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Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD)

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Disclaimer

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Abstract

This report contains a validated database of pollutant emission factors applicable to the disposal of energetic-containing materials through open-air burning (in burn pans) and unconfined detonation processes (OB/OD). The emission factors in the database were compiled using data from studies, which measured the quantities of particles, semivolatile organic compounds, polychlorinated dibenzo-p-dioxins and furans, toxic metals, volatile organic compounds, and inorganic gases released when 0.22 kg of energetic materials were detonated and 2.2 kg of these materials were burned in 930 m^3 chambers, called BangBoxes. Air samples from the chamber were analyzed for over 275 analytes. The actions taken in validating the database are also described along with the minimum quantification limits for each pollutant measurement system. Summary statistics were calculated and compared to the results from smaller (0.02 kg)and larger (250-3,200 kg) scale detonations and burns of energetic materials. These comparisons confirm and expand upon results from earlier studies which determined that emission factors derived from chamber-based results can be used to predict the emission products that would be released from much larger scale detonations and burns, that is, the results are scalable. These comparisons also indicate that OB- and OD-based processes can be environmentally friendly ways to dispose of many of the energetic materials in the demil inventories of the world.

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List Of Abbreviations And Terms

Abbreviations

DPG: Dugway Proving Ground, UT

LLNL: Lawrence Livermore National Laboratories

SNL: Sandia National laboratories

Definition of Terms

Blast effect: the high pressure generated by the explosion.

Brisance: the ability of an explosive to provide shock waves to shatter the target. After shattering the target, the shock wave can continue moving through the target. In this respect, brisance differs from blast effect. The blast itself can not transmit the energy through solid material without moving the target, but shock waves can.

Composite Explosive: A solid propellant comprised of an oxidizer (e.g., ammonium perchlorate) and a metallic fuel (e.g., aluminum powder) held together by a polymeric substance (e.g., polybutadiene).

Double-base Propellant: A solid propellant comprised of nitrocellulose (NC) and nitroglycerin (NG).

Emission Factor: The mass of an analyte released by a detonation or burn normalized to the energetic mass of the material (MEM) detonated. In the database, the emission factors are in terms of Kg analyte/kg MEM.

Encapsulated Energetic: An assembled energetic-containing material, such as a mine or a fuze.

Energetic: A substance, either a pure compound or a mixture of compounds, capable of undergoing a very rapid chemical change, releasing large quantities of heat and large volumes of hot gases. Includes high explosives, low explosives (propellants and pyrotechnics), incendiaries, fuse powders and thermites.

Explosive: A chemical compound or mixture which, when subjected to heat, impact, friction, shock or other suitable stimulous, undergoes a very rapidchemical reaction with the evolution of large volumes of heated gases that exert high pressures in the surrounding medium. Explosives are a subset of energetics, excluding those which do not produce large volumes of hot gases (e.g., incendiaries, fuse powders and thermites).

High Explosive: An energetic material in which the decomposition process (detonation) proceeds through the entire material at

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supersonic speed. The rate at which the decomposition process passes through the explosive is determined by the velocity of the shock wave. TNT, RDX and PETN are examples of high explosives.

Low Explosive: An energetic material in which the decomposition process (deflagration) occurs at subsonic speed. The decomposition occurs on the surface of the explosive only; there is no shock wave. Propellants and pyrotechnics are examples of low explosives.

Single -base Propellant: A solid propellant containing only nitrocellulose (NC) as the primary energetic material.

Target Analytes: The chemical species sought in the emissions from the detonations and burns, e.g., Pb, Al, acetylene. The target analytes are identified in Appendix C.

Triple-base Propellants: A solid propellant comprised of nitrocellulose (NC), nitroglycerin (NG) and nitroguanidine (NQ).

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Executive Summary

A database of emission factors applicable to the open burning (in burn pans, OB) and open detonation (OD) practices routinely used to destroy surplus or unserviceable energetic materials has been constructed and validated using emissions data from 16 energetic materials which were burned and 23 materials which were detonated in a 930 m^3 chamber called a BangBox. Both high and low explosives in bulk and assembled (encapsulated) form were detonated, but only low explosives in bulk and encapsulated forms were burned.

The database also contains emission factors from the burning of two surrogate materials, dunnage and an energetic-containing waste. The waste simulated one that would result from cleaning the processing equipment after an aluminized ammonium perchlorate (Al-AP) waste had been manufactured. The burns of these surrogate materials were initiated with diesel fuel.

A comparison of the emission factors in the database to those generated in other chamber studies and in large scale, unconfined field tests showed that all test results conformed to detonation theory. This finding indicates strongly that it should be possible to classify energetic materials into broad categories for the purpose of predicting the emission products and confirmed that chambers can be used to derive emission factors for use in predicting the emissions from unconfined detonations and burns.

Significant findings from these comparisons follow.

Findings Applicable To Both OB and OD

(1) Unconfined detonations, lightly-confined detonations and burns yield similar emission products, but the mix of products is different. If the energetic materials do not contain toxic metals, chlorine, plastic, wood or diesel fuel, the emission products will be CO_2, H_2O and N_2 along with small quantities of NOx and light hydrocarbons. Consistent with detonation theory, molecules larger than the starting molecules are not formed, even when the detonation is partially confined.

(2) The following four parameters are statistically the same across all the items detonated and burned in an unconfined state: %C as COx, %CO/COx, %N as NOx, and %NO/NOx.

(3) The emission products from most energetic materials destroyed by OB and OD processes will be adequately represented by the following analytes: CO_2, CO, NO, NO_2, total saturated hydrocarbons (e.g., ethane, propane, butane), acetylene, ethylene, propene, benzene, toluene, and particulate.

(4) Low recoveries of aluminum, lead, sulfur and chlorine were common across all detonation and burn studies used in these comparisons. In all studies 98 to 99% of the chlorine recovered was

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determined to be HCl. The high reactivity of chlorine is a likely explanation for the low recoveries. The reasons for the low recoveries for sulfur and the metals still need to be determined to more fully characterize the environmental safety of OB and OD practices.

(5) Because most of the emission products from OB and OD operations are all species commonly found in the environment, it is particularly difficult to correct for contamination of metals and semi-volatile organic compounds (SVOCs)released from the walls of the chamber or the soil by the blast wave or the rapid movement of heated air. To compensate for the sample contamination from these sources when measuring the emission products from OB and OD activities, background samples should be collected by sampling the emissions from burning or detonating a material that would not be expected to release SVOC's or metals, e.g., detonation cord and nitrocellulose.

Findings Applicable to OD Only

(1) For the unconfined detonations, the median % recovery of carbon as carbon oxides (CO_2 + CO) was 98.5%; only 1.6% of the carbon was recovered as CO. The median % recovery of nitrogen as NOx was 1.2%. The remaining nitrogen was likely converted to N_2 in conformance with detonation theory and the results from large scale detonations conducted in the tunnels at the Nevada Test Site.

(2) Detonation-based processes can be an environmentally-safe way to dispose of bulk energetic materials, particularly for those which have been recovered from assembled munitions and for which there is no commercial or military use. This is especially applicable when: (1) the detonation occurs in an unconfined or lightly-confined state; (2) the detonation goes high order; (3) the soil particles released to the atmosphere are not hazardous in their own right; and (4) the toxic metals in the energetic materials are either at concentrations low enough not to endanger the health of humans or ecosystems or, their release to the environment can be kept below these levels. Coupling OB with phytoremediation techniques could be particularly rewarding in terms of protecting human health and the environment in both the short term and long term.

(3) It is also possible that many assembled munitions could be destroyed in an environmentally safe manner using detonation-based processes, provided research can provide a better understanding on how the following variables affect the emission products: donor charge placement, stacking geometry, mass of energetic material, degree of blast confinement and the type of casing.

(4) Compared to an unconfined detonation of the same material, detonating an energetic under a soil cover (buried detonation), or under other conditions which inhibit the formation of a fireball, will cause a decrease in CO_2 and an increase in soot (free carbon), CO, light saturated hydrocarbons, acetylene, ethylene, propene, benzene and toluene. It will very likely also increase the quantities of

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undegraded or partially degraded energetic starting materials. Placing an oxygen source next to a buried energetic material will not automatically ensure that detonation will convert all the carbon in the energetic to carbon oxides.

(5) Buried detonations should be avoided whenever possible. For those situations where OB is not acceptable and blast noise control is needed, numerous, small scale detonations in chambers should be considered as an alternate to buried detonations.

Findings Applicable to OB Only

(1) The median % recovery of carbon as carbon oxides (CO_2 + CO) from the materials burned was 98.5%; only 0.2% of the carbon was recovered as CO. The median % recovery of nitrogen as NOx was 0.9%. The remaining nitrogen was likely converted to N_2 in conformance with detonation theory and the results from large scale detonations conducted in the tunnels at the Nevada Test Site.

(2) Open burning is an environmentally-safe means to dispose of single, double and triple base (organic-based) propellants when the propellants do not contain significant amounts of other combustible materials, such as diesel fuel, wood and chlorinated plastics or toxic metals. OB may be particularly appropriate for destroying energetic materials which result from steamout, water jet cutting and other demilitarization processes. Coupling OB with phytoremediation techniques could be particularly rewarding in terms of protecting human health and the environment in both the short term and long term.

(3) Open burning may also be appropriate for energetic materials containing AP, if the HCl and any metals in the energetic released could be prevented from entering the environment in quantities which could endanger the health of humans or ecosystems. Pollution control technologies that could accomplish this are available, although their suitability for this application needs to be established.

(4) Burning energetics containing plastics and chlorine in the presence of diesel fuel and wood may produce dioxins and furans.

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Chapter 1
Introduction

U.S. EPA Regulations For the Disposal of Energetic Materials

During the Cold War, the United States of America, its allies and the former Soviet Union accumulated over 9,000,000 tons of energetic materials. With the ending of the Cold War, the United States, as well as these other countries, are now faced with disposing of large inventories of these materials in an environmentally sound manner. For example, in 1997, the U.S. Department of Defense (DoD) had 450,000 tons in its "demil inventory" and the inventory has been increasing by 40,000 to 50,000 tons per year.

The four methods commonly used to dispose of unneeded energetic materials are: (1) incineration; (2) disassembly, recovery and recycling (DRC); (3) burning in pans in an open area (OB); and (4) detonating either at ground level (OD) or under a soil cover (buried OD).

Although incineration and DRC are the environmentally-preferred methods of disposal, for the following reasons, they are not suitable for disposing of many of the items already in the demil inventory or likely to enter the inventory in the near future. First, the composition of many of the materials is either unknown, unstable, obsolete or has degraded. Second, the materials cannot be safely disassembled. Third, the financial and environmental expense of developing a recovery and reuse technology for them cannot be justified based on the quantity in the demil inventory or the commercial value of the material that would be recovered. For these materials, OB and OD are the only disposal techniques currently available and, thus, they continue to be an integral part of this nation's demil programs.

In the U.S., as elsewhere, there are concerns about the impact of OB and OD-based practices on human health and the environment. In the U.S., the disposal of energetic materials by OB and OD has been regulated under the Resource Conservation and Recovery Act (Subpart X of 40CFR264)[1], since 1984. One of the major concerns is the degree to which the energetic and its associated packing or containment materials are converted to innocuous chemicals. Other concerns relate to the toxicities and dispersion in the environment of the ash, soil and chemical pollutants released and the impact of the blast waves and sound waves released.

Because of these concerns the Subpart X permits that have been issued are very restrictive in terms of the conditions under which OB and OD can be carried out and the quantities that can be destroyed at one time, and over selected periods. To obtain a Subpart X permit, a facility must, at a minimum, provide the following information to the regulatory agency. First, the identity and quantities of pollutants and debris that will be released per event and over time. Second, the

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intensity of the blast waves and sound waves that will be generated. Third, a description of how these pollutants, debris, blast waves and sound waves will be distributed in the environment. Fourth, the degree to which the health of humans and the environment may be endangered in the short term (event basis) and over the lifetime of the OB and OD program.

The Detonation Process

Explosives are the class of energetic materials normally disposed of by OB and OD procedures. Explosives fall into two general classes: high and low[2]. High explosives are energetic materials in which the decomposition process (detonation) proceeds through the entire material at supersonic speed. The rate at which the decomposition process passes through the explosive is determined by the velocity of the shock wave and not by the rate of heat transfer. Low explosives (propellants and pyrotechnics) are energetic materials in which the decomposition process (deflagration) occurs at subsonic speed. The decomposition occurs on the surface of the explosive only and there is no shock wave. The rate determining factors in the deflagration process are the rate of heat transfer into the propellant itself from the burning surface and the rate of decomposition of the propellant formulation. The rate of the heat transfer is affected by the pressure of the combustion products.

The amount of energy released by propellant burning is comparable to that released when a high explosive of that same mass is detonated; the difference is in the rate at which the energy is released. In high explosives, a fast reaction produces a very high pressure shock in the surrounding medium. This shock is capable of shattering objects. In propellants (low explosives), a lower pressure is produced that extends over a longer period of time. High explosives produce peak pressure of 36,000 to 360,000 atmospheres in less than 4 microseconds; this pressure wave radiates through the material at a velocity (detonation velocity) between 2,500 and 10,200 m/s. The detonation also produces a 2-10 second fireball (afterburn) which has initial dimensions 1.2 to 1.5 times the dimensions of the material detonated. Propellants on the other hand, seldom produce peak pressures in excess of 3,500 atmospheres. TNT, RDX, Comp B are examples of high explosives and nitrocellulose (NC) and nitroguanidine (NQ) are examples of low explosives. Nitroglycerin (NG) by itself is a high explosive, but when added to NC, it becomes part of a low explosive. For both types of explosives, the initial release of energy results from adiabatic, oxidation reduction processes, which involve oxidant (e.g., $-ONO_2$, $-NO_2$, $-NHNO_2$) and reductant (e.g., C_xH_y) radicals within the energetic material.

Cook[3] and Ornellas[4,5] have published extensively regarding the mechanisms involved when explosives are detonated and burned. The information presented in this section was taken primarily from their publications.

Cook's publication provides a very lucid, comprehensive description of

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how explosives are made and how their performance is modified by the addition of accelerators and retardants. Ornellas's publications, on the other hand, describe results from experiments conducted to derive thermodynamic codes for use in predicting the explosive performance of C,H,N,O,Al-based explosives. These studies primarily assessed the effect the following factors had on the efficiency and effectiveness of the detonation process: explosive density, purity, and particle size; degree of confinement; and type of initiating charge. One of his reports[4] presents a comprehensive summary of the results obtained from detonating 25g cylindrical pellets (6.4 to 12.7 mm diameter, 114 mm long) of 43 energetic materials in a 5.3L bomb calorimeter at Lawrence Livermore National Laboratories (LLNL). Most of the detonations were done with the calorimeter evacuated, but a few were done when the calorimeter was pressurized with either CO_2 or O_2. Some of the detonations were done with the energetic simply suspended by a string (unconfined detonation), others were done with the energetic encased in glass or metal cylinders; sometimes the ends of the cylinders were open (partially-confined detonation), but at other times they were closed (fully-confined detonation). Approximately 90 minutes after the detonation, gas samples were taken from the bomb calorimeter and analyzed for N_2, CO, CO_2, H_2, H_2O, CH_4, NO, NO_2, HCN, HCl, HF, C_2H_2, C_2H_4 C_2H_6, and CH_2O, as appropriate. The calorimeter itself was also rinsed out and the rinse analyzed for solid carbon (C_s), HCl, HF Al_2O_3, and Zr_2O_3, as appropriate.

Ornellas's studies determined the following:

(1) The major reaction products from an unconfined detonation are primarily the fully oxidized, thermodynamically-stable compounds: N_2, CO_2, and H_2O. The detonation also produces small quantities of incompletely-oxidized, combustible products such as elemental carbon (C_s or soot), CO, H_2, CH_4, NO, NO_2, HCN, HCl, HF, C_2H_2, C_2H_4, C_2H_6, and CH_2O, but, as the fireball expands all or most all of these latter products react with O_2 in the air or with each other to form CO_2, N_2, and H_2O. The oxidation (afterburn) of these initial products releases energy which helps support additional combustion. After the burning gas mass cools to about 1800° K, the reaction rates fall to a point where further chemical change takes hours or longer to occur.

(2) The actual composition of initial detonation products depends on a variety of factors; one of the most important of these is the amount and form of oxygen in the energetic molecule. If the energetic is oxygen-balanced or only slightly oxygen-deficient, most of the carbon is converted to CO_2 and most of the hydrogen is converted to H_2O at the instant of detonation. As the oxygen-balance becomes more negative, the amount of soot, CO and other incompletely oxidized products formed increases and the fireball must occur if the incompletely oxidized products formed by the detonation are to converted to CO_2, N_2, and H_2O.

(3) Generally, at least 97% of the nitrogen in the energetic is released as N_2; almost all the rest is released as NO and NO_2.

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(4) As noted above, the initial release of energy by an explosive results from an adiabatic oxidation reduction mechanism. This was dramatically demonstrated by Ornellas using a 20:80 blend (by weight) of ammonium nitrate (AN) and TNT. In his experiments, Ornellas used unlabeled AN (contains 99.8% $_{14}N$), labeled AN (contains 99.1% $_{15}N$ isotope) and unlabeled TNT (contains 99.8% $_{14}N$). In one of the experiments he made a slurry of TNT and AN in toluene, dried the slurry, blended it, sieved it through a 30-mesh screen and pressed the resulting powder into 12.7 mm diameter pellets, which he then detonated in the calorimeter. In the other experiment he detonated a 12.7 mm diameter AN pellet containing a 6.4 mm diameter core of labeled AN and an annulus of unlabeled AN. After each detonation, Ornellas measured the isotopic content of the N_2 formed, i.e., $_{14}N_{14}N$, $_{14}N_{15}N$, and $_{15}N_{15}N$. The two experiments yielded similar results, i.e., only about 13% of the nitrogen in the TNT and the AN mixed.

(5) If the oxygen in the energetic is bonded with nitrogen, the energy released upon detonation is much greater than that which is released when the oxygen is bonded to hydrogen.

(6) The composition of the initial detonation products is not greatly affected by the degree of confinement, but, the composition of the final products is affected. The more oxygen-deficient the energetic, the more the degree of confinement affects the final product mix.

(7) If an oxygen-deficient energetic is detonated in an oxygen-enriched environment, the final products will be CO_2, N_2 and H_2O. On the other hand, the products formed by detonating an energetic in an inert atmosphere (e.g., CO_2) will be essentially the same as those formed when the energetic is detonated in a vacuum, regardless of the degree the energetic is oxygen-balanced (Table 1-1). The oxygen-rich atmosphere will also yield a much higher total energy release (Table 1-1), because of the heat released when the incompletely oxidized radicals are oxidized by the oxygen.

(8) Generally, less than 20% of the Cl and F in the energetics detonated in the bomb calorimeter was recovered, but all of the Cl and F recovered was in the form of HCl and HF. The missing Cl and F were assumed to have reacted with the steel walls of the calorimeter, because they were not found in the rinse of the calorimeter.

(9) Al and Zr in the energetic were usually not quantitatively recovered, but the portion recovered was all in the oxide form.

(10) The packing density has a profound influence on the ratios of initial products formed from a detonation. For example, free-flowing loose granules do not explode as efficiently as cast explosives.

(11) As the density of a high explosive is increased, the detonation pressure and temperature also increases. On the other hand,

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when the density of a propellant is increased the detonation pressure decreases, even though the reaction (deflagration) temperature increases.

(12) A trace impurity can substantially increase or decrease the efficiency with which the detonation will occur.

(13) The manner in which the charges are placed, the priming method, and the placement of the initiating charge can influence the effectiveness of the detonation in destroying all of the energetic. The most desirable circumstance would be to assure that the explosive detonates ideally. An explosive stack with an irregular shape will usually impact much more force in the direction of the longest dimension.

The studies described above were conducted to improve the in-use performance of energetic materials. The nature of the emissions and the impact of these emission products on the health of humans and ecosystems when surplus or unserviceable energetic materials are destroyed by OB and OD processes were not addressed. These latter energetic materials frequently contain degraded or below specification grade energetics and other materials, such as asphalt, resinous shell linings, binders, cardboard, wood, metal foil, etc., which could adversely impact the efficiency of the detonation and burning processes.

Also, real world OD processes are usually not truly adiabatic, because the fireball and plume encounter a myriad of heat sinks which prematurely quench the fireball or cool the plume and therefore can hinder the oxidation of the incompletely oxidized products released by the detonation. For example, even in a truly spherical fireball having the lowest possible ratio of surface to mass of any geometrical form, the outermost layer of the expanding fireball will be in direct contact with the ambient air. Also, the expanding gases penetrate the earth under the cloud, where they are both cooled by conduction and denied access to air for further oxidation until below equilibrium maintaining temperature. Further, for noise control purposes, at many facilities the detonations are conducted under a soil cover.

Studies To Assess The Environmentally Important Emissions From OB and OD Activities

In response to public concerns about the ability of OB and OD processes to convert degraded energetics into innocuous products, the Department of Defense (DOD) began its first comprehensive study to characterize the emissions from OB and OD activities in 1984. The DOD hoped to demonstrate that OB and OD would yield emission products which were similar to those from energetics when used for their intended purpose.

In this study, helicopters equipped with commonly-used air pollutant sampling equipment measured the pollutants in the plumes released when

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900 to 5000 kg quantities of energetic materials were open burned and open detonated at DPG, UT. The results were inconclusive.[6] Few of the target compounds (analytes) were detected, but it wasn't clear if this was because they weren't present or because they were present at concentrations which were below the detection limits of the sampling equipment. Also, it was subsequently established that the helicopter frequently sampled only the outer portion of the plume and that the plume volume measurement technique was not reliable.

In 1988, the United States Army initiated a second study which had two major objectives: (1) to determine if toxic or hazardous pollutants were released when energetic materials were detonated or burned; and (2) to determine if emission factors produced by detonating and burning small quantities of energetic materials in large chambers containing ambient air would provide emission factors equivalent to those determined when large quantities of energetic materials were open-detonated and open-burned in the ambient air in the unconfined state.

Detonating and burning the energetic materials in large chambers provided DOD the opportunity to: (1) characterize ten or more energetic materials at a cost comparable to conducting field tests on one energetic material; (2) collect sufficient sample to meet the minimum quantification limits of the pollution measurement systems; (3) study the decay rates of the primary and secondary products released from detonations and burns; (4) minimize testing delays due to adverse weather conditions; and (5) obtain the minimum number of detonations and burns required to calculate statistically valid emission factors on each type of PEP material under repeatable and controlled conditions.

In this second study, 225 g quantities of flaked TNT were detonated and 2 kg quantities of two types of propellants were burned in a 930 m^3 hemispherical chamber (BangBox) at Sandia National Laboratories (SNL) in Albuquerque, NM and the emission products were measured with state-of-the-art air sampling equipment. This sampling equipment was then installed in a twin-engine, turboprop aircraft and used to sample the plumes released when 900 kg quantities of four explosives (reclaimed TNT, PBXN, Explosive D and Composition B) contained in treated wood boxes were detonated on the ground and 2,000-3100 kg quantities of four bulk propellants (M1, M6, M30 and a composite propellant) were burned in steel pans in the open at Dugway Proving Ground (DPG), UT.[7,8] Three, 2000-kg TNT detonations were also conducted with the TNT in iron cages suspended 10 m above the ground.

Based on their review of the test results, the U.S. Army concluded that the emission factors derived from the BangBox tests were: (1) more reliable and reproducible than those from the field tests; (2) were statistically equivalent to those determined from the field tests; and (3) supported the original assumption that the detonations and burns were producing emission products consistent with detonation theory. For example, the CO_2 and CO emission factors derived from the

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TNT-BangBox detonations (TNT block suspended 1 m above the floor) were the same as those from the 2000-kg, suspended, reclaimed-TNT detonation, but both were substantially higher than those from the 2000-kg surface reclaimed-TNT detonatio.n[8] In this latter detonation, the expanding gases likely penetrated the earth under the detonating TNT and some of the energy released by the detonation was lost (transferred) to the soil. The resultant "cooling" of the fireball in combination with the reduced access to O_2 prevented the complete oxidation of the incompletely-oxidized products which were released by the detonation of the severely oxygen-deficient TNT molecules.

In their test reports the Army also noted the similarity of the emission products from the BangBox and field tests across all the materials tested, i.e., the emission products were primarily: N_2 (assumed), H_2O and CO_2; particles and metals; and small quantities of CO, NO, NO_2, low molecular weight volatile organic compounds (VOCs)and a few semivolatile organic compounds (SVOCs) commonly found in the ambient air. The report also noted: (1) that the soil at DPG had a high organic content and that the soil could have been the primary source for the SVOC's associated with the detonations; and (2) that the % C Recovered as CO_2 followed detonation theory, i.e., 99% for the 900 kg suspended field detonations (no detonation energy losses to soil), 97.5% for the 0.2 kg detonation in the BangBox and 95% for the 900 kg surface field detonations.[8]

In 1992, the U.S. EPA concurred with the Army's conclusion and agreed to accept BangBox derived emission factors for energetic materials as representative of those that would be derived through ground level, open-air tests. The Army then installed a BangBox at DPG identical to the one at SNL and initiated a program to characterize the compounds released when a wide variety of bulk and assembled munitions representative of those in the demil inventory were destroyed by OB and OD.

BangBox Study Results Used To Construct Database

Seven studies to characterize the emissions from the detonation and burning of energetic materials have now been conducted in BangBoxes. In these studies, 16 energetic materials have been burned and 23 have been detonated under conditions representing standard, unconfined OB and OD disposal practices. Since the seven studies used similar sampling and analysis procedures and had extensive documentation on what was done, it was possible to develop and validate the database of emission factors described in this report.

