007; Maya Brehm, *Unacceptable Risk Use of Explosive Weapons in Populated Areas through the Lens of Three Cases Before the ICTY*, Pax, Utrecht, 2014, pp. 50–57.

181 ICTY, *Prosecutor v. Milan Martić*, Case No. IT-95-11-T, Testimony of Tetsuo Itani, Public Transcript of R61 Hearing, 27 February 1996, pp. 10, 98, 103.

182 ICTY, *Martić*, above note 181, p. 112: “I would not have used an Orkan system to attack a military target in Zagreb. It is a built up area. I would have used some other system that would have provided me with appropriate precision, and appropriate destructive force.”

183 ICTY, *Prosecutor v. Milan Martić*, Case No. IT-95-11-A, Judgment (Appeals Chamber), 8 October 2008, para. 256.

184 ICTY, *Martić*, above note 180, paras 463, 472.

capable of high accuracy for an unguided rocket system, but the manufacturer also states that the impact point of the rockets will cover a target densely from a long range.¹⁸⁵ The TOS-01, despite the differences between it and the Orkan, will thus, in a similar manner, be considered indiscriminate when directed toward an urban environment.

The next inquiry that applies to all forms of thermobaric weapons relates to the ability of the user to control the enhanced blast effects produced by the thermobaric explosion. Rule 84 of the ICRC Customary Law Study, concerning incendiary weapons, states that “*particular care* must be taken to avoid, and in any event to minimise, incidental loss of civilian life, injury to civilians and damage to civilian objects” when these weapons are deployed.¹⁸⁶ It is also submitted that this rule may be applied, by analogy, to the use of thermobaric weapons. Rule 84 is similar to Article 57(2)(a)(ii) of AP I, which states that belligerents must, when attacks are considered, take “all *feasible* precautions in the choice of means and methods of attack with a view to avoiding, and in any event to minimizing, incidental loss of civilian life, injury to civilians and damage to civilian objects”.¹⁸⁷ The United Kingdom, when ratifying AP I, interpreted the term “feasible” to mean “that which is practicable or practically possible, taking into account all circumstances ruling at the time, including humanitarian and military considerations”.¹⁸⁸ Boothby suggests that the term “particular care” means that attackers must consider the particular dangers or enhanced risk associated with the use of incendiary weapons, such as the potential for firestorms or uncontrollable consequences, that would necessitate increased caution prior to the use of such weapons.¹⁸⁹

Belligerents must therefore consider the reasonably foreseeable, direct or reverberating civilian harm that may be expected to result from an attack with a specific weapon. Some forms of thermobaric weapons, as seen above with the TOS-01, have an extremely large blast and secondary fragmentation radius,¹⁹⁰ which creates a considerable destructive area surrounding the detonation point and produces victims with injuries that are difficult to treat.¹⁹¹ As with explosive

185 “TOS-1A BM-1 Soltsepek”, *Army Recognition*, 2 June 2022, available at: www.armyrecognition.com/russia_russian_army_vehicles_system_artillery_uk/tos-1a_bm-1_soltsepek_heavy_flamethrower_armoured_vehicle_technical_data_sheet_specifications.html.

186 ICRC Customary Law Study, above note 24, Rule 84 (emphasis added).

187 AP I, Art. 57(2)(a)(ii) (emphasis added); UK Ministry of Defence, *The Manual of the Law of Armed Conflict*, JSP 383, Oxford University Press, Oxford, 2004, paras 5.32.1, 5.33.4; Laurent Gisel, Palar Gimeno Sarciada, Ken Hume and Abby Zeith, “Urban Warfare: An Age-Old Problem in Need of New Solutions”, *Humanitarian Law and Policy Blog*, 27 April 2021, available at: <https://blogs.icrc.org/law-and-policy/2021/04/27/urban-warfare/>; Eirini Giorgou, “Explosive Weapons with Wide Area Effects: A Deadly Choice in Populated Areas”, *Humanitarian Law and Policy Blog*, 25 January 2022, available at: <https://blogs.icrc.org/law-and-policy/2022/01/25/explosive-weapons-populated-areas/>.

188 DoD, *Law of War Manual*, Office of General Counsel, 2012, p. 191.

189 W. Boothby, above note 1, p. 199.

190 Juliee Sharma, “Use of Explosive Weapons in Populated Area [sic] and International Humanitarian Law”, *ISIL Yearbook of International Humanitarian and Refugee Law*, Vol. 16, 2016–17, p. 179.

191 Ove Dullum, “Collateral Damage from the Use of Indirect Fire in Populated Areas – Can It Be Avoided?”, *Humanitarian Law and Policy Blog*, 5 May 2022, available at: <https://blogs.icrc.org/law-and-policy/2022/05/05/collateral-damage-indirect-fire-populated-areas/>.

weapons, these effects produced by blast weapons may further be influenced by numerous factors, such as the specific weapon's parameters¹⁹² and battlefield parameters.¹⁹³ It is, as a result, extremely difficult to accurately simulate these effects, even by way of the systematic testing of the weapon under consideration. Any estimation of the effects of the weapon would therefore probably be unreliable. Nonetheless, it is ultimately accepted that all thermobaric explosions will generally impact everything within their blast radius. Special care must accordingly be taken when there are any civilians, critical civilian infrastructure, means of livelihood or cultural sites near the intended detonation point of the weapon. As a direct consequence, these challenges will create doubt about the reliability of the mitigation measures taken to appreciably reduce the weapon's area effects and harm to civilians.¹⁹⁴ The use of thermobaric weapons, especially those with inaccurate delivery systems, should therefore be avoided in urban or populated areas.

Humanity and public opinion

Public opinion, or “the dictates of public conscience”, that regards the continued possession or use of thermobaric weapons as unacceptable may also become relevant in determining the legality of thermobaric weapons.¹⁹⁵ The Martens Clause, as codified in AP I, states that

[i]n cases not covered by this Protocol or other international agreements, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the *principles of humanity* and from the *dictates of public conscience*.¹⁹⁶

The Ottawa Anti-Personnel Mine Ban Convention pertinently refers to “the role of public conscience in furthering the principles of humanity as evidenced by the call for a total ban of anti-personnel mines”.¹⁹⁷ There are, however, numerous and even contradictory interpretations of the meaning of the Martens Clause.¹⁹⁸ The phrases “principles of humanity” and “dictates of public conscience” have been interpreted as independent legal standards for considering moral and ethical implications of

192 Including characteristics of the warhead body material, thermobaric explosive composition, mass, and initial velocity.

193 Including current conditions, terrain configuration, detonation height, impact angle, projectile impact velocity, and the final angular velocity of the projectile.

194 See E. Giorgou, above note 187; HRC Res. 28/20, 27 March 2015; R. Weinheimer and K. Vuorio, above note 3.

195 AP I, Art. 1(2).

196 *Ibid.*, Art. 1(2) (emphasis added). See also Hague Declaration II, above note 13; Protocol Additional (II) to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts, 1125 UNTS 609, 8 June 1977 (entered into force 7 December 1978); CWC, above note 16; Nuclear Weapons Advisory Opinion, above note 71, para. 55.

197 Ottawa Convention, above note 18, Preamble.

198 Antonio Cassese, “The Martens Clause: Half a Loaf or Simply Pie in the Sky?”, *European Journal of International Law*, Vol. 11, No. 1, 2000, p. 188.

weapons compliance, particularly where no regulations on the matter exist¹⁹⁹ and where a particular weapon receives strong public disapproval.²⁰⁰ However, the Clause has also been regarded as merely an interpretative guide through which IHL is applied during armed conflict.²⁰¹ Meron, as a result, argues that the significance of the two phrases has diminished over time. Consequently, the principles of humanity and the dictates of public conscience will, except in remarkable instances and where general agreement exists, not cause a particular weapon to be unlawful.²⁰²

Public opinion may, however, influence the conduct of hostilities during armed conflict – an intense dislike of a particular weapon by the public, in general, may become a significant consideration in the development of weapons law. That said, public opinion on thermobaric weapons, unlike the previous campaigns to prohibit landmines and cluster munitions, cannot be regarded as an extreme or uncontested instance where the dictates of public conscience alone have created enough impetus to delegitimize the use of such weapons.²⁰³ Public sentiment may nonetheless change depending on the content, quantity, quality and tone of mass media coverage, relevant internet content and awareness campaigns on the nature and effects of the use of thermobaric weapons. This outcome seems improbable, however, as the public mainly receives a sanitized version of armed conflict. The reality of the violence and harm inflicted in armed conflict is also generally presented with jargon, euphemisms, acronyms and fabrications. The specific manner in which language is employed by those reporting on an armed conflict may, as a result, diminish the perception of the degree of actual violence and suffering or may even suggest a conflict of sterile precision with the use of terms such as “surgical strikes” and “precision bombings”.²⁰⁴