The database also includes the results from two special experiments. One experiment involved burning a surrogate dunnage to determine the contribution the burning dunnage makes to the emissions when it is used to initiate or support burning of an energetic material.

The other experiment involved using bags of water to suppress the detonations of two, TNT-based energetic materials, amatol and tritonal. These suppressed detonations were done primarily to assess how

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detonating an energetic under a soil cover could change the emission products compared to detonating the same weight of the energetic material on the ground. (As mentioned above, buried detonations are frequently used in the U.S. to mitigate the sound and blast waves released by the detonation.) Amatol and tritonal were selected for this experiment because they represent two extremes in the oxygen content of commonly used explosives. When detonated, amatol, an oxygen-balanced explosive, contains sufficient oxygen to convert its C and H to CO_2 and H_2O, whereas tritonal contains only 20% of the oxygen required to convert all its carbon to CO2 and H_2O.

These suppressed detonation experiments were also done to provide some robust emission factors for a blast and noise suppression technology developed in the U.S.[9], but refined in Europe[10,11] and South Africa [12]. The technology involves detonating munitions in contact with plastic bags containing water. This technology reduces the blast noise by more than 90% when compared to an equivalent unrestricted detonation[10]. However, the water also quenches the fireball which, based on the amount of sooty particulate found after the detonation, reduces the overall destruction efficiency of the detonation process.

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Table 1-1. Distribution of Carbon in Emission Products from Detonating TNT in Different Atmospheres in Bomb Calorimeter[a].

	Calorimeter Atmosphere		
	Vacuum	CO_2 (1.66 Atm.)	O_2 (2.46 Atm.)
Total Energy Released (kcal/mol)	1093	1116	3575
% C Recovered as CO_2	18	17	97
% C Recovered as CO	28	29	5
% C Recovered as(soot)	52	52	Not Detected
Total % Carbon Recovered	98	98	102

a.) Data taken from Table 44 on page 77 of Reference 4.

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Table 1-2. Heats of Reaction (kcal/mol) for Selected Gas Phase Reactions at 1 Atmosphere and 298° K

REACTANTS		PRODUCTS	HEATS OF REACTION
$C + \frac{1}{2} O_2$	=	CO	-26
$C + O_2$	=	CO_2	-94
$CO + \frac{1}{2} O_2$	=	CO_2	-68
$2\ CO$	=	$CO_2 + C$	-41
$CH_4 + \frac{1}{2} O_2$	=	$CO_2 + H_2O$ (gas)	-192
$H_2 + \frac{1}{2} O_2$	=	H_2O (gas)	-58
$H_2 + CO$	=	$C + H_2O$ (gas)	-31
$\frac{1}{2} N_2 + \frac{1}{2} O_2$	=	NO	+22
$NO + \frac{1}{2} O_2$	=	NO_2	-14
$3/2\ H_2 + \frac{1}{2} N_2$	=	NH_3	-11
$NH_3 + 3/4\ O_2$	=	$\frac{1}{2} N_2 + 3/2\ H_2O$ (gas)	-78
$NH_3 + 3/2\ NO$	=	$5/4\ N_2 + 3/2\ H_2O$ (gas)	-108
$4/3\ NH_3 + NO_2$	=	$7/6\ N_2 + 2\ H_2O$ (gas)	-108
$CH_4 + 2\ NO_2$	=	$N_2 + 2\ H_2O$ (gas) $+ CO_2$	-208
$S + O_2$	=	SO_2	-71
$SO_2 + \frac{1}{2} O_2$	=	SO_3	-23
$H_2 + S$	=	H_2S	-5

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Chapter 2
Methods and Materials

Composition of the Energetic Materials Characterized

Table 2-1 identifies the materials detonated and burned in the seven studies. Table 2-1 also presents: the abbreviation used for each material in the other tables in this paper; the total weight (mass) of each energetic material (MEM) tested; and the number of times (trials) each material was detonated or burned. MEM includes the weight of all supplemental energetic materials such as blasting caps, donor charge, smokeless powder, etc. used in initiating the detonation or burn.

Tables 2-2 and 2-3 present the weights of the energetic components and Pb and Al in each material detonated and burned to the extent information is available. The abbreviations used in these tables represent the following compounds: TNT (2,4,6 trinitrotoluene); RDX (1,3,5-trinitro-1,3,5-triazacyclohexane); PETN (pentaeyrthritol tetranitrate); TETRYL (2,4,6, N-tetranitro-N-methylaniline); NC (nitrocellulose); NG (nitroglycerin); NQ (nitroguanidine); HMX (1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane); AP (ammonium perchlorate); and AN (ammonium nitrate), KN (potassium nitrate); zinc powder (Zn) and aluminum powder (Al).

Appendix A contains detailed descriptions of the compositions of each energetic material.

Description of the BangBoxes

Each BangBox sits on a concrete pad and is divided into two sections: an inflatable, 930 m^3, 16.5 m diameter hemispherical test chamber made from a flexible polyvinyl-coated polyester fabric and a 5.5 x 2.1 x 2.5 m building (airlock) with a plywood front and a wood frame covered with the same material as the BangBox. The test chamber is kept inflated by two high-capacity blowers; six fans spaced 60^0 apart circulate the air in the test chamber to produce a homogeneous pollutant mix that is sampled with instruments in the chamber and the attached air lock. The energetic materials are burned in stainless steel burn pans placed on a steel pad located in the center of the test chamber and detonated in a 1 m^3 steel-lined pit after the steel cover is removed. The test chamber is purged with air for at least 60 minutes (two air volume exchanges) between trials.

When detonations and burns are initiated, a known quantity of SF_6 is released in the chamber. The concentration of the SF_6 is then measured over the time air pollutant samples are taken and used to establish the actual volume of the chamber and the dilution of the emission products which occurred (due to the chamber blowers) between initiation of the burn/detonation and completion of sample collection. This information is used to calculate the initial concentrations of the compounds released by the burn/detonation. (The SF_6 was collected in 0.85 L Summa canisters and analyzed by a gas chromatograph equipped with a flame photometric detector (GC/FPD).

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Sampling and Analysis Procedures Used in the DPG BangBox

The following sampling equipment was located in the test chamber: (1) high volume samplers (Hi-Vol) for measuring particle mass, metals, and EPA SW846 Method 8270 semivolatile organic compounds (SVOCs); (2) Hi-Vol-based PM-10 sampler for measuring particles and metals in the respirable range; (3) EPA PS-1 samplers for measuring Method 8270 SVOCs and chlorinated dioxins and furans; (4) EPA Method 26 samplers for HCl and Cl_2.

The following sampling equipment for gases was located in the airlock attached to the chamber: (1) continuous emission monitors (CEMs) for CO_2, CO, NO, NO_2, O_3, and HCl; and (2) canisters for measuring volatile organic compounds (VOCs), CO_2, and CO.

Background samples were collected in the test chamber at the beginning of every test day, analyzed in a manner identical to the test samples, and the results used to correct the emission factors for any contribution background levels of the target compounds (analytes) made to the measured (uncorrected) emission factors.

The sampling equipment used in each study was selected based on the composition of the materials being tested and the objective(s) of the study. Table 2-4 identifies the sampling systems used in each study.

Appendix B contains a more detailed description of the actual sampling systems used and Appendix C delineates the target analytes used in the seven studies.

Sampling and Analysis Procedures Used in the SNL BangBox

The procedures used at SNL were similar to those used at DPG. The differences are: (1) particle mass was determined from the PS-1 filter; (2) the extract from the PS-1 sampler was analyzed by selective-ion SFC/MS as well as by the full scan GC/MS procedure used for the DPG BangBox samples; (3) the PS-1 samplers for dioxins and furans contained polyurethane foam rather than XAD-2; (4) samples for metals were collected on Teflon filters and analyzed using x-ray fluorescence; (5) individual VOC compounds from the canister analysis were not reported except for acetylene and benzene; and (6) two, [illegible] SVOC, two PS-1 dioxins/furans samples, two metals samples and five VOC canister samples were collected during each detonation or burn.

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Table 2-1. Energetic Materials Burned and Detonated in the BangBoxes

Study	Item	Abbreviation	MEM (g)	OB Trials	OD Trials
1	TNT (block)	TNT-SNL	230		1
	TNT (block)	TNT-SNL	230		1
	TNT (block)	TNT-SNL	230		1
	Foam-suppressed TNT OD	TNT-foam	225		1
	Double-based Propellant	Dbl-base-SNL	471	1	
	MK-6 Propellant	MK-6	448	1	
2	PBXN-110	PBXN	1064	1	
	MK-23	MK-23	1030	1	
	M-43-LOVA	M-43	1060	1	
	Smokeless Powder	Smkles-pwdr	454	1	
	Smokey Sam	Smky-sam	273	1	
3	TNT (flake)	TNT-ACC1	230		3
	20 mm HEI cartridge	20 mm	189		3
	40 mm HEI cartridge	40 mm	158		3
	M18A1 Claymore mine	Claymore	229		3
	T45E7 Adapter Booster	T45E7	193		3
4	M-9 Propellant in Bags	M-9	2406	3	
	M-1 Propellant in M-3 Bag	M-1	2273	3	
5	TNT (block)	TNT-ACC2	230		1
	Detonation Train	Det. train	178		3
	M187 Impulse Cartridge	ARD-446	215		3
	BBU-36B Impulse Cartridge	BBU-36	144		3
	Gas Generator GCU-2A	GGU-2A.	139		3
	MK-107 Impulse Cartridge	MK-107	208		3
	Signal, Red Star, M-158	M-158	239		3
	Fuze, Tail Bomb, FMU-54	FMU-54	210		3

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Table 2-1. Continued.

Study	Item	Abbreviation	MEM (g)	OB Trials	OD Trials
5	IR Flare, M-206	M-206	241		3
	Fuze, Tail Bomb, FMU-139	FMU-139	172		3
	Signal, Red Star, M43A2	M43A2	260		3
6	M31A1E1 Propellant	M31A1E1	2276	3	
	Double-based Propellant	Dbl-base-DPG	2227	2	
	Ammonium Perchlorate	AP	2270	2	
	Aluminized AP Propellant	Al-AP	1183	2	
7	Detonation Cord	Det cord	205		3
	Tritonal	Tritonal	235		3
	Tritonal With Wax	Tritonal-wax	235		3
	Amatol	Amatol	235		3
	Composition B	Comp B	235		3
	Composition B With Alum.	HBX	220		3
	H_2O-Suppressed Tritonal	Tritonal-H_2O	235		3
	Manufacturing Waste	AP-waste	1139	3	
	H_2O-Suppressed Amatol	Amatol-H_2O	235		3
	Diesel Fuel/Dunnage	Dunnage	913	3	

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Table 2-2. Weights (grams) of Energetic Materials in Items Detonated

Item	TNT	RDX	TETRYL	PETN	Al	KNO_3	AN	NC	NG
TNT	227	2							
Tritonal	182	8			46				
Tritonal-wax	173	8			43				
Amatol	114	8					113		
Comp B	86	136							
HBX	72	111			39				
FMU-139		28	126	17					
FMU-54		28	163	18					
T45E7		28	177						
ARD-446		54		32		50		53	15
BBU-36		54		32		45		28	8
MK-107		54		32		6		87	25
Det train		108		65					
M43A2		54		32					
M-158		54		32		44			
M-206		54		32					
Claymore		229							
20 mm		79						100	10
40 mm		145						7	2
Det cord				203					
GCU-2A[a]		26		15					

a Energetic composition and weight classified.

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Table 2-3. Weights (grams) of Energetic Materials in Items Burned

Item	RDX	AP	Al	Zn	KNO_3	NC	NG	NQ	HMX
Dbl-base-SNL						240	184		
M-1						1815			
M-9					36	1387	960		
Dbl-base-DPG						(a)	(a)		
M31A1E1						493	410	1245	
PBXN						16	1		924
M-43	775					38	2		
Smkles pwdr						435	23		
MK-6		381	1						
AP[b]		1946							
Al-AP[b]		821	226			4	0.2		
MK-23		800	20			28	2		
Smky-sam[b]		110		100		22	1		
AP-waste		738	140			4			

a Actual weights classified

b. Identity and weights of other energetic materials either classified or not available

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Table 2-4. Sampling Systems Used in Each Study[a]

System	Analyte	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Study 7
CEM	CO2	S	S	NA	NS	S	S	S
	CO	S	S	NA	NS	S	S	S
	NO/NO2	S	S	NA	NS	S	S	S
	SO2	S	S	NA	NS	S	S	S
	O3	S	S	NA	NS	S	S	S
	HCl	S	NS	S	NS	NS	S	S
Bubbler	HCl/Cl2	S	NS	NS	NS	NS	S	S
Canister	VOC	S	S	S	S	S	S	S
	CO/CO2	S	S	S	S	S	S	S
Hi-Vol	Mass	NS	NA	S	S	S	S	S
	SVOC/GCMS	NS	NA	S	S	S	S	S
	SVOC/SFCMS	S	NA	S	S	S	NA	NA
	Metals	S	NA	S	S	S	S	S
PM-10	Mass	NS	S	S	S	S	S	S
	Metals	NS	NS	S	S	S	S	S
PS-1	Mass	S	NS	NS	NS	NS	NS	NS
	SVOC/GCMS	S	NA	S	S	S	S	S
	SVOC/SFCMS	S	NS	NS	NS	NS	NS	NS
	Dioxins/Furans	S	NS	NS	NS	S	S	S
Teflon filter	Metals	S	NS	NS	NS	NS	NS	NS

a. S = sample taken; NS = no sample taken; NA = sample taken, results not valid or not available.

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Chapter 3
Construction and Validation of the Database

Construction of the Raw Database

A matrix was developed to accommodate all the emission factors that could exist if every study had used the complete suite of sampling systems available. This matrix was then completed using data from each study's documentation file, e.g., test design plans, final reports, field notes, calibration data, laboratory reports, QA and QC reports, etc. Instances where data were missing were identified and the reason(s) determined. Some of these reasons were: (1) no sample collected; (2) sample collected, but no emission factor calculated because the sample was determined to be invalid; and (3) only those target compounds (analytes) actually detected were specifically identified in the final report. In this latter case, the Experimental Section of that final report listed all the target analytes and, if a target analyte was not mentioned in the Results Section of that report, then the reader was to assume that it was not detected. This latter situation was common for the VOC and SVOC analytes.

In addition to the previously reported results, previously unreported results were converted to emission factors and placed in the database, except when the analyte had not been detected in any study. There were a large number of analytes in the not detected category, e.g., 103 of the 108 Method 8270 analytes and 65% of the VOCs. **Thus, if an analyte is listed in Appendix C, but is not in the database, the user of the database can safely assume that it was never detected, or if it was detected, it was not above the concentration in the associated background sample.**

After all quantitative values had been put into the database, the matrix was filled in using the following codes: (1) NS (no sample collected); (2) ND (sample collected, but analyte either not detected or not detected above background concentration); and (3) NA (sample was supposed to have been collected, but either no results were found or result had been invalidated). The emission factors were then examined to assure that the total mass of the energetic material (MEM) detonated/burned had been used in calculating each emission factor. When this was not the case, the emission factors were recalculated using the correct MEM and the corrected emission factors were then entered into the database.

The emission factors from the seven studies had been adjusted to compensate for the concentrations of the analyte in the background sample(s) taken the day of the test, hereafter designated as (EF_{BC}). The uncorrected emission factors were not reported. Since it is helpful to know the extent to which an emission factor has been adjusted for the background concentration, the concentration of each analyte measured in each background sample was converted to the equivalent emission factor for that test (EF_B) and entered in the database. In Studies 1, 5, 6, and 7 (Table 2-1), the actual volume of gas sampled was used for this

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calculation. Because the original sampling volumes were not available for the other three studies, the average volume of gas collected by the sampling systems used in Studies 5, 6 and 7 was used instead.

Two additional types of emission factors were also calculated, the minimum quantitation limit (MQL) emission factors (EF_{MQL}), which are shown in Table 3-1, and the "uncorrected (for background)" emission factors (EF_{UC}). Each EF_{MQL} was calculated by entering the laboratory-determined MQL for the analyte (expressed in units of mass/m^3) into the pollutant concentration term of the emission factor equation. Each EF_{UC} was calculated by adding the average background-corrected emission factor (EF_{BC})to the associated background emission factor (EF_B).

After these additional types of emission factors were added to the database, statistical outlier tests were done to identify anomalous values. The records associated with these values were examined to determine if there was an explanation for them being identified as an anomalous value, e.g., transcription error, misspelled word, etc. Values that could not be rejected for scientifically-defendable reasons were left in the database.

After these outlier tests were completed, it was clear that most of the uncorrected Method 8270 SVOC emission factors were considerably less than the corresponding MQL emission factors. A subsequent investigation showed that in the actual test report, these SVOC emission factors were identified as qualitative or tentative in nature; thus, they were not useful in calculating quantitative emission factors. To address this situation, it was decided to change the uncorrected emission factor (EF_{UC}) and the associated background-corrected emission factor (EF_{BC}) to ND if the EF_{BC} was less than 30% of the associated MQL emission factor.

Because Hg, As, Ni and Be were never detected above background levels, they were not included in the validated database. It was also apparent that the PM-10 mass emission factors for metals were less reproducible and sometimes were larger than the corresponding Hi-Vol values. Much of this variation likely occurred because each PM-10 mass emission factor represented a single measurement whereas each Hi-Vol value represented the average of three measurements. Also, most of the uncorrected PM-10 mass emission factors were at or below the EF_{MQL}. For the above reasons, the PM-10 mass emission factors for metals were not included in the "raw database". The PM-10 emission factors themselves, however, were included, because there wasn't an alternative source for these emission factors.

At this point, the raw database contained approximately 100,000 values. However, 80% of these values were identified as either ND, NS or NA. To facilitate the validation and statistical analysis of the database using SAS , all NS and NA values were changed to "." and all ND values were changed to "0.0E+00".

Validation of the Database

Adjustment of the Emission Factors for Metals from the Floor

Bulk explosives which did not contain any metals still yielded emission factors above the MQL emission factors for: Al, Ba, Cu, Pb, Ti and Zn. These "emission factors" likely came from metals in or on the concrete floor of the BangBox, since dust from the floor was commonly found on Hi-Vol filters collected after detonations. Thus, it was decided to use the emission factors from the bulk explosives to derive the detonation-related, background emission factors for these six metals rather than use the pre-test background samples. These detonation-related, background emission factors were calculated by averaging the emission factors for the following five bulk explosives : TNT-DPG1; TNT-DPG2; Amatol; Comp B; and Det. train. These calculations yielded the following background emission factors (g analyte/g MEM): Al (7.2E-04); Ba (3.7E-04); Cu (4.8E-04); Zn (3.8E-04) and Pb (5.9E-04). The averages were then subtracted from the individual and average trial emission factors and the uncorrected emission factors to obtain the corrected emission factors.

Comparisons Between Sampling Systems

As part of the validation effort and to remove redundant data from the database, the following comparisons were done using the average emission factor for each analyte: (1) CO/CO_2 (CEM vs canister); (2) VOC (GC/FID vs GC/MS); and (3) PS-1/GCMS vs Hi-Vol GCMS vs Hi-Vol/SFCMS. These comparisons yielded the following results.

<u>Canister vs CEM for CO and CO_2</u>: The CEM CO emission factors are statistically equivalent to the corresponding canister values at the 95% confidence level (based on a comparison of 53 paired values). In contrast, the CEM CO_2 emission factors are on the average 5% higher than the corresponding canister emission factors (based on a comparison of 48 paired values) and the CEM mean difference is statistically different from the canister mean value at the 95% confidence level. Because the canisters were also used to measure the VOC emissions, it was decided to include the canister-derived CO and CO_2 emission factors in the validated database and to include the CEM-derived values if the canister-derived values were not available.

<u>GC/FID vs GC/MS for VOCs</u>: The GC/FID emission factors for (o,m,p)-xylene, are statistically equivalent to the corresponding GC/MS values, but for the seven other VOCs (measured by GC/FID and GC/MS) the emission factors are statistically different at the 95% confidence level. For 1,3-butadiene, the GC/FID mean emission factor is 66% of the GC/MS value (based on a comparison of 12 paired values), but for the other six VOCs, the GC/FID mean values are larger than the GC/MS values. The magnitudes of these mean differences are: benzene (34% larger, 51 paired values); ethylbenzene (21% larger, 38 paired values); styrene (102% larger, 19 paired values); toluene (39% larger, 38 paired values); and 1,3,5-trimethylbenzene (130% larger, 9 paired values). On an absolute basis, however, the mean differences are small, i.e., benzene (0.00002);

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ethylbenzene (0.0000006); styrene (0.000002); toluene (0.000004); and 1,3,5-trimethylbenzene (0.000001). Since the GC/FID emission factors were larger than the GC/MS values for most compounds and GC/FID was also used for all the other VOC compounds, it was decided to include the GC/FID-derived emission factors in the validated database and to include the GC/MS-derived values only when the GC/FID values were not available.

PS-1/GCMS vs Hi-Vol/GCMS vs Hi-Vol/SFCMS: The PS-1 sampling system yielded non-zero emission factors for 5 of the 108 Method 8270 (non-energetic SVOC) target compounds. These compounds and the energetic materials they were associated with are: acenaphthalene (AP-waste); fluoranthene (AP-waste); phenol AP-waste); 2-chlorophenol (AP-waste) and diethylphthalate (BBU-36, FMU-139, MK-107, GGU and M-9).

(1) Phenol: The PS-1 sampler detected phenol only in the first of the two AP-waste burns; it also detected phenol in the background sample (at a concentration only slightly less than that measured in the burn sample) taken in the BangBox before this burn. The Hi-Vol/SFCMS system also detected phenol for only the first burn and the emission factor (3.8E-05) is essentially the same as that from the PS-1 sampling system (3.4E-05). The phenol emission factors for the AP-waste burn were excluded from the validated database for three reasons. First, it was a common component of background samples in the concentration levels equivalent to the emission factors calculated from the burn. Second, it was in the background sample for the surrogate waste burn. Third, phenol was not found in the samples from the second burn. The Hi-Vol/SFCMS sampling system did detect phenol in the detonation products from the following four energetic-containing items: ARD-446 (1.9E-06); MK-107 (8.4E-07); FMU-54 (4.7E-06); and 40mm (1.5E-06). These emission factors are very close to the MQL emission factor (2.9E-06), and, as noted above, phenol was a common constituent of the ambient air in the BangBox. Also, the PS-1 sampling system detected phenol in the background samples associated with these four items at levels which would have yielded emission factors of the same magnitude reported for these four items. Therefore, these latter phenol emission factors were not included in the validated database.

(2) Acenaphthalene and Fluoranthene: The Hi-Vol GC/MS sampling system yielded emission factors for only two of the 108 EPA-8270 compounds (acenaphthalene and fluoranthene) and both compounds were associated only with the AP-waste burn. These two compounds are normally released when diesel fuel and wood, two of the materials in the AP-waste material, are burned. These two compounds were also found by the corresponding PS-1 sampler. For acenaphthalene the average PS-1 emission factor was 1.0E-04 and the corresponding Hi-vol emission factor was 1.6E-04. Similarly, for fluoranthene the PS-1 emission factor was 2.0E-04 and the Hi-Vol value was 1.0E-04. Since it is highly likely that these are valid emission factors, the PS-1 derived emission factors were included in the validated database.

(3) 2-Chlorophenol: This compound was detected only by the PS-1

sampler during the two AP propellant burns conducted July 31, 1995. Both trials yielded the same emission factor (1.0E-05), a value approximately 30% of the MQL. Since 2-chlorophenol was not found in the associated background samples and it was not a common background contaminant, the 2-chlorophenol emission factors were included in the validated database.

(4) Diethylphthalate: Non-zero emission factors for diethylphthalate came only from the PS-1 sampler. They were associated with the four items which were detonated (BBU-36,MK-107,FMU-139 and GGU-2A) and one item which was burned (M-9). For the following reasons the emission factors associated with the four items detonated (BBU-36, MK-107; FMU-139, and GGU-2A) were included in the validated database. First, diethylphthalate was not detected in the background samples associated with these energetic materials. Second, the MQL emission factor (2.1E-04) associated with the four materials is less than the average emission factors reported for these materials. Third, it was found in almost all samples.

The emission factor from the single M-9 propellant burn was excluded from the validated database for the following reasons. First, the MQL for diethylphthalate is higher than the emission factor from the M-9 propellant burn. Second, although diethylphthalate was not found in the background sample associated with this burn, it was frequently found in background samples at levels tenfold greater than the M-9 emission factor.

Mass Balance Assessments for C, N, S, Cl, Al and Pb

Carbon Mass Balance

The carbon mass balance was conducted by calculating the total mass (weight) of carbon in the material (MEM) detonated or burned and comparing it to the mass of carbon found using the sum of the average emission factors for CO_2 and CO (expressed as their carbon equivalent values). Sufficient composition data was available to conduct the mass balance calculation for 23 of the materials detonated and burned. Only the detonation cord gave a % Conversion (210%) which differed by more than 18% from the value of 100% that was expected if all the carbon had been converted to CO and CO_2. The extremely high % Conversion value for the det. cord was unexpected because each of the three trials involved detonating 203 g of PETN with an electric blasting cap and because the emission factors for the three trials agreed so closely. A subsequent review of the raw data also showed that this material had an usually large difference between the CEM and canister values for both CO_2 and CO. It also showed that PETN was not detected in the emission from any of the three detonations. This was particularly unusual, because, when much lower quantities of PETN had been detonated (as part of donor charges), measurable quantities of PETN had been detected. For the above reasons all emission factors for the det. cord were excluded from the validated database.

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Nitrogen Mass Balance
Although N was not measured directly in the BangBox studies, there is solid scientific evidence from detonation and burn experiments on explosives where the N_2 emissions were measured directly.[4,5,13,14] The experiments described in references 13 and 14 are particularly relevant here because they involved detonating M107, 155 mm artillery rounds (965 - 2260 kg) and burning NIKE rocket motors in a 4,100 m^3 chamber. More than 99.8% of the N in the Comp B in the M107 rounds and 99.7% of the N in the NIKE's double base propellant were converted to N_2. These low %N Conversion are particularly striking when compared to those for other CHNO-based materials. For example, the percentages of N (in the fuel) converted to NOx in utility boilers firing residual fuel oil, distillate oil and coal are: 50-60%, 60-80% and 20-25%, respectively[15,16].

The N mass balance calculations used the NO and NO_2 emission factors (expressed as N) to determine how much of the N in the energetic material was converted to nitrogen oxides. Sufficient chemical composition data was available to conduct the assessment on 25 of the materials detonated and burned. The AP-waste burn, which had a % Conversion of N to nitrogen oxides of 17%, was the only material with a % Conversion of N value greater than 6%. Since all the % Conversion of N values are reasonable based on the work of Cook[3] and Ornellas[4], all the NO and NO_2 emission factors were included in the validated database.

Chlorine Mass Balance
Percent recoveries for Cl could be calculated for five energetic materials. These materials and the associated % recoveries are: AP (85%), Al-AP (102%), MK-23 (99%), MK-6 (37%) and AP-waste (60%). Since these % Recoveries are reasonable based on the work of Ornellas[4], all HCl and Cl_2 emission factors were included in the validated database.

Sulfur Mass Balance
Four of the materials detonated contained known quantities of S. These materials and their associated % Conversion to SO_2 are: M31A1E1 (28%), HBX (5%), M43A2 (5%), and M158(1%). Because no literature references on recovery of S from detonations was found, the SO_2 emission factors were included in the validated database.

Lead Mass Balance
The two materials known to contain Pb (Dbl-SNL and Dbl-DPG) yielded % Recoveries of 37% ((Dbl-DPG) and 128% (Dbl-SNL). The reason for the low % Recovery for Dbl-DPG burn is not known. (Pb was found in the residue from this latter burn, but, the quantity in the residue was not reported.) Because Pb is one of the most likely toxic compounds potentially released from OB and OD activities, the Pb emission factors were included in the validated database.

Aluminum Mass Balance
The six materials known to contain measurable quantities of Al yielded a wide range of % Recoveries. These materials and the associated % Recoveries are: tritonal (6%), tritonal-wax (9%), HBX (5%), Al-AP (7%),

AP-waste (29%) and MK-6 (60%). Although Al was found in the residue from the three burns and observed on the floor of the BangBox for the three detonations, the actual amount was never determined. Because Ornellas[4] also reported low recoveries for Al, all the Al emission factors were included in the validated database.

Energetic Material Mass Balance

The database contained non-zero emission factors for only four of the original energetic compounds: NG, HMX, RDX and PETN; all were associated with detonations. The other target energetics (including TETRYL and TNT) were never detected. However, it should be noted that sampling results for energetics were only available for the energetic materials detonated and burned in Studies 1,3,4 and 5. Air samples for energetics were also taken in Studies 6 and 7, but the samples were not analyzed because the SFC/MS unit was broken and it was not repaired until six months after the samples had been extracted. (The analytical method specified that the extract must be analyzed within 60 days after extraction). Thus, it is possible that additional energetic emission factors would have resulted had these latter samples been analyzed.

NG was associated only with detonations of energetic materials which did not contain NG and it was found in the background samples associated with these detonations. Therefore, the NG emission factors were not included in the validated database.

The PETN and RDX emission factors were included in the validated database, because they were associated only with detonations in which materials containing these energetics were used to initiate the detonation.

The emission factors for HMX were included in the validated database because: (1) the HMX was consistently detected only when RDX was also detected in the emission products; (2) military grades of RDX contain between 4 to 15% HMX by weight; and (3) with one exception, the HMX emission factors were 3 to 24% of the corresponding RDX emission factor.

Validation of Chlorinated Dioxins and Furans Results

The validation of the dioxin and furan data was difficult because of the excellent MQL_{EF} (E-10 to E-11) and the ubiquitous nature of these compounds in all environmental media[17]. Dioxin and furan samples were collected during four burns (AP propellant, aluminized AP propellant, AP-waste and diesel fuel and dunnage) and after the detonations of the M-158, M43A2 and M-206 flares.

Furans were detected only in the emissions from the AP waste burn. The five isomers (octochlorinated dibenzo-p-furan (OCDF), 1234678 HpCDF, 1234789 HpCDF, 123478 HxCDF and 123678 HxCDF) were detected at levels 100 to 1,000 times larger than the MQL emission factor (2.6E-11) and therefore, were included in the validated database. No total furan values (e.g., total HxCDF) were reported.

Octochlorinated dibenzo-p-dioxin (OCDD) was detected in the emissions

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from the detonation of the M43A2 flare and the burning of the diesel fuel and dunnage surrogate. The OCDD emission factor for the M43A2 was included in the validated database, because: (1) it was not found in the background sample; and (2) was found at levels 4 to 10 times larger than the EF_{MQL} (2.1E-10) for the three trials (detonations).

The OCDD emission factor for the dunnage burn was not included because: (1) it was found for only one of the three trials; (2) the background emission factor accounted for 70% of the corrected emission factor; and (3) the uncorrected emission factor was only 30% larger than the MQL emission factor (2.1E-10). A total HpCDD emission factor was also reported for the M43A2 detonation. It was included in the validated database, because it was found in each of the three trials (detonations) at levels which were 1.3, 2.5 and 5 times the EF_{MQL} (2.1E-10). No other dioxins were reported for any of the items tested.

Table 3-1. Representative MQL Emission Factors (kg.analyte/kg MEM)

Analyte	MQL for Detonations	MQL for Burns
HCl	9.2E-05	1.2E-05
Cl_2	4.6E-05	6.0E-06
CO_2	4.3E-07	5.5E-08
CO	4.3E-07	5.5E-08
NO	3.1E-05	3.9E-06
NO_2	4.7E-05	6.0E-06
SO_2	2.2E-05	2.8E-06
SVOCs	2.0E-04	2.6E-05
Dioxins & Furans	2.0E-10	2.6E-11
RDX, PETN & HMX	2.9E-07	3.7E-08
VOCs	4.3E-07	5.5E-08
Al	2.7E-04	3.5E-05
Sb & Ba	6.7E-04	8.6E-05
Cd	3.9E-05	4.9E-06
Cu	8.7E-05	1.1E-05
Pb	3.6E-04	4.6E-05
Ti	1.1E-05	1.4E-06
Zn	9.0E-04	1.2E-05

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Chapter 4
Overview of the Validated Database

Appendices D and E contain printouts of the BangBox-derived emission factor databases for burns and detonations, respectively. These emission factors apply to the disposal of energetic materials through OB in a pan and through unconfined, surface detonations (OD) with the following exceptions: dunnage burn; AP-manufacturing waste burn; gas generator detonation; and water-suppressed tritonal and amatol detonations. The reasons these latter materials were designated as exceptions is discussed below.

The validated database contains emission factors for 83 analytes: 7 inorganic gases; total nonmethane hydrocarbons (TNMHC); total unidentified hydrocarbons; 22 unsaturated hydrocarbons (including a total unsaturated hydrocarbons); 16 saturated hydrocarbons (including total unsaturated hydrocarbons); 10 aromatics (including total aromatics); 8 chlorinated hydrocarbons; 8 metals; 5 chlorinated furans; 1 chlorinated dioxin; 4 non-energetics SVOCs; and 3 energetic SVOCs. Most of the analytes are nonhazardous compounds commonly found in ambient air. If an analyte is listed in Appendix C, but is not in the database, the user of the database can safely assume that it was never detected, or if it was detected, it was not above the concentration in the associated background sample.

The many similarities between the emission products from detonations and burns reported earlier[7,8] are also present in the expanded database. For example, ethane, propane and isobutane were associated with almost every energetic material tested and their emission factors were usually much greater than those for the other saturated hydrocarbons. Also, almost every energetic material tested released ethylene, propene and acetylene and these three compounds represented a very substantial part of the emission factor for total unsaturated compounds.

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Chapter 5
Discussion of Results from Unsuppressed Detonations

The materials detonated in the BangBoxes without water suppression, were placed into two categories: BangBox bulk explosives and BangBox assembled (encapsulated) explosives, e.g., fuzes, flares and impulse cartridges. A third category (DPG field bulk explosives) was also created using the emission factors from the 900-kg surface detonations (TNT-Phase A, TNT-Phase B, TNT-Phase C, Comp B, Explosive D and PBXN) and the 900-kg suspended detonations conducted at DPG in 1989 and 1990.[8] The mean emission factors and associated standard deviations were then calculated for the following analytes within each category (if the data were available): total saturated hydrocarbons; ethylene, propene, acetylene, and (total of) other unsaturated hydrocarbons; benzene, toluene and (total of)other aromatics; and PM-10 (Table 5.1). The mean %C and %N converted to the corresponding oxides (COx, NOx) and the ratios $\%CO/CO_2$ and $\%NO/NO_2$ and the associated standard deviations were also calculated (Table 5.2).

These analytes were selected because they are found in the emissions from most of the materials detonated. Emission factors for individual saturated hydrocarbon compounds, such as ethane, propane and butane, were excluded for two reasons. First, these compounds are environmentally benign. Second, the background concentrations of these saturated hydrocarbons averaged approximately 50 percent of the concentrations found in the samples collected after the detonations (compared to average values of 10% and 30% for the unsaturated hydrocarbons and aromatic hydrocarbons, respectively.

The means were then subjected to a Student's t-test to determine if the means for the same ratio or analyte were statistically the same across at least two of the three categories. These t-tests determined that the means were statistically equivalent across all three categories for %C Converted to COx; %CO/COx and PM-10 mass and therefore the individual values could be combined to create larger data sets (Table 5.3).

No other means were equivalent. However, because the absolute differences between the mean values for the %N Converted to NOx were small across the three categories, the individual values were ranked from highest to lowest to see if they were sufficiently intermixed across the three data sets to justify combining them into one large data set. For this exercise, the BangBox bulk detonations, the DPG field detonations, and the BangBox encapsulated detonations were designated by the numbers 1, 2 and 3, respectively.

This ranking exercise, which is shown below, demonstrated that for all practical purposes, there is sufficient overlap of values across the three categories to rationalize combining them (Table 5.3).

%N as NOx: 3, 1, 3, 3, 3, 1, 1, 3, 1, 3, 3, 3, 1, 2, 1, 1, 2, 2, 1, 2, 2, 2, 2, 2

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As shown below, a similar ranking exercise performed on the %NO/NOx ratios also yielded results which justified combining the three data sets into one large data set (Table 5.3).

%NO/NOx: 1, 1, 1, 1, 1, 3, 1, 3, 3, 3, 3, 3, 2, 2, 3, 3, 2, 2, 2, 2, 1, 2, 2, 3, 3.

Users of the database who are estimating the emissions from a variety of energetic materials should consider using the data in Table 5.3 rather than the average CO_2, CO, NO and NO_2 emission factors in the validated database. Users should also assume that BangBox-derived PM-10 mass emission factors will likely underestimate the PM-10 emissions from detonations, since they do not include the soil particles that are entrained in the plume by the surface detonations.

On the other hand, the differences between the means for the organic analytes were too large to rationalize combining them into larger data sets. The means in Table 5.1 are normalized to the mass of the energetic material (MEM) detonated, but for some applications, having the emission factors normalized to the carbon content of the material detonated might be more appropriate. Users who need the organic analytes normalized to the carbon content of the material detonated will find this information in Table 5.4.

Other VOC Compounds

Other than benzene and toluene, styrene, a common air pollutant, was the only other aromatic found at high levels. It was found after the detonation of the Claymore mines (average emission factor of 1.7E-03) and the T-45E7 adapter boosters (average emission factor of 1.2E-04). These emission factors are likely valid, because both materials contained polystyrene (the casing of the Claymore mine contained 150g and the T45E7 contained a 31g polystyrene plug).

Sulfur and Aluminum

The low and variable recoveries for S and Al should be investigated further. It is possible that the S was converted to compounds, such as SO_3, H_2SO_4, H_2S, metallic sulfates or even free $S(S_8)$; none of which were target analytes. The low recovery of Al may be completely, or at least partly, explained by the silvery-gray residue observed on the floor after each detonation of an Al-containing material. Unfortunately, the identity and mass of this residue was never determined. However, Ornellas[4] also reported low recoveries of Al for some materials. Until the reasons for the low recoveries are determined, it would be prudent to assume that all the Al (and any other metal in the explosive detonated) is released to the environment.

Method 8270 Compounds (SVOCs)

Diethylphthalate was the only Method 8270 compound found in the detonation samples and it was associated with items which were either known to contain phthalates or were likely to contain them. Consistent with detonation theory, no SVOC's attributable to molecular rearrangement reactions of the energetic molecule were found.

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Dioxins and Furans

Furans were not detected, despite the extremely sensitive sampling and analysis method employed (MQL emission factor of 2.0E-10). One dioxin, OCDD (octochlorinated dibenzo-p-dioxin) was found (average emission factor of 1.8E-09) in the samples from the detonation of the M43A2 flare and likely resulted from the reaction of the chloride-containing compound(s) and the plastic materials in the flare.

Residual Energetics

The presence of HMX, RDX and PETN in some of the air samples collected after detonations is expected, because detonations are usually not 100.0% efficient. However, it must be noted that for most of these detonations, the ratio of the donor charge mass to the total mass (MEM) detonated was two to four times greater than that used in a routine OD activities. The emission factors in the validated database are calculated based on the total MEM detonated, rather than the actual mass of PETN and RDX used. Table 5.5 compares these original emission factors to those which result when the actual mass of PETN and RDX detonated is used to calculate the emission factors.

As noted in Chapter 3, HMX is an accepted contaminant in RDX; military-grade RDX contains between 4 to 15% HMX by weight. If the percentage of HMX in the RDX being used is known, one should consider using an emission factor for HMX derived by multiplying the RDX emission factor by the percentage of HMX in the RDX rather than using the values in the database.

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Table 5.1 Mean Emission Factors (kg Analyte/kg MEM) for Selected Analytes for Detonations

Analyte	Category	MEM (kg)	No. Of Values	Mean	Std. Dev.
PM-10	BB, Encapsulated	0.2	12	0.30	0.26
	BB, Bulk	0.2	8	0.13	0.13
Total Saturated HC	BB, Encapsulated	0.2	11	55E-06	59E-06
	BB, Bulk	0.2	7	11E-06	11E-06
Ethylene	BB, Encapsulated	0.2	11	256E-06	132E-06
	BB, Bulk	0.2	8	69E-06	130E-06
Propene	BB, Encapsulated	0.2	11	50E-06	40E-06
	BB, Bulk	0.2	8	14E-06	24E-06
Acetylene	BB, Encapsulated	0.2	11	300E-06	171E-06
	BB, Bulk	0.2	8	56E-06	70E-06
Other Unsaturated HC	BB, Encapsulated	0.2	11	61E-06	NM
	BB, Bulk	0.2	8	11E-06	NM
Benzene	BB, Encapsulated	0.2	11	69E-06	41E-06
	BB, Bulk	0.2	8	9E-06	9E-06
	Field, Bulk	900	6	69E-06	37E-06
Toluene	BB, Encapsulated	0.2	11	26E-06	12E-06
	BB, Bulk	0.2	8	4E-06	2E-06
Other Aromatics	BB, Encapsulated	0.2	11	42E-06	NM
	BB, Bulk	0.2	8	10E-06	NM

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Table 5.2 % Recoveries of C and N as the Oxides for Detonations

Parameter	Category	MEM (kg)	No. Of Values	Mean	Std. Dev.
%C as COx	BB, Encapsulated	0.2	5	100%	10%
	BB, Bulk	0.2	9	102%	10%
	Field, Bulk	900	8	96%	2%
%CO/COx	BB, Encapsulated	0.2	13	6.6%	16%
	BB, Bulk	0.2	9	0.6%	4%
	Field, Bulk	900	8	3.4%	2.0%
%N as NOx	BB, Encapsulated	0.2	8	2.9%	2.0%
	BB, Bulk	0.2	8	1.9%	1.4%
	Field, Bulk	900	8	0.6%	0.3%
%NO/NOx	BB, Encapsulated	0.2	9	69%	20%
	BB, Bulk	0.2	8	92%	18%
	Field, Bulk	900	8	55%	8.1%

Table 5.3 Emission Factor Averages Across Categories for Detonations

Parameter	No. Of Values	Median	Mean	Std. Dev.
%C as COx	22	98.55	99.6%	[illegible]
%CO/COx	30	1.60%	3.96%	11.1%
%N as NOx	24	1.20%	1.78%	1.57%
%NO / NOx	25	66.0%	71.0%	22.3%
PM-10	20	0.21	0.230	0.180

Table 5.4 Mean Emission Factors (kg Analyte/kg C in Energetic) for Selected Analytes for Detonations

Analyte	Category	No. Of Values	Mean
Total Saturated HC	BB, Encapsulated	5	117E-06
	BB, Bulk	8	14E-06
Ethylene	BB, Encapsulated	5	1302E-06
	BB, Bulk	8	239E-06
Propene	BB, Encapsulated	5	209E-06
	BB, Bulk	8	47E-06
Acetylene	BB, Encapsulated	5	1267E-06
	BB, Bulk	8	187E-06
Other Unsaturated HC	BB, Encapsulated	5	6700E-06
	BB, Bulk	8	38E-06
Benzene	BB, Encapsulated	5	231E-06
	BB, Bulk	8	32E-06
	Field, Bulk	6	244E-06
Toluene	BB, Encapsulated	5	95E-06
	BB, Bulk	8	12E-06
Other Aromatics	BB, Encapsulated	5	137E-06
	BB, Bulk	8	33E-06

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Table 5.5 Original and Adjusted Emission Factors for PETN and RDX

	PETN Emission Factors		RDX Emission Factors	
	Original	Adjusted	Original	Adjusted
FMU-139	1.7E-05	1.7E-04	3.4E-04	2.1E-03
FMU-54	9.6E-06	1.1E-04	9.0E-05	6.4E-04
T45E7	PETN Not Used	PETN Not Used	2.4E-04	1.6E-03
ARD-446	0	0	8.4E-04	3.3E-03
BBU-36	5.8E-04	2.6E-03	0	0
MK-107	5.1E-05	3.4E-03	0	0
Det. Train	5.6E-04	1.5E-03	7.4E-03	1.2E-02
M43A2	1.2E-05	1.5E-03	1.9E-04	9.1E-04
M-158	8.4E-06	6.2E-05	5.5E-05	2.4E-04
M-206	1.6E-06	1.0E-05	6.0E-05	2.5E-04
GGU-2A	4.9E-05	4.5E-04	1.4E-04	7.4E-04
Claymore	PETN Not Used	PETN Not Used	9.9E-06	1.0E-05
20-mm	PETN Not Used	PETN Not Used	1.2E-05	2.7E-05
40-mm	PETN Not Used	PETN Not Used	3.7E-05	4.0E-05
Number of Values	10	10	14	14
Median	1.45E-05	2.55E-04	1.7E-04	7.4E-04
Mean	1.28E-04	6.74E-04	6.84E-04	1.61E-03
Standard dev.	2.33E-04	8.87E-04	1.94E-03	3.14E-03

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Chapter 6
Results for Water-Suppressed Detonations

Tables 6.1 and 6.2 compare the emission factors derived from the water-suppressed detonations of amatol and tritonal to those derived from the unsuppressed detonations of these materials. The suppressed detonations were done primarily to assess in a robust manner the impact that detonating oxygen balanced (amatol) and severely oxygen-deficient (tritonal) explosives under a soil or water-blanket cover might have on the emissions. Amatol, an oxygen balanced explosive comprised of a mixture of TNT and AN, contains sufficient oxygen to convert its C and H to CO_2 and H_2O, whereas tritonal contains only 20% of the oxygen required. The water quenched the fireball (afterburn) required by the tritonal to convert its C, N and H to COx, NOx, and H_2O.

These experiments were also done to provide some robust emission factors for a blast and noise suppression technology developed in the U.S.[9], but refined in Europe[10,11] and South Africa[12]. This technology involves detonating munitions in contact with plastic bags containing water. This technology reduces the blast noise by more than 90% when compared to an equivalent unrestricted detonation[11]. However, the water also quenches the fireball which, based on the amount of sooty particulate found after the detonation, reduces the overall destruction efficiency of the detonation process.

The data in Tables 6.1 and 6.2 are consistent with the results from Ornellas.[4,5] That is, quenching the afterburn significantly increases the emissions of incompletely-oxidized species such as soot and the hydrocarbons, and sharply decreases the emissions of CO_2. The results also are in general agreement with detonation theory.[3,4,5] For example, the increase in hydrocarbons is limited to molecules which are smaller than the starting energetic molecules (Table 6.2), i.e., rearrangement into larger molecules did not occur.

The decrease in the CO_2 and increase in the CO and hydrocarbon emissions for the water-suppressed detonation of amatol (an oxygen-balanced energetic) may seem surprising, but conforms to detonation theory. That is, the oxygen balance in amatol is achieved by mixing a strong oxidizer (AN) with the oxygen-deficient TNT. Thus, for the optimum energy release from amatol, the oxidant and reductant radicals formed behind the shock wave must diffuse between two molecules in order to react with each other. In contrast, when the redox reaction occurs within the same molecule, the affect of fireball-suppression on the emissions is less severe.

The results show that placing an oxygen source in contact with the explosive molecule will not ensure an efficient detonation when it is conducted under a soil or water blanket cover. Unfortunately, there is no information on the TNT emissions which might have resulted from the water suppressed detonations, because the air samples collected for the energetic analytes were not analyzed (SFC/MS unit was broken).

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Table 6.1. Comparison of Emission Factors for Unsuppressed and Water-Suppressed Detonations of Tritonal and Amatol.

Analyte	Tritonal-H_2O (T-H_2O)	Tritonal (T)	(T-H_2O)/(T)	Amatol-H_2O (A-H_2O)	Amatol (A)	(A-H_2O)/(A)
CO_2	0.28	1.2	0.23	0.3	0.7	0.43
CO	2700E-04	29E-04	93	2.3E-04	97E-04	0.24
NO	40E-04	59E-04	0.68	77E-04	180E-04	0.43
NO_2	2.7E-04	0.3E-04	9	2.4E-04	1.2E-04	2
Ethane	120E-06	0.4E-06	300	1100E-06	4.1E-06	268
Propane	55E-06	0.7E-06	78	190E-06	0.1E-06	1900
Butane	15E-06	0.3E-06	50	52E-06	0.6E-06	87
Other Saturated HC	30E-06	8E-06	4	158E-06	135E-06	1
Ethylene	1100E-06	25E-06	44	980E-06	31E-06	32
Propene	160E-06	5E-06	32	360E-06	5.5E-06	65
Acetylene	4400E-06	43E-06	102	140E-06	1.0E-06	140
Other Unsaturated HC	240E-06	87E-06	6	20E-06	103E-06	5
Benzene	200E-06	1.5E-06	133	270E-06	23E-06	12
Toluene	73E-06	1.8E-06	40	120E-06	6.7E-06	18
Other Aromatics	87E-06	11E-06	8	0.0E+00	13E-06	NM

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Table 6.2. Distribution of C and N Across Selected Analyte Classes for Tritonal and Amatol Detonations

Analyte Class	Tritonal-H_2O	Tritonal	Amatol-H_2O	Amatol
%C as COx	65%	106%	98%	104%
%CO/COx	49%	0.2%	0.07%	1.3%
%N as NOx	2.7%	0.95	2.2%	5.0%
%NO/NOx	94%	99%	97%	99%
%(E+P+B)/Total Saturated HC[a]	86%	14%	100%	30%
%(E+P+A)/Total Unsaturated HC[b]	96%	46%	99%	27%
%(B+T)/Total Aromatics[c]	76%	24%	100%	55%

a. (Ethane + propane + butane) emission factors/total saturated HC emission factor.

b. (Ethylene + propene + acetylene) emission factors/total unsaturated HC emission factor.

c. (Benzene + toluene)/total aromatic HC emission factor.

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Chapter 7
Discussion of Results from Burns

AP-Waste Burn Results

This surrogate waste was supposed to simulate the mix of AP-contaminated plastic gloves, cotton rags, Kimwipes, wood towel rods and similar materials that result from the clean-up of the vessels used to manufacture AP-based propellants. These materials are usually disposed of by open burning in pans or by incineration. The original plan was to bring an actual AP-based manufacturing waste to DPG for the experiment, however, this was prohibited because DPG did not have a permit for destroying this type of waste. In hindsight, the surrogate waste burned was not truly representative of a real manufacturing waste. The chemical composition was appropriate, i.e., 65% aluminized AP (69% AP, 19% aluminum), 20% plastic material (polyethylene gloves), 11% paper/wood/cloth and 4% diesel fuel; the problem lies with the manner in which the propellant was placed in contact with the combustible materials. That is, 1-in. cubes randomly dispersed on top of the combustible materials. In an actual waste, the propellant would be dispersed on the combustible materials as a fine powder.

Also, because the first burn resulted in a hole in the bottom of the pan, the second and third burns were done with the surrogate waste sitting on top of a 7.6 cm layer of pea gravel. At the completion of each of these last two burns, holes were found in the side of the burn pan, and melted plastic was found in the pea gravel. Approximately 110g of ash remained in the burn pan after the first burn, 40g of ash after the second burn and 65g of ash after the third burn. It was difficult to determine the weight of ash remaining when the pea gravel was used. The weight of waste surrogate burned in the three trials was 1,139g, including the 4g of Hercules Unique Smokeless Powder used to initiate each burn.