Conclusion

Thermobaric weapons generate blast that is primarily designed to cause damage and harm through negative overpressure and secondary harm due to fragmentation,

199 Bonnie Docherty, “Statement to Convention on Conventional Weapons Group of Governmental Experts on Lethal Autonomous Weapons Systems”, Human Rights Watch, 26 March 2019, available at: [https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_-_Group_of_Governmental_Experts_\(2019\)/IHL%2BGGGE%2Bstatement-3%2B26%2B19-FINAL.pdf](https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_-_Group_of_Governmental_Experts_(2019)/IHL%2BGGGE%2Bstatement-3%2B26%2B19-FINAL.pdf).

200 ICRC, *Conference of Government Experts on the Use of Certain Conventional Weapons: Report*, Geneva, 1975, p. 12, para. 36, available at: https://library.icrc.org/library/docs/DOC/DOC_00169.pdf.

201 See, in general, Jochen von Bernstorff, “Martens Clause”, *Max Planck Encyclopedia of Public International Law*, Oxford University Press, Oxford, 2009.

202 Theodor Meron, “The Martens Clause, Principles of Humanity, and Dictates of Public Conscience”, *American Journal of International Law*, Vol. 94, No. 1, 2000.

203 See, in general, *ibid.*, p. 78; Ann M. Florini (ed.), *The Third Force: The Rise of Transnational Civil Society*, Carnegie Endowment for International Peace, Washington, DC, 2000, p. 2.

204 Conor Friedersdorf, “What’s with the U.S. Media’s Aversion to Graphic Images?”, *The Atlantic*, July/August 2013, available at: <https://www.theatlantic.com/magazine/archive/2013/07/the-gutless-press/309405/>. See, in general, Stephen Thorne, *The Language of War*, Taylor and Francis, London, 2006.

thermal effects, the consumption and depletion of ambient oxygen, and the release of toxic gases and smoke. Thermobaric weapons are, therefore, extremely destructive and cause trauma that requires specialized medical equipment to treat those affected. Various international instruments prohibit or limit the use of weapons that generate asphyxiating or toxic gases, weapons that poison, chemical weapons and weapons primarily designed to be incendiary. Thermobaric weapons incorporate some toxic chemical agents and toxic substances that generate incendiary effects, but they are primarily designed as enhanced blast weapons. Thermobaric weapons are thus not prohibited by any specific treaty.

The general customary law principles and rules of IHL should also be evaluated to determine the legality of using thermobaric weapons. The relevant IHL principles include the prohibition against causing SI/US, as well as the prohibition against indiscriminate weapons. Thermobaric weapons create effects that result in severe suffering, but the pattern of injury and suffering associated with the normal intended or designed use of thermobaric weapons cannot be regarded as disproportionate to the nature and scale of the military advantage anticipated. All weapons are capable of being used indiscriminately and may, as a result, be subject to potentially unlawful methods of deployment. The prohibition and limitations against the deployment of indiscriminate weapons would therefore affect thermobaric weapons in the same manner as most other means of warfare. The use of thermobaric weapons, when directed at military objectives and accompanied by feasible precautions while limiting the weapon's effects and respecting the principle of proportionality, would accordingly be lawful.

Thermobaric weapons can also not be considered to be automatically and inherently indiscriminate, as their primary design typically incorporates the capability to engage in a precision attack against the selected military objective. The capacity to direct a thermobaric weapon at a precise aimpoint effectively achieves humanitarian benefits while also reducing the number of munitions required to effectively target the selected military objectives. Humanitarian considerations alone have therefore not resulted in the total prohibition of thermobaric weapons. Nevertheless, the application of the IHL rules governing the conduct of hostilities has progressively increased the protection of the civilian population, notwithstanding the military utility of particular weapons. There would, accordingly, be an obligation on belligerents, where thermobaric weapons are used, to minimize or avoid injury to, or incidental loss of, civilian life and damage to civilian objects, which would include damage to the natural environment. Thermobaric weapons, as with any other heavy explosive weapon, should thus, wherever possible, be avoided in urban or populated areas, as the multiple mechanisms which they employ to inflict harm, and their dispersed wide-area effects, make it extremely difficult to adequately mitigate or appreciably reduce their harmful effects on civilians.