The unique mix of emission products, the melted plastic and the 17% conversion of N to NOx observed for the surrogate AP-manufacturing waste demonstrates that this burn was very different from all other burns which involved energetic materials. Most of the emission factors for chlorinated VOC's, those for the five furans, and two of those for the SVOCs are associated only with this material. There were also notable quantities of diesel-fuel-related VOCs in the emissions.

These results are consistent with a combination deflagration (AP) and incineration type burn (melting of polyvinyl gloves and charring of the wood dowel sticks by the heat released from the deflagration). This environment would have provided the conditions which favor the formation of SVOCs and dioxins and furans. These conditions are[17]: low temperature (250-400°C), long residence time (seconds), presence of Cl and organic materials and a metal that could serve as a catalyst. Additional work should be done on this type of material.

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Dunnage Burn Results

The dunnage burn is unique in that it did not involve any energetic-containing materials. Not surprising, almost all of the emission factors in the database for C_7 and higher saturated hydrocarbons are associated with the diesel fuel used in this burn and the AP-waste burn. These emission factors could be useful for predicting the VOC emissions from diesel fuel-initiated or supported burns of energetic-containing materials.

Smokey Sam Burn Results

The smokey sam is an HC-type obscurant (Chemical Agent, Group B Class). Its energetic composition is: 110.0g AP, 100.2g Zn, 30g hydroxyl-terminated polybutadiene and 7.5g dioctyl adipate. It was the only encapsulated propelling material burned in the BangBox. In use, its purpose is to provide a screening smoke of $ZnCl_2$ particles. The burn was very dirty; the BangBox airlock was filled with a pungent, noxious odor and the BangBox test chamber was filled with a dense fog. In comparison to the other AP-based propellant burns, its CO emissions were very high (17%) relative to its CO_2 emissions. Although the emission factors are included in the database, this item is sufficiently unique to justify not using it to calculate summary statistics for bulk propellants.

Discussion of Results for Other Energetic Materials

The other materials burned in the BangBoxes were placed into two categories: BangBox organic-based propellants and BangBox AP-based propellants. A third category (DPG field organic-based propellants) was also created using the emission factors from the 2000-3100 kg propellant burns conducted at DPG in 1989 and 1990.[8] The mean emission factors and associated standard deviations were then calculated for the following analytes within each category (if the data were available): total saturated hydrocarbons; ethylene; propene; acetylene; (total of) other unsaturated hydrocarbons; benzene; toluene; (total of) other aromatics; and PM - 10 (Table 7.1). The mean %C and %N converted to the corresponding oxides (COx, NOx) and the ratios $\%CO/CO_2$ and $\%NO/NO_2$ and the associated standard deviations were also calculated (Table 7.2).

The means were then subjected to a Student's t-test to determine if the means for the same ratio or analyte were statistically the same across at least two of the three categories. These t-tests determined that the means were statistically equivalent across all three categories for %C Converted to COx, %CO/COx, %N Converted to NOx, %NO/NOx and PM-10 mass, and, therefore the individual values could be combined to create larger data sets (Table 7.3).

Users of the database should consider using the data in Table 7.3 rather than the average CO_2, CO, NO and NO_2 emission factors in the validated database. Also, in contrast to the detonation PM-10 data, the BangBox-derived PM-10 mass emission factors likely provide reasonable estimates of the emissions from the open burning of propellants.

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Analogous to the detonation data, the differences between the means for the organic analytes are too large to permit combining them into larger data sets. The means in Table 7.1 are normalized to the mass of the energetic material (MEM) burned. While it would be desirable for some applications to have these emission factors normalized to the carbon content of the material burned, this could not be done because the information necessary to do the calculations was available for too few materials.

Other VOC Compounds
No other VOC compounds were found at notable levels for the bulk propellant burns. This is consistent with the theory of propellant burns.[4,5]

HCl and Cl_2
The mean, median and standard deviation of the mean % Recoveries for the five Cl-containing materials burned in the BangBox are: 68%, 73% and 32.8%, respectively. For the four materials for which both HCl and Cl_2 values were available, at least 98% of the Cl was found as HCl, regardless of the amount of total Cl recovered. These results are similar to those obtained by Ornellas for AP-based explosive materials.[5] At this time, it would be prudent to assume that all the Cl in an AP-based propellant will be released to the environment as HCl.

Lead and Aluminum
The low and variable recoveries for Pb and Al were not expected and should be investigated further. It is possible that some of the Pb is converted to a chemical form which is not collected by a quartz fiber filter. Until the reasons for the low recoveries are determined, it would be prudent to assume that all the Pb and Al not accounted for in the ash, was released to the environment.

Method 8270 Compounds (SVOCs)
No Method 8270 SVOC compounds were found for the bulk propellant burns. This is consistent with detonation theory.

Dioxins and Furans
Dioxins and furans were not detected, despite the extremely sensitive sampling and analysis method employed (MQL emission factor of 2.6E-11).

Residual Energetics
No residual energetics were detected for any of the bulk propellant burns. However, as mentioned earlier, the air samples collected for energetic analyses in the last two studies were not be analyzed because the SFC/MS unit was broken.

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Table 7.1. Mean Emission Factors (kg Analyte/kg MEM) for Selected Burn Analytes

Analyte	Category	MEM (kg)	No. Of Values	Mean	Std.. Dev.
PM-10	BB, AP-Based	0.2	4	0.15	0.19
	BB, Organic-Based	0.2	7	0.28	0.36
Total Saturated HC	BB, AP-Based	0.2	4	0.0E+00	NM
	BB, Organic-Based	0.2	7	4.7E-06	9.7E-06
Ethylene	BB, AP-Based	0.2	4	0.0E+00	NM
	BB, Organic-Based	0.2	7	3.7E-06	3.5E-06
Propene	BB, AP-Based	0.2	4	0.0E+00	NM
	BB, Organic-Based	0.2	7	1.0E-06	1.1E-06
Acetylene	BB, AP-Based	0.2	4	9.0E-06	9.0E-06
	BB, Organic-Based	0.2	7	4.6E-06	5.0E-06
Other Unsaturated HC	BB, AP-Based	0.2	4	26E-06	NM
	BB, Organic-Based	0.2	7	3E-06	NM
Benzene	BB, AP-Based	0.2	4	1.5E-06	[illegible]
	BB, Organic-Based	0.2	7	3.0E-06	[illegible]
Toluene	BB, AP-Based	0.2	3	0.0E+00	NM
	BB, Organic-Based	0.2	7	0.8E-06	1.3E-06
Other Aromatics	BB, AP-Based	0.2	4	0.0E+00	NM
	BB, Organic-Based	0.2	7	8E-06	NM

NC = not calculable

Table 7.2. % Conversion of C and N to the Oxides from Burns

Parameter	Category	MEM (kg)	No. Of Values	Mean	Std. Dev.
%C as COx	BB, AP-Based	02	4	99%	14%
	BB, Organic-Based	0.2	3	91%	8%
	Field, Organic-Based	3200	3	100%	2%
%CO/COx	BB, AP-Based	0.2	4	0.55%	0.32%
	BB, Organic-Based	0.2	7	0.27%	0.37%
	Field, Organic-Based	3200	3	0.007%	0.01%
%N as NOx	BB, AP-Based	0.2	2	1.8%	1.0%
	BB, Organic-Based	0.2	4	0.5%	0.4%
	Field, Organic-Based	3200	3	0.9%	0.4%
%NO/NOx	BB, AP-Based	0.2	3	75%	16%
	BB, Organic-Based	0.2	4	72%	46%
	Field, Organic-Based	3200	3	75%	6%

Table 7.3. Emission Factor Averages Across Categories for Burns

Parameter	No of Values	Median	Mean	Std. Dev
%C as COx	10	98.5%	95.0%	9.87%
%CO/COx	14	0.20%	0.300%	0.366%
%N as NOx	9	0.90%	0.89%	0.74%
%NO/NOx	10	77.0%	73.9%	25.6%
PM-10	10	0.019	0.233	0.300

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Chapter 8
Suggestions For Using the Database

Detonation Emission Factors

Rather than using all the emission factors, user's of the database should consider using the means and medians in Tables 5.1, 5.3 and 5.4 as the starting point for predicting the emissions from OD-based processes and adjust the data for their own situation using commonly accepted information on detonation theory and processes, such as that presented in Chapter 1 and the information presented in Chapters 5 and 6 of this document.

For example, a database user attempting to estimate the emissions at a facility which surface-detonated a wide variety of bulk and assembled energetic-containing materials, could calculate an average emission factor for each analyte which covers both bulk and encapsulated energetic materials. On the other hand, if the detonations are to be conducted under a soil cover, one should consider the likelihood that the fireball will be suppressed and use either the data in Tables 6.1 and 6.2 or select the uppermost part of the ranges for %CO/COx and hydrocarbons species in Tables 5.3 and 5.4.

Unfortunately, if the energetic contains Pb or Al, at this time, one has to assume that all the Pb and Al is released to the atmosphere. More research is needed on these release of these and other metals from OD activities. The low and variable % recoveries for Cl and S observed in all the studies also needs to be studied further to more fully characterize the environmental safety of OD practices. At this time, one has to assume that all the metals, S and Cl enter the environment and attempt to estimate how they will disperse in the environment.

The most difficult emissions to estimate are those for PM-10 and undegraded energetic starting materials. It would be reasonable to assume that the PM-10 emission factors in Table 5.1 and 5.3 underestimate the PM-10 emissions for a surface detonation, but how low is the estimate? Also, if the mass of the energetic being detonated is small and the ratio "donor charge to total energetic mass," is large, one can assume that some amount of undegraded energetic will be released to the environment. But again, how much?

Open Burning Emission Factors

Users should apply the data in Tables 7.1, 7.2 and 7.3 and the other information presented in Chapter 7 in a manner analogous to that recommended above for the detonation emission factors, e.g., one has to assume that all Pb, Al Cl and S in the energetic material being burned will be released to the environment, except for whatever was recovered in the burn pan ash. However, for burns, one can assume that

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undegraded energetic emissions would be low and that the PM-10 emission factors in Tables 7.1 and 7.3 are reasonable estimates of the PM-10 emissions expected.

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Chapter 9
Recommendations for Future Work

The low and variable % recoveries for metals and for Cl and S observed in all studies reviewed needs to be determined to more fully characterize the environmental safety of OB and OD practices. At this time, one has to assume that all the metals, S and Cl enter the environment.

All emission products studies to date have used relatively clean energetic materials. Recovered high and low explosives should be burned and detonated in chambers to confirm the representativeness of these earlier studies.

Existing knowledge on the affect that accelerators and retardants have on the rate of energetic processes should be applied to OB and OD technologies to see if the environmental safety of OB and OD can be improved further.

Buried detonations should be avoided until the impact that burial and partial confinement have on the emission is established through rigorous research testing. Computer simulations using computational fluid dynamic techniques followed by experimental confirmation should be an integral part of these studies, because of the large number of factors which could affect the emissions. Other noise suppression techniques which do not inhibit the formation of the fireball, such as detonating in chambers, should also be developed and evaluated.

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Appendix A
Detailed Descriptions of the Energetic Materials

Description of Materials Used in Study 1

This study, which was funded by the United States Army Matériel Command (AMCCOM), was conducted in the SNL Bang Box between January 30 and February 16, 1989. In this study TNT blocks were detonated while suspended approximately 1 m above the concrete floor and two propellants were burned in stainless steel pans 103 cm in diameter and 12.7 cm deep. During the propellant burns, the pan was covered with a coarse stainless steel screen to prevent pieces of the propellant from sputtering out of the pan during the burn. The propellants were ignited with an Atlas electric match.

TNT Block

TNT blocks weighing 227g were detonated on January 31, February 2 and February 6, 1989. The TNT was obtained by removing the Mylar film from TNT demolition block and cutting the TNT into the shape and weight desired. The TNT block was made from pressed TNT grains ranging in size from 35 to 65 mesh; graphite (used to facilitate the pressing process) was the only other component in the block. An RP-83 initiator, which consisted of PETN and RDX encased in an aluminum alloy casing, was used as the initiator.

Foam Suppressed TNT Block Detonation

The suspended TNT block was encased in a glycol-based foam which had an expansion ratio of 130:1. The foam contained glycol ether, a 5-carbon alcohol, xanthin biopolymer, formaldehyde, a sulfonate surfactant and C_{12} - C_{14} fatty acids. The foam blanket was held in place with polyethylene sheeting. The diameter of the foam to that of the block was approximately 17:1. The TNT block was detonated on February 13, 1989 in the same manner as the bare TNT blocks had been detonated. This test was done to determine the capability of foam to reduce the blast wave and improve the environmental safety of OD activities. It was found that the foam did not substantially reduce the blast wave to the degree expected and that it impaired the efficiency of the detonation (as evident by the sharp reduction of the CO_2 emissions and the free carbon in the residue left on the floor after the detonation). **The results from this single test were not included in the database because of the uniqueness of the test.**

Double-base Propellant-NOSIH-AA2

The MEM burned was 471g. The major constituents of the propellant were: 240g NC, 184g NG, 26.6g ethyl cellulose, 12.3g triacetin, 9.1g of di-n-propyl adipate and 4.5g lead. A single burn was conducted on February 9, 1989.

Composite Propellant MK-6, 88 P-217

The MEM burned was 448g. The major energetic constituents of the propellant were: 381g AP, 35.9g hydroxy-terminated polybutadiene, 20.2g dioctyl sebacate and 4.5g aluminum oxide.

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Description of Materials Used in Study 2

This Navy-funded study, which was conducted from January 19 to January 21, 1993, was the first study conducted in the DPG BangBox. Its objective was to collect emissions data for use in designing a confined-burn facility for propellants. Five propellants were burned in stainless steel pans and the dimensions of the pans were not recorded in the final report. The burn pans were placed at the center of the BangBox on the steel plate covering the 1 x 1 x 1 m detonation pit. The burns were ignited using Hercules Unique Smokeless Powder, which is a mixture of NC (95%) and NG (5%). A single burn was done on each material.

PBXN-110 Propellant

The MEM burned on January 19, 1993 was 1064g, which included 14g of smokeless powder. The major energetic components of the 1050g of PBXN-110 burned were: 924.1g HMX, 53g hydroxyl-terminated polybutadiene, and 53g isodecyl pelargonate.

MK-23 CTBN Propellant

The MEM of energetic material burned on January 19, 1993 was 1030g, including 30g Hercules smokeless powder. The major energetic components of the 1000g of MK-23 propellant burned were 800g AP, 142g carboxyl-terminated polybutadiene and 20 g Al.

MK-43 LOVA Propellant, MIL-P-70818

The MEM of energetic material burned on January 20, 1993 was 1060g, including 40g Hercules smokeless powder. The energetic composition of the MK-43 propellant burned was: 775g RDX, 41g NC, 122g cellulose acetate butyrate (CAB) and 78g of a mix of bis(2,2-dinitropropyl)acetal and bis(2,2-dinitropropyl)formal (BDNPA/F).

Hercules Unique Smokeless Powder

The MEM burned on January 21, 1993 was 454g; it was comprised only of smokeless powder (431.3g NC and 22.7g NG).

Smokey Sam (Obscurant)

The MEM of energetic material burned on January 21, 1993 was 273g, including 23g of Hercules smokeless powder. One smokey sam was burned in each trial. The energetic components of the smokey sam were: 110.0g AP, 100.2g Zn, 30g hydroxyl-terminated polybutadiene and 7.5g dioctyl adipate. The burn was very dirty; the BangBox airlock was filled with a pungent, noxious odor and the BangBox test chamber was filled with a dense fog.

Description of Materials Used in Study 3

Study 3 was funded by the United States Air Force (USAF) and was conducted from February 8 to February 12, 1993. Its objective was to obtain emissions data for a Subpart X permit application for a USAF base. Four USAF items were detonated in the BangBox; the detonations were initiated using C-4 and an electric blasting cap (EBC). (C-4 is the donor charge used in the routine detonation of the four USAF

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of the reducer charge was not given in the final report. The major energetic constituents of the 2,156g of M-1 propellant burned were: 1,815g NC, 213g dinitrotoluene, 106g dibutylphthalate and 22g diphenylamine. The three M-1 propellant burns were conducted on March 17 and 18, 1993; each burn was conducted under different temperature and humidity conditions. These conditions were generated using electric heaters and pans containing water. The first burn was conducted at low humidity and at a temperature above ambient temperature; the second burn was conducted early in the morning of March 18 under conditions of cool temperature and high relative humidity, and the third burn was conducted at ambient temperature. Unfortunately, the specific temperatures and humidities used are not given in the final report. Because the three trials gave emission factors which were essentially the same, the emission factors are identified in the database as M-1 propellant burn without referencing the environmental conditions under which each burn was done.

Description of Materials Used in Study 5

This study, which was funded by the USAF, was conducted from February 23 to March 9, 1995. Its objective was to obtain emissions data for a Subpart X permit application at a USAF base. During this study, the emission from 10 USAF items were characterized when these materials were detonated. C-4, detonation cord and an EBC assembly (detonation train) were use to initiate each detonation. Three detonations were conducted for each item. Each item detonated was suspended either 1 m or 0.5 m above the floor of the 1 x 1 x 1 m detonation pit. The C-4 was obtained by removing the Mylar film from M112 demolition charges; it was shaped to the size and weight needed for the test and then wrapped in a 12.7 cm x 30 cm sheet of polyethylene (weighing 1.9g) to prevent C-4 particles from falling to the floor of the BangBox before the detonation was initiated.

TNT Block

To ensure that the pollutant measurement instruments and other BangBox equipment was operating properly, three TNT blocks with a total MEM of 222g were tied together with 16 gauge iron wire, wrapped with 1.9g of polyethylene sheeting and detonated (using an EBC inserted in the bottom of the assembly) on February 23, 1995.

Detonation Train

This item represents the detonation train used to initiate the detonation of the other nine items used in the study. It was detonated to determine the effect that its detonation could have on the emissions measured from the other nine items. Each detonation train contained 57g C-4, 32g detonation cord (PETN), and an EBC. The C-4 was shaped into blocks weighing 57g with dimensions approximately 7.7 x 2.5 x 2.5 cm and the detonation cord was cut into 3 m lengths and coiled around the polyethylene-wrapped C-4. For this test, two detonation train assemblies were tied together with 16 gauge iron wire, wired in parallel to the firing line and detonated above the floor of the detonation pit using one EBC on each detonation train. The MEM used in each of the three detonations conducted on February

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24, 1995 was 178g.

Cartridge, Impulse, M187 Mod O, ARD446-1, NSN 1377-00-516-9924
This item has a MEM of 12.5g. For each trial, ten ARD446's were wrapped together in polyethylene sheeting and detonated using one detonation train. The MEM of the assembly was 216g, including 91g from the detonation train. Each cartridge was stated to contain 0.9g charcoal, 0.9g sulfur and 5.0g potassium nitrate and approximately 8g of smokeless powder. It is assumed that the smokeless powder was 70% NC and 20% NG and 10% ethyl centralite. Three detonations were done on February 25, 1995.

Cartridge, Impulse, BBU 36B, NSN 1377-01-037-8650, Lot T0592A002012
This item deploys chaff from aircraft and contains a pyrotechnic filler which readily burns when initiated. Each cartridge has a MEM of 875mg. Sixty cartridges were used in each of the three detonations conducted on February 27, 1995. In each detonation, 42 cartridges were clustered around a 57g block of C-4 and 18 cartridges were placed on the sides of a 0.5 m length of detonation cord which had been folded into a 0.25 m length. In trial 1, the two assemblies were hung separately with one end of the detonation cord inserted in the block of C-4. An EBC was used to detonate the C-4. In trials 2 and 3, the C-4 and detonation cord assemblies were bound together using 16 gauge iron wire. The MEM of the assemblies detonated was 144g, including 91g from the detonation train. The energetic composition of the cartridge is not fully known; it did contain 0.1g potassium nitrate, 0.1g charcoal 0.7g NC, 0.2g NG and 0.06g amorphous boron.

Generator, Gas Pressure, Propellant Actuated, GCU-2/A, NSN-1336-00-420-2980
This item, which is used in the LGM30 minuteman missile, has a MEM of 95.3g; its energetic composition is classified. The item was prepared for detonation by removing the outer metal jacket to expose the solid propellant which is cast as a short hollow cylinder. Twenty-eight and a half grams of C-4 was packed into the hollow cylinder and the cylinder wrapped in polyethylene sheeting. This assembly was then wrapped with 1.5 m of detonation cord and the gas generator's plastic shipping plug was taped on top of the detonation cord. The gas generator was then oriented with its steel plug facing into the detonation pit and detonated with an EBC. One gas generator was used in each detonation; three detonations were done on March 1, 1995. The MEM of each assembly detonated was 139g.

Cartridge, Impulse, MK107, Mod 01, NSN-1377-00-779-2601
This cartridge has a MEM of 24.5g. Five cartridges were placed around a 57g block of C-4. Tney were parallel to each other, but alternated tip to base. This assembly was wrapped with 3 m of detonation cord and detonated over the detonation pit using an EBC. The MEM of each assembly was 208g, including 91g for the detonation train. The energetic composition of the MK107 cartridge was 17.4g NC, 5.0g NG, 1g barium nitrate and 1.2g of potassium nitrate. Three detonations were

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conducted on March 3, 1995.

Signal, Illumination, Ground, Red Star, M158 NSN 1370-00-490-7363
This flare has a MEM of 36.8g. Four flares along with their bandoliers were used in each detonation. Two flares were placed on one side of a 57g block of C-4 and two were placed on the opposite side. This assembly was wrapped in polyethylene sheeting; 3 m of detonation cord was then wrapped around the assembly and secured with 16 gauge iron wire. This final assembly was detonated with the flare-releasing end pointed down into the pit. An EBC was used to initiate each of the three detonations conducted on March 4, 1995. The MEM of each assembly was 239g, including 91g from the detonation train. The complete energetic composition of the item is unknown. It did contain 2.5g of black powder, 5.2g of strontium nitrate, 2.5g magnesium, 11g potassium nitrate, 2.5g charcoal and milligram quantities of cadmium and zinc.

Fuze, Tail Bomb, Fuze Mechanical Unit (FMU) 54A/B, NSN-1325-00-613-0484
This fuze, which contains 163g of TETRYL, initiates the longitudinal detonator cast into general purpose (GP) air-dropped bombs such as the M117 and MK82. The MEM of the fuze is 163.3g. One fuze was used in each of the three detonations conducted on March 6, 1995. Each fuze was prepared for detonation as follows. A 28.5g block of C-4 was taped to the side of the fuze near its main explosive charge and the assembly wrapped in polyethylene sheeting. 1.5 m of detonation cord was then wrapped around the fuze and the fuze was screwed onto a threaded shaft. (The opposite end of the shaft was attached to a 1.9 cm thick by 30.5 cm diameter steel plate. The purpose of the steel plate was to break up any focused blast effect resulting from the detonation.) The fuze was detonated 0.5 m above the floor of the detonation pit using an EBC. The MEM was 209g, including 46g from the detonation train.

Flare, Countermeasure, Aircraft, M206, NSN-1370-01-0482138
This flare is used to decoy heat-seeking missiles away from aircraft. Each flare has a MEM of 150.2g and contains 102g powered magnesium [illegible] potassium nitrate, 5g NC and 13g rubber. The flare, which had an aluminum case, was prepared for detonation as follows. A 57g block of C-4 was cut in half lengthwise and the two halves placed on the [illegible] axis of the flare such that two halves remained in contact. This assembly was wrapped in polyethylene sheeting and then 3 m of detonating cord was wrapped around the assembly starting at the end opposite the C-4. The plastic plug in the forward end of the flare was left in place and the final assembly suspended 0.5 m above the floor of the detonation pit. The pit cover was partially extended over the pit when the flare was detonated using an EBC to initiate the detonation. The MEM of the final assembly was 241g, including 91g from the detonation train. Three detonations were done on March 7, 1995.

Fuze, Tail Bomb, Fuze Mechanical Unit, 139A/B, NSN 1325-01-214-7311
This fuze contains 126g of TETRYL; it initiates the longitudinal

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detonation cast into GP air-dropped bombs. The MEM of the fuze is 126g. One fuze was detonated in each of the three detonations conducted on March 8, 1997. The procedure employed was similar to that used for the FMU 54 A/B fuzes detonated on March 6, 1995. The MEM of the each assembly detonated was 172g, including 46g from the detonation train.

Signal, Illumination, Aircraft, Red Star M43A2, NSN-1370-00-618-5790
This flare has a MEM of 56.8g with 56.6g of this MEM in the illuminating charge. The illuminating charge contains 10.2g magnesium powder, 13.6g potassium perchlorate, 24.9g strontium nitrate, 3.4g hexachlorobenzene, 4g asphaltum and mg quantities of cadmium, barium, and lead. Three flares along with their bandoliers were used in each of the three detonations conducted on March 9, 1997. The three flares were tied to a 57g block of C-4 and detonated employing a procedure similar to that used for the M158 flares detonated on March 4, 1995. The MEM of each assembly detonated was 260g, including 91g from the detonation train.

Description of Materials Used in Study 6

Study 6 was a R&D study funded by the Strategic Environmental Research and Development Program (SERDP); its objective was to determine the emissions released when double-based and AP-based propellants were burned. The testing was conducted from July 26 to August 3, 1995. The four propellants burned were placed in stainless steel pans and ignited with an electric squib and 4g of Hercules Unique Smokeless Powder.

M31A1E1, Triple Based Propellant, NSN 1376-01-213-5669
During the first burn, the stick propellant was burned in an upright position, which resulted in extensive propellant kickout. To reduce propellant kickout, for the second and third burns, the propellant sticks were placed horizontally in the pan. For these latter burns, four propellant sticks were broken into fourths (18.4 cm) and placed in the pan. Then additional propellant sticks were broken in half (36.8 cm) and placed crosswise on top of the other propellant sticks. The MEM (including the 4g of smokeless powder) used in the three burns conducted on July 26, 1995 were 2,284g, 2,280g and 2,264g, for the first, second and third burns, respectively. The major energetic constituents of the M31A1E1 propellant burned were: 492g NC, 410g NG, 1,245g NQ, 34g ethyl centralite and 1g of charcoal.

Double-Based Propellant
Other than the following elemental composition, no information is available for this cast propellant which was burned on July 27, 1995: 20.36% C, 2.97% H, 28.73% N, 46.14% O, 0.89% Pb, 0.89% Zr and 0.02% Sn. The MEM of propellant burned in each of the two burns was 2,227g, including 4g of smokeless powder. Each propellant burn would potentially release 19.8g of Pb.

Ammonium Perchlorate (AP) Propellant
Other than the following elemental composition, no information is

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available for this propellant which was burned on July 31, 1995: 25.87% Cl, 11.32% C, 4.31% H, 10.35% N, 47.31%O, and 0.89% Zr. This formulation implies that the propellant was 85% AP. The MEM burned in each of the two trials was 2,270g, including the 4g of smokeless powder used to initiate each burn. Based on the above elemental composition, the 2,270g of propellant burned contained: 1946g AP, 300g of a material or materials with the elemental formula of $C_{21}H_{32}$, 3.8g NC, 0.2g NG and 20g Zr.

Aluminized Ammonium Perchlorate (AP) Propellant
Other than the following elemental composition, no information is available for this propellant which was burned on August 3, 1995: 19% Al, 20.8% Cl, 10.09% C, 3.7% H, 8.3% N, 38.1% O and 0.008% P. This formulation implies that the propellant contained 69% AP by weight. The MEM (including 4g of smokeless powder) for the first and second burns were 1,216g and 1,159g, respectively for an average MEM of 1192g (821g AP, 226g Al, 141g of a material or materials with an elemental composition of $C_{20}H_{34}O$, 3.8g NC and 0.2g NG).

Description of Materials Used in Study 7

Study 7 was a SERDP-funded R & D project designed to determine the emissions released when TNT-based explosives are detonated at ground level and underground. This study was also done to obtain information on the emissions released to the atmosphere when waste from an aluminized AP propellant manufacturing process and diesel fuel-soaked dunnage are burned. All detonations and burns were done in triplicate. Except as indicated below, all detonations were done using an M-6 EBC and a 6.5g block of C-4 cut from an M112 demolition charge. The detonations were done with the material suspended 1 m above the floor of the BangBox.

Detonating Cord
Twenty-one and three tenths (21.3) meters of PETN-based detonating cord were shaped into a 61 cm diameter coil and the coil suspended over the detonating pit such that a 2.5 cm space existed between each successive turn of the coil. The MEM used in each of the three detonations conducted on August 15, 1995 was 205g, including the M6 EBC used to detonate the detonation cord. **For the reasons discussed in Chapter 3, all the detonation cord results were determined to be invalid and, therefore, were not included in the validated database.**

Tritonal Surrogate
Low density tritonal is used in 750 lb. air-dropped bombs; it consists of 80% TNT and 20% Al by weight. There is no commercial or military use for tritonal recovered from these out-of-date bombs. A tritonal surrogate was prepared using crushed TNT block and aluminum powder. These components were placed in a jar and mixed until the mixture appeared to be homogeneous. This mix contained 1274g TNT and 431g Al. Three, 227g portions of this mix were placed in thin polyethylene bags and the bags closed with cotton string. One bag was used in each detonation; the detonations were done with the bags suspended approximately 1 m above the concrete floor of the Bang Box. In the

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first two trials, a single M-6 EBC was used to initiate the detonation. It was apparent from the noise of the blast and the residues on the floor that the two detonations did not go high order. To ensure that the third detonation went high order, the EBC was inserted into a 6.5g block of C-4 for this detonation. The MEM of the material detonated in the three detonations was 229g for the first two detonations and 235g for the last detonation. Because they were not high order detonations, the results from the first two detonations are not included in the database. The detonations were done on August 16, 1995.

Tritonal Surrogate with 2.5% Calcium Stearate

The calcium stearate served as a surrogate for the organic materials associated with tritonal when it is steamed out of 750 lb. bombs. Three detonations were done on August 17, 1995; a 6.4g block of C-4 and an EBC were used to initiate each detonation. The tritonal/calcium stearate mixes detonated were contained in thin polyethylene bags in a manner identical to the tritonal surrogate detonations. Each bag contained 216g of the tritonal surrogate mix prepared earlier and 11g of calcium stearate. The MEM of the material detonated was 226g, including 8g from the C-4/EBC.

Water-Suppressed Tritonal Surrogate Detonation

The purpose of these water-suppressed detonations was to obtain a preliminary comparison between the emissions from unconfined, surface and buried detonations. The purpose of the water was to quench the fireball that forms when an energetic material is detonated. This fireball is important for ensuring that the molecular fragments of the energetic materials formed in the detonation are converted to CO and CO_2. Three, water-suppressed detonations of tritonal were done on August 22, 1995 using 227g of tritonal surrogate, 1,362g of water, a 6.5g block of C-4 and an EBC. For the first two detonations, the tritonal was in contact with three bags each of which contained 454g of water. (The four bags (3 water, 1 tritonal) were in a larger bag which was tied with cotton string such that the water bags remained in contact with the tritonal bag.) For the third detonation the 1,362g of water was divided equally among five polyethylene bags to increase the tritonal surface area covered by the water. In this latter detonation, three of the water bags were in the same plane as the tritonal bag, one was on top of the tritonal bag and the last was underneath the tritonal bag. The six bags were held in a larger bag which was tied with cotton string to keep the water bags in contact with the tritonal bag. The MEM detonated in each trial was 235g, including 8g from the C-4/EBC.

Amatol Surrogate

Amatol is a secondary explosive comprised of TNT and ammonium nitrate (AN). It is used in a wide variety of munitions. Three detonations of an amatol surrogate containing 113.5g of TNT and 113.5g AN were done on August 18, 1995. The amatol was prepared by mixing crushed TNT block with AN powder in a manner similar to that used to prepare the tritonal surrogate. The amatol surrogate was placed in the

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polyethylene bags and detonated in the same manner as the tritonal surrogate. The MEM of the material detonated in each of the three trials was 235g, including 8g from the C-4/EBC.

Water-suppressed Amatol Surrogate Detonation

Three detonations of 227g amatol surrogate in contact with 5 bags containing a total of 1362g of water were done on August 28, 1995. The five water bags were distributed around the amatol surrogate bag in a manner similar to that used for the third water-suppressed tritonal detonation on August 22, 1995. The MEM detonated was 235g, including 8g from the C-4/EBC.

Low-Density Composition B Surrogate

Composition B, a secondary explosive found in a wide variety of bombs and artillery projectiles, is a combination of RDX and TNT. The Composition B surrogate detonated on August 19, 1995 was prepared by mixing crushed TNT block with C-4. Three, 227g mixtures of the Composition B surrogate in thin polyethylene bags were detonated. The energetic composition of this composition B was 128g RDX, 86.3g TNT and 12.7g of mineral oil/polyisobutylene (from the C-4). The MEM detonated was 235g, including 8g from the C-4/EBC.

HBX Surrogate

HBX is an aluminized form of Composition B; it is used in a variety of bombs, depth charges and torpedoes. The HBX surrogate was prepared by mixing aluminum powder with Composition B surrogate. Two hundred and twenty seven gram quantities of the HBX surrogate were placed in thin polyethylene bags and detonated on August 21, 1995. Three detonations were done. The energetic composition of the HBX surrogate detonated was: 109g RDX, 72g TNT, 7.8g mineral oil/polyisobutylene and 38.5g Al. The MEM of the material detonated was 235g, including 8g from the C-4/EBC.

Aluminized Propellant Manufacturing Waste Surrogate

This surrogate waste simulated the mix of plastic gloves, cotton rags, kimwipes, wood towel rods and similar materials that result from the clean-up of the vessels used to manufacture propellants; it is usually disposed of by open burning. The composition of the surrogate waste burned in the stainless steel pans on August 23, 1995 was: 65% aluminized AP (69% AP, 19% aluminum), 20% plastic material (gloves, anti-static polyethylene), 11% paper/wood/cloth and 4% diesel fuel. The propellant in one inch cubes was randomly dispersed in the combustible materials. Because the first burn resulted in a hole in the bottom of the pan, the second and third burns were done with the surrogate waste sitting on top of a 7.6 cm layer of pea gravel. At the completion of each of these last two burns, holes were found in the side of the burn pan, and melted plastic was found in the pea gravel. Approximately 110g of ash remained in the burn pan after the first burn, 40g of ash after the second burn and 65g of ash after the third burn. It was difficult to determine the weight of ash remaining when the pea gravel was used. The weight of waste surrogate burned in the three trials was 1,139g, including the 4g of Hercules Unique

Smokeless Powder used to initiate each burn. Since this burn was done to characterize the emissions from the waste itself, the mass of the material burned (1,139g), rather than the mass of energetic burned (741.8g) was used to calculate the emission factors.

Diesel Fuel and Dunnage Surrogate

Scrap wood from ammunition boxes, dead branches from bushes/trees, styrofoam packing materials and other combustible materials (dunnage) are sometimes used with diesel fuel or other flammable liquid to assist in the open burning of munitions and other energetic materials found on training ranges, battlefields, etc. A surrogate diesel fuel-soaked dunnage was burned on August 29, 1995 to determine the emissions released when dunnage is burned. Three burns were done in unlined stainless steel pans using 909g of the surrogate material and 4g of smokeless powder. The composition of the surrogate material, which was prepared using styrofoam, pasteboard and irregularly shaped pieces of wood, was: 87.5% cellulose (795.4g), and 12.5% plastic/diesel fuel (114g). Since this burn was done to characterize the emissions from the diesel fuel and dunnage mixture itself, i.e., the mixture did not contain any energetic materials, the mass of the material burned (909g) was used to calculate the emission factors.

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Appendix B
Sampling and Analysis Methodologies Used

Continuous Emission Monitors (CEMs)

Thermo Environmental (TECO) CEMs were used to measure the concentrations of CO_2, CO, NO, NO_2, SO_2, O_3 and HCl in the test chamber for a minimum of 25 minutes after a detonation or burn was initiated. The CEMs were located in the airlock and connected to the test chamber via a passivated stainless steel sampling manifold; their output voltages were recorded by a calibrated data acquisition system (DAS) comprised of five computers and a LAN. The pollutant concentrations measured before the detonation/burn was initiated were used to correct the pollutant concentrations measured after the detonation/burn was initiated. The model numbers and measurement principles of the TECO analyzers are: CO_2 (Model 41H, gas filter correlation); CO (Model 48, gas filter correlation); NO/NO_2 (Model 42, chemiluminescence); SO_2 (Model 43A, pulsed fluorescence); O_3 (Model 49, UV absorption); and HCl (Model 15, gas filter correlation). The analyzers were calibrated at least once each test day using NIST-traceable gas standards.

EPA Method 26 Sampling System for HCl and Cl_2.

Two EPA Method 26 samplers, located in the test chamber, were used to measure Cl_2 and HCl concentrations when chlorine-containing propellants were burned. This sampler uses a set of Midget impingers connected in series to collect HCl and Cl_2. The second and third impingers, which contain 0.1N H_2SO_4, remove HCl from the sampled gas stream, and the forth impinger, which contains 0.1 N NaOH, removes Cl_2. The impinger contents are analyzed for Cl by ion chromatography. The sampling flow rate is 1 L/min.

Evacuated Canisters for CO, CO_2, and SF_6

Evacuated canisters were used to measure the CO_2, CO and SF_6 concentrations in the test chamber. Generally, three CO_2/CO samples and five SF_6 samples were collected from the sampling manifold in the airlock during each trial. These samples were taken at 5 to 10 minute intervals and spanned the time during which the other pollutant samples were being collected/measured. Depending on the concentration of the gases, the CO and CO_2 analyses were done using a GC equipped with either a flame ionization detector (GC/FID) or a thermal conductivity detector (GC/TCD) and the SF6 analyses were done using an electron capture detector (GC/ECD).

Evacuated Canisters for Volatile Organic Compounds (VOCs)

Three, 6-L canister samples were collected from the test chamber via the sampling manifold during each burn/detonation event. The first sample was taken approximately 5 min after the burn/detonation was initiated, the second was taken 5 to 10 minutes later and the third was taken 5 to 10 minutes after the second. Each sample was taken over a 1 to 3-min. period. The canister samples were analyzed for total non-methane hydrocarbons using EPA Method TO-12 (GC/FID) and for over 200 individual compounds using GC/FID and GC/MS. Most of these compounds were quantified by GC/FID; approximately 20 were quantified by GC/MS. Ten of these latter compounds were also quantified by GC/FID. The VOC target analytes are listed in Appendix C.

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High Volume Sampler

This sampler collected samples for determination of: (1) particle mass; (2) metals; (3) EPA SW-846 Method 8270 SVOC compounds (Soxhlet extraction with analysis by GC/MS); and (4) remnants of the energetic materials (e.g., TNT, PETN, RDX, NG, NC, etc.) and other thermally-labile analytes. Three samplers, equipped with 20.3 x 30.8 cm quartz filters, were used for each detonation/burn event. They collected test chamber samples for 20 to 30 minutes after a detonation/burn was initiated. Although the initial flow rate was 1.1 m^3 /min, the flow rate generally decreased over the sampling period. Sometimes the filters were recovered after each trial; at other times they were recovered after the last trial had been done (composite samples). The filters were processed in the laboratory as follows.

Particle Mass and Metals

The weight gain of each filter was determined using a laboratory balance, and then two, 6.5-cm^2 sections were taken from each filter, combined, acid extracted and the extract analyzed using inductively coupled plasma atomic emission spectrometry (ICP) for Al, Sb, Ba, Be, Cd, Cr, Cu, Pb, Ni, Ti; and Zn. A portion of each filter was also analyzed for mercury using EPA SW-846 Method 7000. In some studies all filter sections from the same detonation/burn were combined, but in others, all filters from the same sampler were combined.

Method 8270 SVOCs

The composited filters were Soxhlet-extracted with 700 ml of acetonitrile, the extract was concentrated to 1 to 2 ml via rotary evaporation, and an aliquot analyzed using a HP Model 5890/5970 GC/MS operated in the full scan GC/MS mode. In some studies all filters from the same detonation/burn were combined before the Soxhlet extraction was done, but in other studies all filters from the same sampler were combined before the extraction was done. The Method 8270 target compounds are listed in Appendix C.

Energetic and Other Thermally-labile Compounds

To determine if these compounds were present, an aliquot from the above SVOC extract was analyzed by SFC/MS (supercritical fluid chromatography/MS) and, at times by SFC/TEA using a modified Lee Scientific Model 600/ Finnigan-Mat Incos 50. Two complementary SFC/MS analyses were performed: (1) negative chemical ionization for nitroaromatics, nitramines, nitrate esters and nitroso compounds; and (2) positive chemical ionization for polynuclear aromatic hydrocarbons, their nitrogen and oxygen heterocyclic counterparts, amines, and nitrosoamines. The SFC unit was run in the selected ion mode, rather than full scan mode. Extracts from some studies were also analyzed using full scan, SFC/TEA to seek out untargeted nitroso and nitro compounds and nitrate esters. The target energetic compounds are listed in Appendix C.

PM-10 Sampler (General Metals Works, Model GUV-10H)

This sampler is essentially a high volume sampler equipped with an inlet which prevents particles with aerodynamic size diameters larger than 10 microns from reaching the 20.3 by 30.8 cm, quartz filter; provided the sampling flow rate is maintained at 1.1 m^3/min. Only one PM-10 sampler was used in the BangBox; it was located in the test chamber. The filter samples were recovered after each

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detonation/burn, weighed, and analyzed for metals in a manner analogous to that used for the high volume samples.

PS-1 Sampler (General Metal Works, Inc. Model PS-1)

This sampler was used to collect air samples for determination of Method 8270 SVOCs and chlorinated dioxins and furans. (See Appendix A.) Separate samplers were used for the SVOCs and the dioxins/furans, because the extraction solvent for the SVOCs (methylene chloride) was not the same as that used for the dioxins/furans (toluene). Three SVOC samplers were used for each detonation/burn, but no more than two dioxins/furans samplers were used in any detonation or burn. The PS-1 samplers contained 65 to 75 g of XAD-2 resin in either a glass or aluminum cartridge. The cartridge had an internal diameter of 6 cm and was 12.5 cm in length; it contained a 10-cm diameter quartz fiber filter in its inlet. This filter was replaced after each detonation/burn, but the XAD-2 resin was not recovered until all detonation/burn trials planned for the test item had been accomplished. All filters from the same sampler were combined with the corresponding XAD-2 cartridge, extracted and analyzed using either full-scan GC/MS (SVOCs) or selective-ion-mode high resolution gas chromatography/high resolution MS (HRGC/HRMS).

Floor and Burn Pan Samples

In some studies, floor sweepings and burn pan residues were analyzed for metals, Method 8270 SVOC compounds, and dioxins and furans using procedures similar to those used for the air samplers. Unfortunately, the total mass of the metal in the ash/residue was not reported.

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APPENDIX C
TARGET ANALYTES

VOCs

The individual target VOC compounds were:

acetaldehyde; acetone; acetonitrile;
acetylene; acrylonitrile; allyl chloride
benzaldehyde; benzene; benzyl chloride;
bromochloromethane; bromodichloromethane; bromoform;
bromomethane; 1,3-butadiene; n-butane;
1-butanol; 2-butanone; 1-butene;
cis-2-butene; trans-2-butene; butylacrylate;
n-butylbenzene; tert-butylbenzene; butylaldehyde;
carbon tetrachloride; chlorobenzene; chlorodifluoromethane;
chloroethane; chloroform; chloromethane;
chloroprene; (o,m,p)-chlorotoluene; cyclohexane;
cyclohexene; cyclopentane; cyclopentene;
n-decane; 1-decene; dibromochloromethane;
dichloromoethane; (o,m,p)-dichlorobenzene; dichlorodifluoromethane;
1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene;
cis-1,2-dichloroethene; trans-1,2-dichloroethene; trichlorofluoromethane;
1,2-dichloropropane; cis-1,3-dichloropropene; diethyl ether;
trans-1,3-trichloropropene; (m, p)-diethylbenzene; 2,3-dimethylbutane;
2,2-dimethylheptane; 2,3-dimethylhexane; 2,5-dimethylhexane;
2,3-dimethylpentane; 2,4-dimethylpentane; 1,4-dioxane;
ethane; ethanol; ethylbenzene;
2-ethyl-1-butene; ethyl chloride; 3-ethylhexane;
ethylene; (o,m,p)-ethyltoluene; heptanal;
n-heptane; 1-heptene; hexachloro-1,3-butadiene;
hexanal; n-hexane; 1-hexene;
cis-2-hexene; trans-2-hexene; cis-3-hexene;
indan; indene; isobutane;
isobutene; isobutylbenzene; isoheptane;
isohexane; isopentane; isoprene;
isopropylbenzene; p-isopropyltoluene; methane;
methyl bromide; methyl tert-butyl ether; 2-methylpentane;
2-methyl-1-butene; 2-methyl-2-butene; 3-methyl-1-butene;
2-methyl-1-pentene; 4-methyl-1-pentene; 2-methyl-2-pentene;
cis-3-methyl-2-pentene; methylcyclohexane cis-4-methyl-2-pentene;
trans-4-methyl-2-pentene; methylcyclohexane; 1-methylcyclohexene;
methylcyclopentane; methylcyclopentene; methylene chloride;
2-methylheptane; 3-methylheptane; 3-methylhexane;
methylisobutylketone; 3-methylpentane naphthalene;
neohexane; neopentane; n-nonane;
1-nonene; 4-nonene; n-octane;
1-octene; cis-2-octene; n-pentane;
1-pentene; cis-2-pentene; trans-2-pentene;
alpha-pinene; beta-pinene; propane;
1-propanol; 2-propanol; n-propylbenzene;
propylene; styrene; Tetrachloroethene;
1,1,2,2-tetrachloroethane; toluene; 1,2,4-trichlorobenzene;
1,1,1-trichloroethane; 1,1,2-trichloroethane; trichloroethene;
trichloroethylene; trichlorofluoromethane; 1,2,3-trimethylbenzene;
1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene; 2,2,4-trimethylhexane;
2,2,4-trimethylpentane; 2,3,4-trimethylpentane; 2,2,5-trimethylhexane 2,4,4-
trimethyl-1-pentene; 2,4,4-trimethyl-2-pentene; 2,2,3-trimethylpentane;
n-undecane; 1-undecene; vinyl acetate;
(o,m,p)-xylene; vinylidine chloride; vinyl chloride.

In addition to the above individual compounds, the following classes of VOC compounds were also measured and converted to emission factors:

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Total Alkanes (saturated hydrocarbos) = sum of all alkanes measured in the sample, including non-target alkanes;

Total Alkenes (unsaturated hydrocarbons) = sum of all alkenes measured in the sample, including non-target alkenes and acetylene

Total Aromatics = sum of all aromatic compounds measured in the sample, including non-target aromatics;

Total Non-methane Hydrocarbons (TNMHC) = sum of total alkanes, total alkenes, total aromatics, and all other chromatographic peaks which did not contain halogen compounds;

Total Unidentified Hydrocarbons (TUHC) = sum of all chromatographic peaks known to be hydrocarbon compounds but not identified.

Method 8270 Analytes (Hi-Vol and PS-1 Sampling Systems)

Acenaphthylene;
acetophenone;
2-acetylmninofluorene;
4-aminobiphenyl;
aniline;
anthracene;
benz(a)anthracene;
benz(a)pyrene;
benzidine;
benzo(b)fluoranthene;
benzo(g,h,i)perylene;
benzoic acid;
benzo(k)fluoranthene;
benzyl alcohol;
biphenyl;
bromophenylphenylether;
butylbenzylphthalate;
p-chloroaniline;
chlorobenzilate;
bis(2-chloroethoxy)methane;
bis(2-chloroethyl)ether;
bis(2-chloroisopropylether;
4-chloro-3-methylphenol;
2-chloronaphthalene;
2-chlorophenol;
4-chlorophenylphenyl ether;
chrysene;
diallate;
dibenz(a,h)anthracene;
dibenzofuran;
1,2-dichlorobenzene;
1,3-dichlorobenzene;
1,4-dichlorobenzene;
3,3'-dichlorobenzidine;
2,4-dichlorophenol;
2,6-dichlorophenol;
diethylphthalate;
p-dimethylaminoazobenzene;
dimethylbenz(a)anthracene;
3,3'-dimethylbenzidine;
dimethylphenethylamine;
2,4-dimethylphenol;
dimethylphthalate;
di-n-butylphthalate;
1,3-dinitrobenzene;
4,6-dinitro-2-methylphenol;
2,4-dinitrophenol;
2,4-dinitrotoluene;
2,6-dinitrotoluene;
di-n-octylphthalate;
1,4-diphenylamine;
1,2 diphenylhydrazine;
bis(2-ethylhexyl)phthallate;
N-nitrosodiphenylamine;
ethyl methanesulfonate;
fluoranthene;
fluorene;
hexachlorobenzene;
hexachlorobutadiene;
hexachlorocyclopentadiene;
hexachloroethane;
hexachloropropene;
indeno(1,2,3-cd)pyrene;
isophoron;
isosafrole;
kepone;
methapyrilene;
3-methylcholanthrene;
methyl methanesulfonate;
2-methylnaphthalene;
2-methylphenol;
4-methylphenol;
3-methylphenol;
naphthalene;
1,4-naphthoquinone;
1-naphthylamine;
2-naphthylamine;
2-nitroaniline;
3-nitroaniline;
4-nitroaniline;
nitrobenzene;
5-nitro-o-toluidine;
2-nitrophenol;
4-nitrophenol;
4-nitroquinoline-1-oxide;
N-nitrosodiethylamine;
N-nitrosodimethylamine;
N-nitroso-di-n-butylamine;
N-nitroso-di-n-propylamine;
N-nitrosomethylethylamine;
N-nitrosomorpholine;
N-nitrosopiperidine;
N-nitrosopyrrolidine;
pentachlorobenzene;
pentachloroethane;
pentachloronitrobenzene;
pentachlorophenol;
perylene;
phenacetin;
phenanthrene;
phenol;
2-picoline;
pronamide;
pyrene;
pyridine;
safrole;
1,2,4,5-tetrachlorobenzene;
2,3,4,6-tetrachlorophenol;
o-toluidine;
1,2,4-trichlorobenzene;
2,4,5-trichlorophenol;
2,4,6-trichlorophenol;
triethylphosphorothioate;
1,3,5-trinitrobenzene.

Energetic Target Analytes

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX);
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX);
methyl-2,4,5-trinitrophenylnitramine (TETRYL);
2,6 dichlorphenol;
nitrobenzene;
dibenzofuran;
2,6-dichlorophenol;
1,3,5-trinitrobenzene;
1,3-dinitrobenzene;
2-nitrodiphenylamine;

2,4,6-trinitrotoluene (TNT);
2-amino-4,6-dinitrotoluene;
2,4-dinitrotoluene;
2-nitronaphthalene;
1-nitropyrene;
4-nitrotoluene ;
nitroglycerin (NG);
nitrocellulose (NC);
pentaerythritol tetranitrate (PETN);
phenol.

4-amino-2,6-dinitrotoluene;
2,6-dinitrotoluene;
2-methylnaphthalene;
naphthalene;
2-nitrotoluene;
3-nitrotoluene;
nitroguanidine (NQ);
Benz(A)pyrene;
benz(a)anthracene;

Polychlorinated dibenzo-p-furan Analytes (Furans)

Total chlorinated dibenz-p-dioxin (TCDD);
Total pentachlorinated dibenzo-p-dioxin (PeCDD);
Total hexachlorinated dibenzo-p-dioxin (HxCDD);
Total heptachlorinated dibenzo-p-dioxin (HpCDD);
Octachlorinated dibenzo-p-dioxin (OCDD);
2378-TCDD; 1234678-HpCDD.

Polychorinated dibenzo-p-dioxin Analytes (Dioxins)

Total tetrachlorinated dibenzofurans (TCDF);
Total pentachlorinated dibenzofurans (PeCDF);
Total hexachlorinated dibenzofurans (HxCDF);
Total heptachlorinated dibenzofurans (HpCDF);
Octachlorinated dibenzofuran (OCDF);

2378-TCDF;	12378-PeCDF;	23478-PeCDF;
123478-HxCDF;	123678-HxCDF;	234678-HxCDF;
1234678-HpCDF;	1234789-HpCDF.	

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Appendix D
Emission Factors for Burns

SPECIAL NOTES:

The emission factors in this database apply to the open burning of energetic materials in a burn pan. A value of 0.00e+00 means that the compound (analyte) was either not detected, or, was detected at only the background level. Values of 0.00e+00 were not used in calculating the average (AVG) emission factors in the database. A blank cell means that either no sample was collected or that the sample collected was either lost or not valid.

The emission factors in this table are unitless. The user can convert them to any mass units desired (e.g., grams compound per gram NEW). A value e-06 means that the quantity in the numerator is to be multiplied by 10 to the -6 power. For example, 1.1 e-06 could be written as either 1.1 x 10^{-6} g/g NEW or 1 microgram/g NEW.

NOTE - M-3 PROPELLANT SHOULD BE M-1 PROPELLANT IN THIS APPENDIX

ED_001691B_00006003

COMPOUND	ITEM	EMISSION FACTORS				
		TRIAL 1	TRIAL 2	TRIAL 3	AVERAGE	UNCORR
cis-2-Pentene	diesel furel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Manufacturer's waste - aluminized propellant with diesel	3.80e-07	3.10e-07	1.00e-06	5.60e-07	6.60e-07
cis-2-Pentene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, M-43 (USN)	9.10e-08			9.10e-08	9.10e-08
cis-2-Pentene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, MK-23	0.00e+00			0.00e+00	9.80e-08
cis-2-Pentene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Propellant, PBXN-110	0.00e+00			0.00e+00	1.00e-07
cis-2-Pentene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butane	Diesel fuel and dunnage	0.00e+00	1.20e-06	0.00e+00	1.20e-06	1.40e-06
i-Butane	Manufacturer's waste - aluminized propellant with diesel	2.30e-07	1.80e-06	2.10e-06	1.40e-06	2.30e-06
i-Butane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butane	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.80e-06
i-Butane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	1.80e-07
i-Butane	Propellant, M-9	4.30e-08			4.30e-08	8.50e-08
i-Butane	Propellant, MK-23	0.00e+00			0.00e+00	2.00e-07
i-Butane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butane	Propellant, PBXN-110	0.00e+00			0.00e+00	2.00e-07
i-Butane	Propellant, Smokey Sam	0.00e+00			0.00e+00	7.80e-07
i-Butane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	9.60e-07
i-Butene	Diesel fuel and dunnage	0.00e+00	1.70e-06	2.30e-06	2.00e-06	2.00e-06
i-Butene	Manufacturer's waste - aluminized propellant with diesel	1.30e-05	2.10e-06	2.60e-06	5.80e-06	5.80e-06
i-Butene	Propellant, ammonium perchlorate, aluminized	1.00e-05	0.00e+00		1.00e-05	1.00e-05
i-Butene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butene	Propellant, M-3	7.90e-07	0.00e+00	0.00e+00	7.90e-07	8.00e-07
i-Butene	Propellant, M-43 (USN)	5.40e-07			5.40e-07	5.40e-07
i-Butene	Propellant, M-9	2.60e-07			2.60e-07	2.60e-07
i-Butene	Propellant, MK-23	4.90e-07			4.90e-07	4.90e-07
i-Butene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Butene	Propellant, PBXN-110	1.30e-06			1.30e-06	1.30e-06
i-Butene	Propellant, Smokey Sam	2.40e-06			2.40e-06	2.40e-06
i-Butene	Smokeless Powder (Hercules Unique)	9.60e-07			9.60e-07	9.60e-07

i-Pentane	Diesel fuel and dunnage	0.00e+00	6.90e-06	1.10e-05	8.90e-06	1.00e-05
i-Pentane	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	0.00e+00	2.30e-05	2.30e-05	1.80e-05
i-Pentane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Pentane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Pentane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Pentane	Propellant, M-3	3.00e-08	0.00e+00	0.00e+00	3.00e-08	1.80e-07
i-Pentane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	3.60e-07
i-Pentane	Propellant, M-9	0.00e+00			0.00e+00	8.50e-08
i-Pentane	Propellant, MK-23	0.00e+00			0.00e+00	6.90e-07
i-Pentane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Pentane	Propellant, PBXN-110	0.00e+00			0.00e+00	1.00e-06
i-Pentane	Propellant, Smokey Sam	7.80e-07			7.80e-07	2.70e-06
i-Pentane	Smokeless Powder (Hercules Unique)	1.20e-06			1.20e-06	3.80e-06
m-Ethyltoluene	Diesel fuel and dunnage	1.10e-04	1.40e-04	1.40e-04	1.30e-04	4.60e-04
m-Ethyltoluene	Manufacturer's waste - aluminized propellant with diesel	2.20e-06	1.50e-06	4.10e-06	2.60e-06	6.90e-05
m-Ethyltoluene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
m-Ethyltoluene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
m-Ethyltoluene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
m-Ethyltoluene	Propellant, M-3	5.00e-08	0.00e+00	1.40e-07	9.70e-08	5.50e-07
m-Ethyltoluene	Propellant, M-43 (USN)	0.00e+00			0.00e+00	3.60e-07
m-Ethyltoluene	Propellant, M-9	4.30e-08			4.30e-08	6.00e-07
m-Ethyltoluene	Propellant, MK-23	3.00e-07			3.00e-07	9.80e-07
m-Ethyltoluene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
m-Ethyltoluene	Propellant, PBXN-110	2.00e-07			2.00e-07	7.00e-07
m-Ethyltoluene	Propellant, Smokey Sam	2.00e-06			2.00e-06	5.90e-06
m-Ethyltoluene	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	2.20e-06
n-Butane	Diesel fuel and dunnage	1.30e-06	6.80e-06	5.70e-06	4.60e-06	5.40e-06
n-Butane	Manufacturer's waste - aluminized propellant with diesel	5.50e-06	2.40e-06	2.00e-05	9.30e-06	1.80e-05
n-Butane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Butane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Butane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Butane	Propellant, M-3	9.00e-08	1.80e-07	0.00e+00	1.50e-07	5.60e-07
n-Butane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	5.40e-07
n-Butane	Propellant, M-9	4.30e-08			4.30e-08	3.40e-07
n-Butane	Propellant, MK-23	0.00e+00			0.00e+00	5.90e-07
n-Butane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Butane	Propellant, PBXN-110	1.00e-07			1.00e-07	6.00e-07
n-Butane	Propellant, Smokey Sam	0.00e+00			0.00e+00	2.70e-06
n-Butane	Smokeless Powder (Hercules Unique)	4.80e-07			4.80e-07	3.80e-06
n-Decane	Diesel fuel and dunnage	1.50e-03	0.00e+00	2.00e-03	1.80e-03	1.80e-03
n-Decane	Manufacturer's waste - aluminized propellant with diesel	9.20e-06	1.10e-05	2.30e-05	1.40e-05	3.10e-05

n-Decane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Decane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Decane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Decane	Propellant, M-3	4.20e-07	8.70e-07	1.40e-07	5.90e-07	1.90e-06
n-Decane	Propellant, M-43 (USN)	8.20e-07			8.20e-07	3.70e-06
n-Decane	Propellant, M-9	0.00e+00			0.00e+00	1.30e-06
n-Decane	Propellant, MK-23	0.00e+00			0.00e+00	3.20e-06
n-Decane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Decane	Propellant, PBXN-110	1.30e-06			1.30e-06	4.40e-06
n-Decane	Propellant, Smokey Sam	5.90e-06			5.90e-06	2.20e-05
n-Decane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	8.60e-06
n-Heptane	Diesel fuel and dunnage	3.10e-05	8.00e-05	6.60e-05	5.90e-05	6.00e-05
n-Heptane	Manufacturer's waste - aluminized propellant with diesel	3.50e-06	2.40e-06	8.30e-06	4.70e-06	7.30e-06
n-Heptane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Heptane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Heptane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Heptane	Propellant, M-3	2.70e-07	5.10e-07	9.40e-08	3.10e-07	1.60e-06
n-Heptane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	2.70e-07
n-Heptane	Propellant, M-9	0.00e+00			0.00e+00	1.10e-06
n-Heptane	Propellant, MK-23	0.00e+00			0.00e+00	4.90e-07
n-Heptane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Heptane	Propellant, PBXN-110	0.00e+00			0.00e+00	8.00e-07
n-Heptane	Propellant, Smokey Sam	2.00e-06			2.00e-06	3.10e-06
n-Heptane	Smokeless Powder (Hercules Unique)	7.20e-07			7.20e-07	1.20e-06
n-Hexane	Diesel fuel and dunnage	6.40e-06	2.30e-05	1.90e-05	1.60e-05	1.70e-05
n-Hexane	Manufacturer's waste - aluminized propellant with diesel	2.70e-06	1.50e-06	6.70e-06	3.70e-06	5.70e-06
n-Hexane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Hexane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Hexane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Hexane	Propellant, M-3	1.60e-05	1.40e-05	4.90e-06	1.90e-05	9.00e-05
n-Hexane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	3.60e-07
n-Hexane	Propellant, MK-23	0.00e+00			0.00e+00	7.90e-07
n-Hexane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Hexane	Propellant, PBXN-110	0.00e+00			0.00e+00	1.30e-06
n-Hexane	Propellant, Smokey Sam	2.70e-06			2.70e-06	3.90e-06
n-Hexane	Smokeless Powder (Hercules Unique)	9.60e-07			9.60e-07	2.20e-06
n-Nonane	Diesel fuel and dunnage	8.00e-04	1.20e-03	1.10e-03	1.00e-03	1.00e-03
n-Nonane	Manufacturer's waste - aluminized propellant with diesel	1.10e-05	7.60e-06	2.10e-05	1.30e-05	2.40e-05
n-Nonane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Nonane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Nonane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

n-Nonane	Propellant, M-3	7.80e-08	1.40e-07	0.00e+00	1.20e-07	2.30e-07
n-Nonane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	9.10e-08
n-Nonane	Propellant, M-9	0.00e+00			0.00e+00	1.70e-07
n-Nonane	Propellant, MK-23	0.00e+00			0.00e+00	2.00e-07
n-Nonane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Nonane	Propellant, PBXN-110	2.00e-07			2.00e-07	5.00e-07
n-Nonane	Propellant, Smokey Sam	1.20e-06			1.20e-06	1.60e-06
n-Nonane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	4.80e-07
n-Octane	Diesel fuel and dunnage	1.50e-04	3.20e-04	2.80e-04	2.50e-04	2.50e-04
n-Octane	Manufacturer's waste - aluminized propellant with diesel	6.30e-06	4.20e-06	1.20e-05	7.60e-06	1.30e-05
n-Octane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Octane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Octane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Octane	Propellant, M-3	2.90e-07	6.40e-07	1.90e-07	4.30e-07	1.60e-06
n-Octane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	2.70e-07
n-Octane	Propellant, M-9	0.00e+00			0.00e+00	1.10e-06
n-Octane	Propellant, MK-23	0.00e+00			0.00e+00	2.00e-07
n-Octane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Octane	Propellant, PBXN-110	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Octane	Propellant, Smokey Sam	1.20e-06			1.20e-06	1.60e-06
n-Octane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	4.80e-07
n-Pentane	Diesel fuel and dunnage	2.00e-06	1.30e-05	1.20e-05	9.10e-06	1.00e-05
n-Pentane	Manufacturer's waste - aluminized propellant with diesel	2.60e-06	1.10e-06	9.00e-06	4.30e-06	7.20e-06
n-Pentane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Pentane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Pentane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Pentane	Propellant, M-3	5.30e-07	1.50e-06	4.20e-07	8.60e-07	3.30e-06
n-Pentane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	3.60e-07
n-Pentane	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Pentane	Propellant, MK-23	0.00e+00			0.00e+00	7.90e-07
n-Pentane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
n-Pentane	Propellant, PBXN-110	0.00e+00			0.00e+00	1.10e-06
n-Pentane	Propellant, Smokey Sam	7.80e-07			7.80e-07	2.70e-06
n-Pentane	Smokeless Powder (Hercules Unique)	9.60e-07			9.60e-07	2.60e-06
p-Ethyltoluene	Diesel fuel and dunnage	1.20e-04	1.70e-04	1.70e-04	1.50e-04	1.60e-04
p-Ethyltoluene	Manufacturer's waste - aluminized propellant with diesel	5.40e-06	2.90e-06	6.70e-06	5.00e-06	8.10e-06
p-Ethyltoluene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, M-3	5.60e-07	3.20e-07	2.20e-06	9.80e-07	2.10e-06
p-Ethyltoluene	Propellant, M-43 (USN)	1.80e-07			1.80e-07	9.10e-07

p-Ethyltoluene	Propellant, M-9	4.00e-06			4.00e-06	5.50e-06
p-Ethyltoluene	Propellant, MK-23	0.00e+00			0.00e+00	1.10e-06
p-Ethyltoluene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, PBXN-110	3.00e-07			3.00e-07	1.40e-06
p-Ethyltoluene	Propellant, Smokey Sam	7.10e-06			7.10e-06	1.10e-05
p-Ethyltoluene	Smokeless Powder (Hercules Unique)	4.80e-07			4.80e-07	2.40e-06
p-Ethyltoluene	Diesel fuel and dunnage	1.20e-04	6.60e-06	6.90e-07	4.10e-05	4.20e-05
p-Ethyltoluene	Manufacturer's waste - aluminized propellant with diesel	2.00e-06	2.00e-06	0.00e+00	2.00e-06	5.30e-06
p-Ethyltoluene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, M-3	0.00e+00	2.00e-07	2.80e-08	3.70e-08	5.70e-07
p-Ethyltoluene	Propellant, M-43 (USN)	0.00e+00			0.00e+00	3.90e-07
p-Ethyltoluene	Propellant, M-9	0.00e+00			0.00e+00	7.20e-07
p-Ethyltoluene	Propellant, MK-23	0.00e+00			0.00e+00	4.20e-07
p-Ethyltoluene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Propellant, PBXN-110	4.30e-07			4.30e-07	8.50e-07
p-Ethyltoluene	Propellant, Smokey Sam	1.70e-06			1.70e-06	3.30e-06
p-Ethyltoluene	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	1.00e-06
trans-2-Butene	Diesel fuel and dunnage	3.60e-06	1.80e-06	3.30e-06	2.90e-06	2.90e-06
trans-2-Butene	Manufacturer's waste - aluminized propellant with diesel	2.70e-05	1.40e-05	2.10e-05	2.10e-05	2.10e-05
trans-2-Butene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Propellant, M-3	1.90e-07	0.00e+00	0.00e+00	1.90e-07	1.90e-07
trans-2-Butene	Propellant, M-43 (USN)	1.80e-07			1.80e-07	1.80e-07
trans-2-Butene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Propellant, MK-23	2.00e-07			2.00e-07	2.00e-07
trans-2-Butene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Propellant, PBXN-110	4.00e-07			4.00e-07	4.00e-07
trans-2-Butene	Propellant, Smokey Sam	2.40e-06			2.40e-06	2.40e-06
trans-2-Butene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Hexene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Hexene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Diesel fuel and dunnage	0.00e+00	0.00e+00	1.10e-06	1.10e-06	1.10e-06
trans-2-Pentene	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	3.80e-07	1.50e-06	9.60e-07	1.20e-06
trans-2-Pentene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

trans-2-Pentene	Propellant, MK-23	0.00e+00			0.00e+00	9.80e-08
trans-2-Pentene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Propellant, PBXN-110	0.00e+00			0.00e+00	2.00e-07
trans-2-Pentene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Acetylene	Diesel fuel and dunnage	1.20e-04	7.30e-05	9.10e-05	9.50e-05	9.60e-05
Acetylene	Manufacturer's waste - aluminized propellant with diesel	1.80e-03	1.30e-03	1.50e-03	1.60e-03	1.60e-03
Acetylene	Propellant, ammonium perchlorate, aluminized	1.00e-05	0.00e+00		1.00e-05	1.00e-05
Acetylene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Acetylene	Propellant, composite (MK-6) (Sandia)	2.10e-05			2.10e-05	
Acetylene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Acetylene	Propellant, double base (Sandia)	2.00e-04			2.00e-04	
Acetylene	Propellant, M-3	7.70e-06	1.50e-05	1.90e-05	1.30e-05	7.90e-06
Acetylene	Propellant, M-43 (USN)	5.90e-06			5.90e-06	6.40e-06
Acetylene	Propellant, M-9	9.00e-06			9.00e-06	9.20e-06
Acetylene	Propellant, MK-23	5.50e-06			5.50e-06	6.20e-06
Acetylene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Acetylene	Propellant, PBXN-110	3.10e-06			3.10e-06	3.70e-06
Acetylene	Propellant, Smokey Sam	8.30e-04			8.30e-04	8.30e-04
Acetylene	Smokeless Powder (Hercules Unique)	1.20e-06			1.20e-06	3.60e-06
Acenaphthalene	Manufacturer's waste - aluminized propellant with diesel	1.10e-04	5.00e-04	3.20e-04	1.60e-04	0.00e+00
Aluminum	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.50e-06
Aluminum	Manufacturer's waste - aluminized propellant with diesel	6.10e-03	8.50e-03	9.30e-02	3.60e-02	3.60e-02
Aluminum	Propellant, ammonium perchlorate, aluminized	9.40e-03	1.20e-02		1.10e-02	1.10e-02
Aluminum	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.00e-05
Aluminum	Propellant, composite (MK-6) (Sandia)	1.30e-03			1.30e-03	
Aluminum	Propellant, M-3	6.80e-07	8.50e-07	1.40e-05	5.10e-06	5.10e-06
Aluminum	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Manufacturer's waste - aluminized propellant with diesel	1.60e-05	2.00e-05	2.20e-04	8.60e-05	8.90e-05
Barium	Propellant, ammonium perchlorate, aluminized	1.00e-05	1.00e-05		1.00e-05	1.00e-05
Barium	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Propellant, composite (MK-6) (Sandia)	1.60e-06			1.60e-06	
Barium	Propellant, double base (Sandia)	0.00e+00			0.00e+00	
Barium	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Benzene	Diesel fuel and dunnage	1.00e-04	5.20e-05	8.10e-05	7.80e-05	8.00e-05
Benzene	Manufacturer's waste - aluminized propellant with diesel	6.40e-04	2.90e-04	4.10e-04	4.50e-04	4.50e-04
Benzene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Benzene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Benzene	Propellant, composite (MK-6) (Sandia)	5.70e-05			5.70e-05	
Benzene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Benzene	Propellant, double base (Sandia)	1.20e-04			1.20e-04	
Benzene	Propellant, M-3	6.40e-06	1.10e-05	1.40e-05	1.00e-05	7.70e-06
Benzene	Propellant, M-43 (USN)	1.70e-06			1.70e-06	2.30e-06
Benzene	Propellant, M-9	3.20e-06			3.20e-06	4.20e-06
Benzene	Propellant, MK-23	0.00e+00			0.00e+00	2.00e-06
Benzene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Benzene	Propellant, PBXN-110	4.90e-06			4.90e-06	7.70e-06
Benzene	Propellant, Smokey Sam	6.60e-05			6.60e-05	7.00e-05
Benzene	Smokeless Powder (Hercules Unique)	1.20e-06			1.20e-06	3.10e-06
Carbon tetrachloride	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.90e-07
Carbon tetrachloride	Manufacturer's waste - aluminized propellant with diesel	3.30e-06	6.30e-06	7.30e-06	5.60e-06	6.00e-06
Carbon tetrachloride	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Propellant, M-43 (USN)	0.00e+00			0.00e+00	5.00e-07
Carbon tetrachloride	Propellant, M-9	2.30e-07			2.30e-07	2.30e-07
Carbon tetrachloride	Propellant, MK-23	1.10e-06			1.10e-06	1.60e-06
Carbon tetrachloride	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Propellant, PBXN-110	0.00e+00			0.00e+00	5.50e-07
Carbon tetrachloride	Propellant, Smokey Sam	0.00e+00			0.00e+00	2.20e-06
Carbon tetrachloride	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	1.30e-06
Chloroform	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Manufacturer's waste - aluminized propellant with diesel	2.20e-06	2.40e-06	2.30e-06	2.30e-06	2.50e-06
Chloroform	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, MK-23	4.20e-07			4.20e-07	4.20e-07
Chloroform	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, PBXN-110	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Propellant, ammonium perchlorate, aluminized	1.00e-05	1.00e-05		1.00e-05	1.00e-05
Chromium	Propellant, ammonium perchlorate, nonaluminized	1.00e-05	1.00e-05		1.00e-05	1.00e-05

Chromium	Propellant, composite (MK-6) (Sandia)	4.80e-05			4.80e-05	
Chromium	Propellant, double base (Sandia)	0.00e+00			0.00e+00	
Chromium	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cl2	Manufacturer's waste - aluminized propellant with diesel	2.80e-04	1.50e-05	1.60e-04	2.00e-04	
Cl2	Propellant, ammonium perchlorate, aluminized	5.00e-03	4.20e-03		4.60e-03	
Cl2	Propellant, ammonium perchlorate, nonaluminized	1.10e-02	8.20e-03		9.20e-03	
Copper	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Manufacturer's waste - aluminized propellant with diesel	1.50e-05	0.00e+00	0.00e+00	1.50e-05	1.90e-05
Copper	Propellant, ammonium perchlorate, nonaluminized	5.00e-05	1.00e-04		8.00e-05	8.00e-05
Copper	Propellant, double base	0.00e+00	3.20e-04		1.60e-04	1.60e-04
Copper	Propellant, double base (Sandia)	3.70e-02			3.70e-02	
Copper	Propellant, M-3	3.40e-06	8.30e-06	2.50e-06	4.40e-06	2.90e-05
Copper	Propellant, M-9	6.50e-06			6.50e-06	4.60e-05
Copper	Propellant, M31A1E1	1.00e-05			1.00e-05	
Cyclohexane	Diesel fuel and dunnage	1.30e-05	3.80e-05	3.00e-05	2.70e-05	2.70e-05
Cyclohexane	Manufacturer's waste - aluminized propellant with diesel	1.70e-06	9.20e-07	3.30e-06	2.00e-06	3.40e-06
Cyclohexane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Propellant, M-3	1.30e-07	1.40e-07	0.00e+00	1.50e-07	5.00e-07
Cyclohexane	Propellant, M-43 (USN)	9.10e-08			9.10e-08	1.80e-07
Cyclohexane	Propellant, M-9	0.00e+00			0.00e+00	4.70e-07
Cyclohexane	Propellant, MK-23	0.00e+00			0.00e+00	3.90e-07
Cyclohexane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Propellant, PBXN-110	0.00e+00			0.00e+00	8.00e-07
Cyclohexane	Propellant, Smokey Sam	1.20e-06			1.20e-06	2.00e-06
Cyclohexane	Smokeless Powder (Hercules Unique)	4.80e-07			4.80e-07	9.60e-07
Cyclopentane	Diesel fuel and dunnage	0.00e+00	1.50e-06	1.40e-06	1.50e-06	1.50e-06
Cyclopentane	Manufacturer's waste - aluminized propellant with diesel	1.50e-07	7.60e-08	5.40e-07	2.50e-07	4.30e-07
Cyclopentane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.70e-08
Cyclopentane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	9.10e-08
Cyclopentane	Propellant, M-9	4.30e-08			4.30e-08	8.50e-08
Cyclopentane	Propellant, MK-23	0.00e+00			0.00e+00	9.80e-08
Cyclopentane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Propellant, PBXN-110	0.00e+00			0.00e+00	2.00e-07
Cyclopentane	Propellant, Smokey Sam	0.00e+00			0.00e+00	3.90e-07
Cyclopentane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	2.40e-07

Cyclopentene	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Manufacturer's waste - aluminized propellant with diesel	9.80e-07	7.60e-07	1.10e-06	9.40e-07	9.40e-07
Cyclopentene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, M-43 (USN)	9.10e-08			9.10e-08	9.10e-08
Cyclopentene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, MK-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Propellant, PBXN-110	1.00e-07			1.00e-07	1.00e-07
Cyclopentene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
CO	Diesel fuel and dunnage	7.40e-03	4.70e-03	6.00e-03	6.00e-03	
CO	Manufacturer's waste - aluminized propellant with diesel	2.20e-02	1.90e-02	1.90e-02	2.00e-02	
CO	Propellant, ammonium perchlorate, aluminized	2.10e-03	3.50e-04		1.20e-03	
CO	Propellant, ammonium perchlorate, nonaluminized	1.30e-04	1.50e-04		1.40e-04	
CO	Propellant, composite (MK-6) (Sandia)	4.20e-03			4.20e-03	
CO	Propellant, double base	1.50e-03	1.50e-03		1.50e-03	
CO	Propellant, double base (Sandia)	9.50e-04			9.50e-04	
CO	Propellant, M-3	1.60e-02	1.60e-02	1.80e-02	1.40e-02	
CO	Propellant, M-43 (USN)	6.60e-04			6.60e-04	
CO	Propellant, M-9	2.70e-03			2.70e-03	
CO	Propellant, MK-23	2.70e-04			2.70e-04	
CO	Propellant, M31A1E1	1.40e-04	1.10e-04	1.30e-04	1.30e-04	
CO	Propellant, PBXN-110	1.20e-03			1.20e-03	
CO	Propellant, Smokey Sam	7.20e-02			7.20e-02	
CO	Smokeless Powder (Hercules Unique)	1.60e-03			1.60e-03	
CO2	Diesel fuel and dunnage	1.50e+00	1.50e+00	1.50e+00	1.50e+00	
CO2	Manufacturer's waste - aluminized propellant with diesel	1.10e+00	1.10e+00	1.20e+00	1.10e+00	
CO2	Propellant, ammonium perchlorate, aluminized	3.10e-01	3.20e-01		3.20e-01	
CO2	Propellant, ammonium perchlorate, nonaluminized	3.70e-01	3.70e-01		3.70e-01	
CO2	Propellant, composite (MK-6) (Sandia)	4.20e-01			4.20e-01	
CO2	Propellant, double base	6.70e-01	6.70e-01		6.70e-01	
CO2	Propellant, double base (Sandia)	9.70e-01			9.70e-01	
CO2	Propellant, M-3	1.20e+00	1.20e+00	1.20e+00	1.20e+00	
CO2	Propellant, M-43 (USN)	7.70e-01			7.70e-01	
CO2	Propellant, M-9	9.40e-01			9.40e-01	
CO2	Propellant, MK-23	5.40e-01			5.40e-01	
CO2	Propellant, M31A1E1	5.40e-01	5.60e-01	6.80e-01	5.90e-01	
CO2	[illegible]	1.00e+00			1.00e+00	
CO2	[illegible]	4.20e-01			4.20e-01	

CO2	Smokeless Powder (Hercules Unique)	8.70e-01			8.70e-01	
Ethane	Diesel fuel and dunnage	0.00e+00	7.20e-06	1.20e-05	9.30e-06	1.00e-05
Ethane	Manufacturer's waste - aluminized propellant with diesel	1.80e-05	3.80e-06	6.90e-06	9.50e-06	1.00e-05
Ethane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethane	Propellant, M-3	1.10e-06	1.20e-06	2.80e-07	1.30e-06	1.50e-06
Ethane	Propellant, M-43 (USN)	1.80e-07			1.80e-07	1.50e-06
Ethane	Propellant, M-9	5.60e-07			5.60e-07	1.40e-06
Ethane	Propellant, MK-23	0.00e+00			0.00e+00	9.80e-07
Ethane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethane	Propellant, PBXN-110	1.00e-06			1.00e-06	2.10e-06
Ethane	Propellant, Smokey Sam	0.00e+00			0.00e+00	5.50e-06
Ethane	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	2.60e-06
Ethylbenzene	Diesel fuel and dunnage	4.30e-05	6.20e-05	6.10e-05	5.50e-05	5.70e-05
Ethylbenzene	Manufacturer's waste - aluminized propellant with diesel	2.30e-06	1.30e-06	3.50e-06	2.40e-06	4.20e-06
Ethylbenzene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylbenzene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylbenzene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylbenzene	Propellant, M-3	3.00e-07	0.00e+00	1.40e-07	2.60e-07	1.00e-06
Ethylbenzene	Propellant, M-43 (USN)	0.00e+00			0.00e+00	3.60e-07
Ethylbenzene	Propellant, M-9	0.00e+00			0.00e+00	8.50e-07
Ethylbenzene	Propellant, MK-23	0.00e+00			0.00e+00	6.90e-07
Ethylbenzene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylbenzene	Propellant, PBXN-110	8.00e-07			8.00e-07	1.60e-06
Ethylbenzene	Propellant, Smokey Sam	1.20e-06			1.20e-06	2.70e-06
Ethylbenzene	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	1.20e-06
Ethylene	Diesel fuel and dunnage	6.60e-05	7.20e-05	8.50e-05	7.40e-05	7.50e-05
Ethylene	Manufacturer's waste - aluminized propellant with diesel	3.10e-04	1.60e-04	2.30e-04	2.30e-04	2.30e-04
Ethylene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylene	Propellant, M-3	5.80e-06	8.80e-06	3.30e-06	7.80e-06	5.90e-06
Ethylene	Propellant, M-43 (USN)	4.80e-06			4.80e-06	5.00e-06
Ethylene	Propellant, M-9	6.50e-06			6.50e-06	6.60e-06
Ethylene	Propellant, MK-23	9.80e-07			9.80e-07	1.20e-06
Ethylene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylene	Propellant, PBXN-110	6.70e-06			6.70e-06	6.80e-06
Ethylene	Propellant, Smokey Sam	7.20e-05			7.20e-05	7.30e-05
Ethylene	Smokeless Powder (Hercules Unique)	2.40e-07			2.40e-07	1.40e-06
Fluoranthene	Manufacturer's waste - aluminized propellant with diesel	5.00e-05	0.00e+00	3.60e-04	2.00e-04	2.00e-04

HCl	Propellant, ammonium perchlorate, aluminized	2.10e-01	2.10e-01		2.10e-01	2.10e-01
HCl	Propellant, ammonium perchlorate, nonaluminized	2.10e-01	2.15e-01		2.15e-01	2.15e-01
HCl	Propellant, composite (MK-6) (Sandia)	9.40e-02			9.40e-02	
HCl	Propellant, M-43 (USN)	1.00e-03			1.00e-03	1.00e-03
HCl	Propellant, MK-23 .	1.90e-03			1.90e-03	1.90e-03
HCl	Propellant, PBXN-110	1.80e-04			1.80e-04	1.80e-04
HCl	Propellant, Smokey Sam	2.90e-02			2.90e-02	2.90e-02
HCl	Manufacturer's waste - aluminized propellant with diesel	8.50e-02	7.70e-02	8.80e-02	8.30e-02	
Lead	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	7.30e-05	4.90e-04	2.80e-04	2.80e-04
Lead	Propellant, ammonium perchlorate, aluminized	4.00e-05			4.00e-05	4.00e-05
Lead	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Propellant, double base	5.80e-03	5.50e-03		5.60e-03	5.60e-03
Lead	Propellant, double base (Sandia)	1.30e-02			1.30e-02	
Lead	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Manufacturer's waste - aluminized propellant with diesel	2.70e-05	1.40e-05	1.90e-05	2.00e-05	2.00e-05
Methyl chloride	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Propellant, M-3	1.60e-07	0.00e+00	1.10e-07	1.40e-07	4.50e-07
Methyl chloride	Propellant, M-43 (USN)	0.00e+00			0.00e+00	1.60e-07
Methyl chloride	Propellant, M-9	1.50e-07			1.50e-07	3.10e-07
Methyl chloride	Propellant, MK-23	7.10e-07			7.10e-07	8.90e-07
Methyl chloride	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Propellant, PBXN-110	1.80e-07			1.80e-07	1.80e-07
Methyl chloride	Propellant, Smokey Sam	5.70e-06			5.70e-06	6.40e-06
Methyl chloride	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	4.30e-07
Methylcyclohexane	Diesel fuel and dunnage	8.40e-05	2.10e-04	1.70e-04	1.60e-04	1.60e-04
Methylcyclohexane	Manufacturer's waste - aluminized propellant with diesel	7.30e-06	4.40e-06	1.20e-05	8.00e-06	1.40e-05
Methylcyclohexane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Propellant, M-3	9.90e-08	0.00e+00	4.70e-08	5.80e-08	4.30e-07
Methylcyclohexane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	1.80e-07
Methylcyclohexane	Propellant, M-9	0.00e+00			0.00e+00	4.70e-07
Methylcyclohexane	Propellant, MK-23	0.00e+00			0.00e+00	3.90e-07
Methylcyclohexane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Propellant, PBXN-110	0.00e+00			0.00e+00	5.00e-07
Methylcyclohexane	Propellant, Smokey Sam	7.80e-07			7.80e-07	1.60e-06

Methylcyclohexane	Smokeless Powder (Hercules Unique)	4.80e-07			4.80e-07	9.60e-07
Methylcyclopentane	Diesel fuel and dunnage	4.20e-06	1.40e-05	1.10e-05	9.90e-06	1.00e-05
Methylcyclopentane	Manufacturer's waste - aluminized propellant with diesel	7.60e-08	3.80e-07	2.70e-06	1.10e-06	2.00e-06
Methylcyclopentane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclopentane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclopentane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclopentane	Propellant, M-3	2.10e-06	2.00e-06	6.60e-07	2.50e-06	1.10e-05
Methylcyclopentane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	1.80e-07
Methylcyclopentane	Propellant, M-9	0.00e+00			0.00e+00	1.70e-06
Methylcyclopentane	Propellant, MK-23	0.00e+00			0.00e+00	4.90e-07
Methylcyclopentane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclopentane	Propellant, PBXN-110	0.00e+00			0.00e+00	7.00e-07
Methylcyclopentane	Propellant, Smokey Sam	1.60e-06			1.60e-06	2.00e-06
Methylcyclopentane	Smokeless Powder (Hercules Unique)	7.20e-07			7.20e-07	1.20e-06
Methylenechloride	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylenechloride	Manufacturer's waste - aluminized propellant with diesel	1.50e-05	9.80e-06	0.00e+00	1.20e-05	1.10e-05
Methylenechloride	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylenechloride	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylenechloride	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylenechloride	Propellant, M-3	5.60e-06	0.00e+00	5.20e-05	2.30e-05	5.80e-05
Methylenechloride	Propellant, M-43 (USN)	0.00e+00			0.00e+00	1.10e-06
Methylenechloride	Propellant, M-9	0.00e+00			0.00e+00	4.30e-05
Methylenechloride	Propellant, MK-23	6.00e-07			6.00e-07	6.00e-07
Methylenechloride	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylenechloride	Propellant, PBXN-110	0.00e+00			0.00e+00	9.00e-07
Methylenechloride	Propellant, Smokey Sam	1.20e-06			1.20e-06	4.70e-06
Methylenechloride	Smokeless Powder (Hercules Unique)	7.20e-07			7.20e-07	7.20e-07
NO	Diesel fuel and dunnage	6.30e-04	8.90e-04	8.80e-04	8.00e-04	
NO	Manufacturer's waste - aluminized propellant with diesel	9.30e-04	8.80e-04	1.20e-03	1.00e-03	
NO	Propellant, ammonium perchlorate, aluminized	2.20e-03	1.60e-03		1.90e-03	
NO	Propellant, ammonium perchlorate, nonaluminized	4.10e-03	3.90e-03		4.00e-03	
NO	Propellant, composite (MK-6) (Sandia)	2.10e-03			2.10e-03	
NO	Propellant, double base	1.70e-03	1.70e-03		1.70e-03	
NO	Propellant, double base (Sandia)	2.40e-02			2.40e-02	
NO	Propellant, M-43 (USN)	6.30e-03			6.30e-03	
NO	Propellant, M31A1E1		1.10e-03	1.20e-03	1.20e-03	
NO	Propellant, PBXN-110	2.60e-03			2.60e-03	
NO	Propellant, Smokey Sam	1.10e-02			1.10e-02	
NO2	Diesel fuel and dunnage	0.00e+00	5.10e-05	3.20e-05	4.20e-05	
NO2	Manufacturer's waste - aluminized propellant with diesel	4.40e-07	9.80e-06	9.70e-06	6.60e-06	
NO2	Propellant, ammonium perchlorate, aluminized	2.10e-04	7.00e-05		1.40e-04	

NO2	Propellant, ammonium perchlorate, nonaluminized	4.30e-03	4.70e-04		2.40e-03	
NO2	Propellant, composite (MK-6) (Sandia)	1.00e-03			1.00e-03	
NO2	Propellant, double base	9.00e-05	1.00e-04		1.00e-04	
NO2	Propellant, double base (Sandia)	2.80e-03			2.80e-03	
NO2	Propellant, M-43 (USN)	4.70e-04			4.70e-04	
NO2	Propellant, M31A1E1		1.00e-04	1.00e-04	1.00e-04	
NO2	Propellant, PBXN-110	2.80e-04			2.80e-04	
NO2	Propellant, Smokey Sam	2.70e-04			2.70e-04	
OCDD	Diesel fuel and dunnage	1.00e-11	0.00e+00	0.00e+00	1.00e-11	3.20e-11
OCDF	Manufacturer's waste - aluminized propellant with diesel	4.00e-08			4.00e-08	
Propane	Diesel fuel and dunnage	1.40e-06	2.20e-06	3.10e-06	2.20e-06	2.50e-06
Propane	Manufacturer's waste - aluminized propellant with diesel	4.20e-06	2.80e-06	6.50e-06	4.50e-06	5.00e-06
Propane	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propane	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propane	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propane	Propellant, M-3	3.30e-07	5.10e-07	5.20e-07	5.00e-07	7.20e-07
Propane	Propellant, M-43 (USN)	0.00e+00			0.00e+00	9.10e-07
Propane	Propellant, M-9	0.00e+00			0.00e+00	3.40e-07
Propane	Propellant, MK-23	4.90e-07			4.90e-07	1.30e-06
Propane	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propane	Propellant, PBXN-110	3.00e-07			3.00e-07	1.00e-06
Propane	Propellant, Smokey Sam	1.60e-06			1.60e-06	4.30e-06
Propane	Smokeless Powder (Hercules Unique)	2.40e-07			2.40e-07	3.40e-06
Propene	Diesel fuel and dunnage	1.00e-05	1.30e-05	1.60e-05	1.30e-05	1.30e-05
Propene	Manufacturer's waste - aluminized propellant with diesel	2.50e-05	2.10e-05	3.20e-05	2.60e-05	2.60e-05
Propene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Propene	Propellant, M-3	1.40e-06	2.00e-06	2.10e-06	2.00e-06	1.50e-06
Propene	Propellant, M-43 (USN)	1.10e-06			1.10e-06	1.20e-06
Propene	Propellant, M-9	7.30e-07			7.30e-07	8.10e-07
Propene	Propellant, MK-23	1.70e-06			1.70e-06	1.80e-06
Propene	Propellant, PBXN-110	3.00e-06			3.00e-06	3.10e-06
Propene	Propellant, Smokey Sam	2.70e-06			2.70e-06	2.70e-06
Propene	Smokeless Powder (Hercules Unique)	2.40e-07			2.40e-07	7.20e-07
PM10	Diesel fuel and dunnage	4.70e-03	4.90e-03	6.80e-03	5.40e-03	
PM10	Manufacturer's waste - aluminized propellant with diesel	3.80e-01	4.40e-01	4.90e+00	1.90e+00	
PM10	Propellant, ammonium perchlorate, aluminized	4.10e-01	4.30e-01		4.20e-01	
PM10	Propellant, ammonium perchlorate, nonaluminized	1.10e-02	1.80e-02		1.50e-02	
PM10	Propellant, double base	1.90e-02	1.90e-02		1.90e-02	
PM10	Propellant, M-3	8.80e-03	8.70e-03	8.20e-03	8.60e-03	

PM10	Propellant, M-43 (USN)	1.20e-03			1.20e-03	
PM10	Propellant, M-9	1.60e-02			1.60e-02	
PM10	Propellant, MK-23	5.90e-02			5.90e-02	
PM10	Propellant, M31A1E1	8.90e-01	9.30e-01	9.10e-01	9.10e-01	
PM10	Propellant, PBXN-110	4.90e-01			4.90e-01	
PM10	Propellant, Smokey Sam	2.60e-01			2.60e-01	
PM10	Smokeless Powder (Hercules Unique)	1.80e-03			1.80e-03	
Styrene	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, M-9	4.70e-07			4.70e-07	4.70e-07
Styrene	Propellant, MK-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, M31A1E1	0.00e+00			0.00e+00	1.00e-05
Styrene	Propellant, PBXN-110	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
SO2	Diesel fuel and dunnage	2.10e-04	7.90e-05	2.80e-04	1.90e-04	
SO2	Manufacturer's waste - aluminized propellant with diesel	8.60e-04	8.40e-04	8.80e-04	8.60e-04	
SO2	Propellant, ammonium perchlorate, aluminized	6.00e-05	4.00e-05		5.00e-05	
SO2	Propellant, ammonium perchlorate, nonaluminized	1.10e-04	1.10e-04		1.10e-04	
SO2	Propellant, composite (MK-6) (Sandia)	1.10e-03			1.10e-03	
SO2	Propellant, double base	3.00e-05	2.00e-05		3.00e-05	
SO2	Propellant, double base (Sandia)	3.20e-03			3.20e-03	
SO2	Propellant, M-43 (USN)	1.20e-04			1.20e-04	
SO2	Propellant, M31A1E1	1.00e-03	1.20e-03		1.20e-03	
SO2	Propellant, PBXN-110	3.50e-04			3.50e-04	
SO2	Propellant, Smokey Sam	1.50e-04			1.50e-04	
SO2	Smokeless Powder (Hercules Unique)	6.10e-04			6.10e-04	
Tetrachloroethylene	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	1.60e-06	1.80e-06	1.70e-06	1.70e-06
Tetrachloroethylene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, MK-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, PBXN-110	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Toluene	Diesel fuel and dunnage	8.00e-05	1.50e-04	1.40e-04	1.20e-04	1.30e-04
Toluene	Manufacturer's waste - aluminized propellant with diesel	3.40e-05	1.50e-05	3.40e-05	2.80e-05	3.90e-05
Toluene	Propellant, ammonium perchlorate, aluminized	0.00e+00			0.00e+00	1.00e-05
Toluene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00			0.00e+00	1.00e-05
Toluene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Toluene	Propellant, M-3	1.80e-06	2.00e-06	8.90e-07	1.80e-06	6.60e-06
Toluene	Propellant, M-43 (USN)	5.40e-07			5.40e-07	1.80e-06
Toluene	Propellant, M-9	0.00e+00			0.00e+00	5.40e-06
Toluene	Propellant, MK-23	0.00e+00			0.00e+00	2.90e-06
Toluene	Propellant, M31A1E1	0.00e+00			0.00e+00	3.00e-05
Toluene	Propellant, PBXN-110	0.00e+00			0.00e+00	4.50e-06
Toluene	Propellant, Smokey Sam	8.60e-06			8.60e-06	1.50e-05
Toluene	Smokeless Powder (Hercules Unique)	3.40e-06			3.40e-06	7.40e-06
Total Alkanes (Paraffins)	Diesel fuel and dunnage	2.70e-03	3.90e-03	3.90e-03	3.50e-03	3.50e-03
Total Alkanes (Paraffins)	Manufacturer's waste - aluminized propellant with diesel	9.40e-05	5.80e-05	2.30e-04	1.30e-04	2.30e-04
Total Alkanes (Paraffins)	Propellant, ammonium perchlorate, aluminized	0.00e+00			0.00e+00	2.00e-05
Total Alkanes (Paraffins)	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00		0.00e+00	1.00e-05
Total Alkanes (Paraffins)	Propellant, composite (MK-6) (Sandia)	5.90e-05			5.90e-05	
Total Alkanes (Paraffins)	Propellant, double base	0.00e+00				1.00e-05
Total Alkanes (Paraffins)	Propellant, double base (Sandia)	2.20e-04			2.20e-04	
Total Alkanes (Paraffins)	Propellant, M-3	3.00e-05	2.10e-05	7.40e-06	2.60e-05	1.30e-04
Total Alkanes (Paraffins)	Propellant, M-43 (USN)	5.40e-07			5.40e-07	1.00e-05
Total Alkanes (Paraffins)	Propellant, M-9	0.00e+00			0.00e+00	2.30e-05
Total Alkanes (Paraffins)	Propellant, MK-23	0.00e+00			0.00e+00	1.40e-05
Total Alkanes (Paraffins)	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Total Alkanes (Paraffins)	Propellant, PBXN-110	0.00e+00			0.00e+00	2.00e-05
Total Alkanes (Paraffins)	Propellant, Smokey Sam	2.30e-05			2.30e-05	7.20e-05
Total Alkanes (Paraffins)	Smokeless Powder (Hercules Unique)	6.70e-06			6.70e-06	4.20e-05
Total Alkenes (Olefins)	Diesel fuel and dunnage	2.00e-04	1.70e-04	2.10e-04	1.90e-04	2.00e-04
Total Alkenes (Olefins)	Manufacturer's waste - aluminized propellant with diesel	2.20e-03	1.50e-03	1.90e-03	1.90e-03	1.90e-03
Total Alkenes (Olefins)	Propellant, ammonium perchlorate, aluminized	3.00e-05	1.00e-05		2.00e-05	2.00e-05
Total Alkenes (Olefins)	Propellant, ammonium perchlorate, nonaluminized	1.00e-05	1.00e-05		1.00e-05	1.00e-05
Total Alkenes (Olefins)	Propellant, composite (MK-6) (Sandia)	1.00e-04			1.00e-04	
Total Alkenes (Olefins)	Propellant, double base	0.00e+00	1.00e-05		1.00e-05	1.00e-05
Total Alkenes (Olefins)	Propellant, double base (Sandia)	7.30e-04			7.30e-04	
Total Alkenes (Olefins)	Propellant, M-3	3.60e-05	2.80e-05	2.50e-05	2.90e-05	3.70e-05
Total Alkenes (Olefins)	Propellant, M-43 (USN)	1.30e-05			1.30e-05	1.40e-05
Total Alkenes (Olefins)	Propellant, M-9	1.70e-05			1.70e-05	1.80e-05
Total Alkenes (Olefins)	Propellant, MK-23	1.10e-05			1.10e-05	1.30e-05
Total Alkenes (Olefins)	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.00e-05
Total Alkenes (Olefins)	Propellant, PBXN-110	1.60e-05			1.60e-05	1.80e-05

Total Alkenes (Olefins)	Propellant, Smokey Sam	9.10e-04			9.10e-04	9.20e-04
Total Alkenes (Olefins)	Smokeless Powder (Hercules Unique)	2.20e-06			2.20e-06	7.40e-06
Total Aromatics	Diesel fuel and dunnage	1.60e-03	2.70e-03	2.60e-03	2.30e-03	2.30e-03
Total Aromatics	Manufacturer's waste - aluminized propellant with diesel	7.80e-04	3.60e-04	5.60e-04	5.70e-04	6.20e-04
Total Aromatics	Propellant, ammonium perchlorate, aluminized	0.00e+00				2.00e-05
Total Aromatics	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00		0.00e+00	2.00e-05
Total Aromatics	Propellant, composite (MK-6) (Sandia)	1.60e-04			1.60e-04	
Total Aromatics	Propellant, double base	0.00e+00	0.00e+00		0.00e+00	1.00e-05
Total Aromatics	Propellant, double base (Sandia)	4.40e-04			4.40e-04	
Total Aromatics	Propellant, M-3	1.60e-05	1.10e-05	1.90e-05	1.40e-05	3.50e-05
Total Aromatics	Propellant, M-43 (USN)	2.80e-06			2.80e-06	1.30e-05
Total Aromatics	Propellant, M-9	5.40e-06			5.40e-06	2.70e-05
Total Aromatics	Propellant, MK-23	0.00e+00			0.00e+00	1.70e-05
Total Aromatics	Propellant, M31A1E1	6.00e-05	7.00e-05	3.00e-05	5.00e-05	9.00e-05
Total Aromatics	Propellant, PBXN-110	7.10e-06			7.10e-06	2.80e-05
Total Aromatics	Propellant, Smokey Sam	1.00e-04			1.00e-04	1.50e-04
Total Aromatics	Smokeless Powder (Hercules Unique)	6.20e-06			6.20e-06	3.50e-05
Total Non-methane Hydrocarbons	Diesel fuel and dunnage	9.90e-03	1.30e-02	1.30e-02	1.20e-02	1.20e-02
Total Non-methane Hydrocarbons	Manufacturer's waste - aluminized propellant with diesel	3.50e-03	2.20e-03	3.10e-03	2.90e-03	3.20e-03
Total Non-methane Hydrocarbons	Propellant, ammonium perchlorate, aluminized	6.00e-05	3.00e-05		5.00e-05	1.10e-04
Total Non-methane Hydrocarbons	Propellant, ammonium perchlorate, nonaluminized	5.00e-05	4.00e-05		4.00e-05	7.00e-05
Total Non-methane Hydrocarbons	Propellant, double base	1.00e-05	1.00e-05		1.00e-05	4.00e-05
Total Non-methane Hydrocarbons	Propellant, M-3	1.10e-04	9.50e-05	5.30e-05	9.30e-05	3.00e-04
Total Non-methane Hydrocarbons	Propellant, M-43 (USN)	4.10e-05			4.10e-05	1.10e-04
Total Non-methane Hydrocarbons	Propellant, M-9	1.50e-05			1.50e-05	1.30e-04
Total Non-methane Hydrocarbons	Propellant, MK-23	0.00e+00			0.00e+00	1.40e-04
Total Non-methane Hydrocarbons	Propellant, M31A1E1	1.00e-04	9.00e-05	1.20e-04	1.00e-04	1.70e-04
Total Non-methane Hydrocarbons	Propellant, PBXN-110	5.10e-05			5.10e-05	1.80e-04
Total Non-methane Hydrocarbons	Propellant, Smokey Sam	1.10e-03			1.10e-03	1.60e-03
Total Non-methane Hydrocarbons	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	2.30e-04
Total Unidentified Hydrocarbons	Diesel fuel and dunnage	5.50e-03	6.00e-03	6.60e-03	6.00e-03	6.20e-03
Total Unidentified Hydrocarbons	Manufacturer's waste - aluminized propellant with diesel	4.10e-04	2.30e-04	4.20e-04	3.50e-04	4.70e-04
Total Unidentified Hydrocarbons	Propellant, ammonium perchlorate, aluminized	2.00e-05	3.00e-05		2.50e-05	4.00e-05
Total Unidentified Hydrocarbons	Propellant, ammonium perchlorate, nonaluminized	3.00e-05	2.00e-05		2.50e-05	3.00e-05
Total Unidentified Hydrocarbons	Propellant, double base	0.00e+00	0.00e+00		0.00e+00	1.00e-05
Total Unidentified Hydrocarbons	Propellant, M-3	2.80e-05	3.50e-05	1.70e-06	2.40e-05	9.10e-05
Total Unidentified Hydrocarbons	Propellant, M-43 (USN)	2.50e-05			2.50e-05	7.40e-05
Total Unidentified Hydrocarbons	Propellant, M-9	0.00e+00			0.00e+00	5.80e-05
Total Unidentified Hydrocarbons	Propellant, MK-23	2.90e-06			2.90e-06	9.10e-05
Total Unidentified Hydrocarbons	Propellant, M31A1E1	3.00e-05	1.00e-05	2.00e-05	2.00e-05	4.00e-05
Total Unidentified Hydrocarbons	Propellant, [illegible]	4.40e-05			4.40e-05	1.10e-04

Total Unidentified Hydrocarbons	Propellant, Smokey Sam	7.50e-05			7.50e-05	4.30e-04
Total Unidentified Hydrocarbons	Smokeless Powder (Hercules Unique)	0.00e+00			0.00e+00	1.40e-04
Vinyl chloride	Diesel fuel and dunnage	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Manufacturer's waste - aluminized propellant with diesel	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Propellant, MK-23	1.50e-06			1.50e-06	1.50e-06
Vinyl chloride	Propellant, PBXN-110	2.20e-07			2.20e-07	2.20e-07
Vinyl chloride	Propellant, Smokey Sam	8.80e-07			8.80e-07	8.80e-07
Vinyl chloride	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Diesel fuel and dunnage	6.40e-05	6.50e-05	5.90e-05	6.30e-05	6.40e-05
Zinc	Manufacturer's waste - aluminized propellant with diesel	1.60e-04	1.10e-04	1.40e-03	5.70e-04	5.80e-04
Zinc	Propellant, ammonium perchlorate, aluminized	6.00e-05	2.00e-05		4.00e-05	4.00e-05
Zinc	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Propellant, double base	0.00e+00	1.00e-05		1.00e-05	1.00e-05
Zinc	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Diesel fuel and dunnage	0.00e+00	4.70e-06	4.60e-06	4.70e-06	4.70e-06
1-Butene	Manufacturer's waste - aluminized propellant with diesel	1.10e-05	5.70e-06	8.00e-06	8.30e-06	8.30e-06
1-Butene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Propellant, M-43 (USN)	2.70e-07			2.70e-07	2.70e-07
1-Butene	Propellant, M-9	2.60e-07			2.60e-07	2.60e-07
1-Butene	Propellant, MK-23	5.90e-07			5.90e-07	5.90e-07
1-Butene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Propellant, PBXN-110	6.00e-07			6.00e-07	6.00e-07
1-Butene	Propellant, Smokey Sam	1.20e-06			1.20e-06	1.20e-06
1-Butene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Diesel fuel and dunnage	1.10e-06	2.70e-06	2.80e-06	2.20e-06	2.20e-06
1-Hexene	Manufacturer's waste - aluminized propellant with diesel	1.10e-06	6.10e-07	1.30e-05	4.80e-06	4.80e-06
1-Hexene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, M-3	1.80e-07	0.00e+00	0.00e+00	1.80e-07	1.80e-07
1-Hexene	Propellant, M-43 (USN)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

1-Hexene	Propellant, M-9	2.10e-07			2.10e-07	2.10e-07
1-Hexene	Propellant, MK-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, PBXN-110	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Hexene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Diesel fuel and dunnage	0.00e+00	1.70e-06	0.00e+00	1.70e-06	1.80e-06
1-Pentene	Manufacturer's waste - aluminized propellant with diesel	4.80e-06	3.30e-06	7.00e-06	5.10e-06	5.30e-06
1-Pentene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Propellant, ammonium perchlorate, nonaluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Propellant, double base	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Propellant, M-3	1.60e-07	0.00e+00	0.00e+00	1.60e-07	2.20e-07
1-Pentene	Propellant, M-43 (USN)	9.10e-08			9.10e-08	9.10e-08
1-Pentene	Propellant, M-9	4.30e-08			4.30e-08	8.50e-08
1-Pentene	Propellant, MK-23	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Propellant, M31A1E1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Propellant, PBXN-110	1.00e-07			1.00e-07	2.00e-07
1-Pentene	Propellant, Smokey Sam	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Diesel fuel and dunnage	0.00e+00	1.30e-06	9.80e-07	1.20e-06	1.20e-06
1,3-Butadiene	Manufacturer's waste - aluminized propellant with diesel	5.40e-06	4.20e-06	2.40e-06	4.00e-06	4.00e-06
1,3-Butadiene	Propellant, ammonium perchlorate, aluminized	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Propellant, M-3	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Propellant, M-43 (USN)	9.10e-08			9.10e-08	9.10e-08
1,3-Butadiene	Propellant, M-9	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Propellant, MK-23	2.00e-07			2.00e-07	2.00e-07
1,3-Butadiene	Propellant, PBXN-110	5.00e-07			5.00e-07	5.00e-07
1,3-Butadiene	Propellant, Smokey Sam	1.20e-06			1.20e-06	1.20e-06
1,3-Butadiene	Smokeless Powder (Hercules Unique)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1234678-HpCDF	Manufacturer's waste - aluminized propellant with diesel	3.40e-08			3.40e-08	
123478-HxCDF	Manufacturer's waste - aluminized propellant with diesel	2.00e-08			2.10e-08	
1234789-HpCDF	Manufacturer's waste - aluminized propellant with diesel	7.90e-09			7.90e-09	
123678-HxCDF	Manufacturer's waste - aluminized propellant with diesel	9.50e-09			9.50e-09	
2-Chlorophenol	Propellant, ammonium perchlorate, nonaluminized	1.00e-05	1.00e-05		1.00e-05	1.00e-05

Appendix E
Emission Factors for Detonations

SPECIAL NOTES:

The emission factors in this database apply primarily to unconfined, ground level detonations of bulk and assembled energetic materials. They do not apply confined or otherwise suppressed detonations, except for the emission factors for the water-suppressed detonations of tritonal and amatol.

A value of 0.00e+00 means that the compound (analyte) was either not detected, or, was detected at only the background level. Values of 0.00e+00 were not used in calculating the average (AVG) emission factors in the database. A blank cell means that either no sample was collected or that the sample collected was either lost or not valid.

The emission factors in this table are unitless. The user can convert them to any mass units desired (e.g., grams compound per gram NEW). A value e-06 means that the quantity in the numerator is to be multiplied by 10 to the -6 power. For example, 1.1e-06 could be written as either 1.1×10^{-6} g/g NEW or 1 microgram/g NEW.

ED_001691B_00006003

COMPOUND	ITEM	EMISSION FACTORS				
		TRIAL 1	TRIAL 2	TRIAL 3	AVERAGE	UNCORR
cis-2-Pentene	Amatol	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Amatol surrogate with water	6.30e-06	1.10e-05	7.80e-06	8.50e-06	9.10e-06
cis-2-Pentene	Cartridge, Impulse, ARD 446-1	7.80e-07	2.60e-07	5.00e-07	5.10e-07	8.70e-07
cis-2-Pentene	Cartridge, Impulse, BBU-36/B	2.70e-07	2.80e-07	5.60e-07	3.70e-07	9.00e-07
cis-2-Pentene	Cartridge, Impulse, MK 107	2.60e-07	2.60e-07	2.60e-07	2.60e-07	2.60e-07
cis-2-Pentene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Detonating train	5.80e-07	3.00e-07	3.00e-07	3.90e-07	9.10e-07
cis-2-Pentene	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	3.40e-07	3.40e-07	3.40e-07
cis-2-Pentene	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	9.70e-07	4.80e-07	6.50e-07	6.50e-07
cis-2-Pentene	Fuze, Tail Bomb FMU-54 A/B	5.90e-07	8.90e-07	0.00e+00	7.40e-07	9.30e-07
cis-2-Pentene	Gas Generator, GGU-2/A	5.90e-07	1.20e-06	6.10e-07	7.90e-07	9.90e-07
cis-2-Pentene	HBX surrogate	3.70e-07	4.10e-07	0.00e+00	3.90e-07	3.80e-07
cis-2-Pentene	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	Signal, Illumination, Red Star AN-M43A2	3.50e-07	3.50e-07	3.50e-07	3.50e-07	3.50e-07
cis-2-Pentene	Signal, Illumination, Red Star M158	3.50e-07	3.50e-07	0.00e+00	3.50e-07	3.50e-07
cis-2-Pentene	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.70e-07
cis-2-Pentene	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	3.60e-07
cis-2-Pentene	Tritonal surrogate with water	2.30e-06	3.70e-06	3.40e-06	3.10e-06	3.30e-06
cis-2-Pentene	TNT (ACC1)	4.60e-07	0.00e+00	0.00e+00	4.60e-07	4.60e-07
cis-2-Pentene	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
cis-2-Pentene	T45E7 Adapter Booster	3.00e-06	2.40e-06	2.90e-06	2.70e-06	2.70e-06
cis-2-Pentene	20 mm HEI Cartridge	0.00e+00	0.00e+00	6.80e-07	6.80e-07	6.80e-07
cis-2-Pentene	40 mm HEI Cartridge	8.30e-07	0.00e+00	0.00e+00	8.30e-07	3.30e-06
i-Butane	Amatol surrogate	7.50e-07	7.50e-07	3.70e-07	6.20e-07	6.20e-07
i-Butane	Amatol surrogate with water	6.70e-06	6.30e-06	6.30e-06	6.40e-06	7.50e-06
i-Butane	Cartridge, Impulse, ARD 446-1	0.00e+00	2.60e-07	2.50e-06	1.40e-06	5.10e-06
i-Butane	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.10e-06
i-Butane	Cartridge, Impulse, MK 107	0.00e+00	1.10e-06	0.00e+00	1.10e-06	1.90e-06
i-Butane	Composition B surrogate	3.70e-07	3.70e-07	0.00e+00	3.70e-07	3.70e-07
i-Butane	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	6.00e-06
i-Butane	Flare, IR Countermeasure M206	6.60e-07	0.00e+00	0.00e+00	6.60e-07	5.00e-06
i-Butane	Fuze, Tail Bomb FMU-139 A/B	2.00e-06	3.90e-06	9.70e-07	2.30e-06	3.90e-06
i-Butane	Fuze, Tail Bomb FMU-54 A/B	3.00e-07	3.00e-07	0.00e+00	3.00e-07	3.70e-06
i-Butane	Gas Generator, GGU-2/A	1.20e-06	5.90e-07	0.00e+00	8.80e-07	9.50e-06
i-Butane	HBX surrogate	7.30e-07	0.00e+00	3.70e-07	5.50e-07	9.20e-07
i-Butane	Mine, Claymore, M18A1	4.90e-07	9.80e-07	0.00e+00	7.30e-07	2.40e-06
i-Butane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	3.50e-07	0.00e+00	3.50e-07	3.10e-06

i-Butane	Signal, Illumination, Red Star M158	2.10e-06	1.80e-06	6.90e-07	1.50e-06	5.70e-06
i-Butane	Tritonal surrogate	7.40e-07	0.00e+00	3.60e-07	5.50e-07	5.50e-07
i-Butane	Tritonal surrogate with calcium stearate		0.00e+00	7.30e-07	7.30e-07	9.10e-07
i-Butane	Tritonal surrogate with water	4.10e-06	4.40e-06	4.10e-06	4.20e-06	4.60e-06
i-Butane	TNT (ACC1)	4.60e-07	0.00e+00	0.00e+00	4.60e-07	4.60e-07
i-Butane	TNT (ACC2)	0.00e+00			0.00e+00	5.20e-06
i-Butane	T45E7 Adapter Booster	0.00e+00	1.20e-06	2.30e-06	1.70e-06	3.50e-06
i-Butane	20 mm HEI Cartridge	7.00e-07	1.40e-06	2.00e-06	1.40e-06	3.90e-06
i-Butane	40 mm HEI Cartridge	0.00e+00	0.00e+00	1.60e-06	1.60e-06	2.90e-06
i-Butene	Amatol surrogate	2.30e-06	0.00e+00	7.40e-07	1.50e-06	1.50e-06
i-Butene	Amatol surrogate with water	1.50e-05	3.10e-05	1.30e-05	2.00e-05	2.00e-05
i-Butene	Cartridge, Impulse, ARD 446-1	2.50e-05	2.00e-05	2.20e-05	2.20e-05	3.20e-05
i-Butene	Cartridge, Impulse, BBU-36/B	2.00e-05	2.10e-05	2.60e-05	2.20e-05	2.20e-05
i-Butene	Cartridge, Impulse, MK 107	6.80e-06	0.00e+00	2.90e-06	4.90e-06	4.90e-06
i-Butene	Composition B surrogate	3.70e-07	7.40e-07	1.80e-06	9.80e-07	9.80e-07
i-Butene	Detonating train	1.00e-05	3.10e-05	3.00e-05	2.40e-05	3.60e-05
i-Butene	Flare, IR Countermeasure M206	2.30e-06	2.40e-06	2.70e-06	2.50e-06	2.50e-06
i-Butene	Fuze, Tail Bomb FMU-139 A/B	5.40e-06	5.30e-06	5.30e-06	5.30e-06	5.50e-06
i-Butene	Fuze, Tail Bomb FMU-54 A/B	4.40e-06	5.60e-06	4.30e-06	4.80e-06	4.80e-06
i-Butene	Gas Generator, GGU-2/A	0.00e+00	2.90e-06	0.00e+00	2.90e-06	2.90e-06
i-Butene	HBX surrogate	3.70e-06	2.50e-06	4.50e-06	3.50e-06	3.50e-06
i-Butene	Mine, Claymore, M18A1	3.40e-06	3.40e-06	4.20e-06	3.70e-06	5.10e-06
i-Butene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	2.80e-06	3.50e-06	3.10e-06	3.30e-06
i-Butene	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	4.50e-06	4.50e-06	4.50e-06
i-Butene	Tritonal surrogate	3.00e-06	3.70e-07	7.30e-07	1.40e-06	1.40e-06
i-Butene	Tritonal surrogate with calcium stearate		2.60e-06	1.50e-06	2.00e-06	2.00e-06
i-Butene	Tritonal surrogate with water	1.30e-05	0.00e+00	0.00e+00	1.30e-05	1.30e-05
i-Butene	TNT (ACC1)	3.70e-06	3.40e-06	3.80e-06	3.60e-06	3.60e-06
i-Butene	TNT (ACC2)	1.50e-06			1.50e-06	1.50e-06
i-Butene	T45E7 Adapter Booster	7.30e-05	8.20e-06	1.30e-05	3.10e-05	3.10e-05
i-Butene	20 mm HEI Cartridge	4.10e-05	9.40e-06	1.70e-05	2.20e-05	2.20e-05
i-Butene	40 mm HEI Cartridge	1.20e-05	9.00e-06	4.90e-06	8.80e-06	8.80e-06
i-Pentane	Amatol surrogate	1.50e-06	1.50e-06	0.00e+00	1.50e-06	1.50e-06
i-Pentane	Amatol surrogate with water	1.50e-06	1.10e-05	5.60e-06	6.20e-06	3.70e-05
i-Pentane	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.90e-06
i-Pentane	Cartridge, Impulse, BBU-36/B	0.00e+00	5.60e-07	1.40e-06	9.70e-07	4.10e-06
i-Pentane	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.20e-06
i-Pentane	Composition B surrogate	3.70e-07	0.00e+00	0.00e+00	3.70e-07	7.40e-07
i-Pentane	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.10e-06
i-Pentane	Flare, IR Countermeasure M206	0.00e+00	3.40e-07	0.00e+00	3.40e-07	2.10e-06
i-Pentane	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	4.80e-07	0.00e+00	4.80e-07	1.10e-06

i-Pentane	Fuze, Tail Bomb FMU-54 A/B	2.70e-06	0.00e+00	0.00e+00	2.70e-06	1.00e-05
i-Pentane	Gas Generator, GGU-2/A	0.00e+00	5.90e-07	0.00e+00	5.90e-07	1.10e-05
i-Pentane	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.70e-06
i-Pentane	Mine, Claymore, M18A1	3.90e-06	0.00e+00	0.00e+00	3.90e-06	3.10e-06
i-Pentane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	0.00e+00	0.00e+00	3.50e-07	5.80e-07
i-Pentane	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.20e-06
i-Pentane	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.10e-06
i-Pentane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	4.20e-06
i-Pentane	Tritonal surrogate with water	3.70e-07	3.70e-07	3.70e-07	3.70e-07	4.70e-06
i-Pentane	TNT (ACC1)	1.40e-06	0.00e+00	0.00e+00	1.40e-06	1.20e-06
i-Pentane	TNT (ACC2)	7.40e-07			7.40e-07	1.50e-06
i-Pentane	T45E7 Adapter Booster	1.20e-06	2.90e-06	1.40e-05	6.20e-06	1.10e-05
i-Pentane	20 mm HEI Cartridge	0.00e+00	1.10e-05	1.20e-05	1.20e-05	1.50e-05
i-Pentane	40 mm HEI Cartridge	9.10e-06	0.00e+00	0.00e+00	9.10e-06	1.80e-05
i-Propylbenzene	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Amatol surrogate with water	1.90e-06	3.20e-06	0.00e+00	2.50e-06	3.20e-06
i-Propylbenzene	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	7.50e-07
i-Propylbenzene	Cartridge, Impulse, BBU-36/B	8.20e-07	1.10e-06	8.40e-07	9.20e-07	9.20e-07
i-Propylbenzene	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	5.20e-07	5.20e-07	5.20e-07
i-Propylbenzene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Flare, IR Countermeasure M206	0.00e+00	6.80e-07	1.00e-06	8.50e-07	8.50e-07
i-Propylbenzene	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	3.00e-07	0.00e+00	3.00e-07	7.90e-07
i-Propylbenzene	Gas Generator, GGU-2/A	1.20e-06	0.00e+00	0.00e+00	1.20e-06	8.80e-07
i-Propylbenzene	HBX surrogate	7.30e-07	0.00e+00	3.70e-07	5.50e-07	1.50e-06
i-Propylbenzene	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	Tritonal surrogate	7.40e-07	0.00e+00	1.10e-06	6.10e-07	1.70e-06
i-Propylbenzene	Tritonal surrogate with calcium stearate		0.00e+00	7.30e-07	7.30e-07	7.30e-07
i-Propylbenzene	Tritonal surrogate with water	0.00e+00	0.00e+00	1.10e-06	1.10e-06	1.90e-06
i-Propylbenzene	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
i-Propylbenzene	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
m-Ethyltoluene	[illegible]	0.00e+00	3.70e-07	0.00e+00	3.70e-07	1.50e-05
m-Ethyltoluene	[illegible]	1.50e-06	1.90e-06	1.50e-06	1.60e-06	3.80e-05
m-Ethyltoluene	[illegible]	5.20e-07	2.60e-07	7.50e-07	5.10e-07	3.00e-06
m-Ethyltoluene	[illegible]	1.10e-06	1.40e-06	5.60e-07	1.00e-06	4.20e-06

m-Ethyltoluene	Cartridge, Impulse, MK 107	0.00e+00	7.90e-07	5.20e-07	6.60e-07	1.20e-06
m-Ethyltoluene	Composition B surrogate	0.00e+00	3.70e-07	3.60e-07	3.70e-07	1.90e-05
m-Ethyltoluene	Detonating train	0.00e+00	3.00e-07	3.00e-07	3.00e-07	3.20e-06
m-Ethyltoluene	Flare, IR Countermeasure M206	3.30e-07	0.00e+00	3.40e-07	3.40e-07	7.90e-07
m-Ethyltoluene	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	9.70e-07	0.00e+00	9.70e-07	1.30e-06
m-Ethyltoluene	Fuze, Tail Bomb FMU-54 A/B	3.00e-07	3.00e-07	6.10e-07	4.00e-07	1.30e-06
m-Ethyltoluene	Gas Generator, GGU-2/A	0.00e+00	5.90e-07	0.00e+00	5.90e-07	2.80e-06
m-Ethyltoluene	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.50e-05
m-Ethyltoluene	Mine, Claymore, M18A1	6.80e-06	3.40e-06	6.60e-06	5.60e-06	6.60e-06
m-Ethyltoluene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	5.80e-07
m-Ethyltoluene	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	3.50e-07	3.50e-07	8.10e-07
m-Ethyltoluene	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.20e-05
m-Ethyltoluene	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	3.70e-05
m-Ethyltoluene	Tritonal surrogate with water	1.50e-06	0.00e+00	7.50e-07	1.10e-06	4.70e-05
m-Ethyltoluene	TNT (ACC1)	0.00e+00	4.80e-07	4.80e-07	4.80e-07	1.70e-06
m-Ethyltoluene	TNT (ACC2)	0.00e+00			0.00e+00	1.10e-06
m-Ethyltoluene	T45E7 Adapter Booster	1.80e-06	2.90e-06	2.90e-06	2.50e-06	2.50e-06
m-Ethyltoluene	20 mm HEI Cartridge	1.40e-06	4.30e-06	5.40e-06	3.70e-06	7.10e-06
m-Ethyltoluene	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.80e-06
n-Butane	Amatol surrogate	7.50e-07	7.50e-07	3.70e-07	6.20e-07	6.20e-07
n-Butane	Amatol surrogate with water	3.80e-05	6.80e-05	4.90e-05	5.20e-05	6.30e-05
n-Butane	Cartridge, Impulse, ARD 446-1	1.50e-06	2.30e-06	2.70e-06	2.20e-06	4.80e-06
n-Butane	Cartridge, Impulse, BBU-36/B	5.40e-06	3.60e-06	5.30e-06	4.80e-06	4.80e-06
n-Butane	Cartridge, Impulse, MK 107	0.00e+00	5.30e-07	7.90e-07	6.60e-07	3.10e-06
n-Butane	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.70e-07
n-Butane	Detonating train	3.80e-06	3.30e-06	2.10e-06	3.10e-06	1.00e-05
n-Butane	Flare, IR Countermeasure M206	3.30e-07	6.80e-07	6.80e-07	5.70e-07	5.10e-06
n-Butane	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	1.90e-06	4.40e-06	2.40e-06	5.20e-06
n-Butane	Fuze, Tail Bomb FMU-54 A/B	3.00e-06	2.10e-06	0.00e+00	2.50e-06	1.90e-05
n-Butane	Gas Generator, GGU-2/A	3.50e-06	2.90e-06	0.00e+00	3.20e-06	3.50e-05
n-Butane	HBX surrogate	7.30e-07	4.10e-07	3.70e-07	5.00e-07	8.90e-07
n-Butane	Mine, Claymore, M18A1	2.90e-06	1.50e-06	9.40e-07	1.80e-06	6.60e-06
n-Butane	Signal, Illumination, Red Star AN-M43A2	2.80e-06	2.40e-06	1.40e-06	2.20e-06	4.10e-06
n-Butane	Signal, Illumination, Red Star M158	3.50e-07	2.10e-06	0.00e+00	1.20e-06	7.10e-06
n-Butane	Tritonal surrogate	1.90e-06	0.00e+00	3.60e-07	1.30e-06	1.40e-06
n-Butane	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-07	3.60e-07	9.20e-07
n-Butane	Tritonal surrogate with water	8.60e-06	1.80e-05	1.80e-05	1.50e-05	1.60e-05
n-Butane	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.30e-06
n-Butane	TNT (ACC2)	0.00e+00			0.00e+00	7.40e-07
n-Butane	T45E7 Adapter Booster	5.30e-06	6.50e-06	1.60e-05	9.10e-06	1.60e-05
n-Butane	20 mm HEI Cartridge	2.10e-06	7.20e-06	1.30e-05	7.40e-06	1.40e-05

n-Butane	40 mm HEI Cartridge	1.70e-06	8.20e-07	1.60e-06	1.40e-06	1.10e-05
n-Decane	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.70e-07
n-Decane	Amatol surrogate with water	1.10e-06	1.30e-06	1.90e-06	1.40e-06	3.50e-06
n-Decane	Cartridge, Impulse, ARD 446-1	2.60e-07	5.10e-07	2.50e-07	3.40e-07	8.70e-07
n-Decane	Cartridge, Impulse, BBU-36/B	3.50e-06	3.90e-06	5.30e-06	4.20e-06	9.10e-06
n-Decane	Cartridge, Impulse, MK 107	2.60e-07	2.60e-07	2.60e-07	2.60e-07	6.40e-07
n-Decane	Composition B surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	4.90e-07
n-Decane	Detonating train	0.00e+00	9.00e-07	3.00e-07	6.00e-07	1.80e-06
n-Decane	Flare, IR Countermeasure M206	3.30e-07	3.40e-07	3.40e-07	3.40e-07	4.50e-07
n-Decane	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	9.70e-07	1.50e-06	1.10e-06	1.30e-06
n-Decane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.00e-07
n-Decane	Gas Generator, GGU-2/A	5.90e-07	5.90e-07	6.10e-07	6.00e-07	1.20e-06
n-Decane	HBX surrogate	3.70e-07	0.00e+00	0.00e+00	3.70e-07	6.40e-07
n-Decane	Mine, Claymore, M18A1	3.90e-06	1.00e-05	1.60e-05	1.00e-05	1.30e-05
n-Decane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	7.00e-07	0.00e+00	5.20e-07	4.60e-07
n-Decane	Signal, Illumination, Red Star M158	7.00e-07	3.50e-07	6.90e-07	5.80e-07	8.10e-07
n-Decane	Tritonal surrogate	0.00e+00	3.70e-07	3.60e-07	3.70e-07	6.10e-07
n-Decane	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-07	3.60e-07	5.50e-07
n-Decane	Tritonal surrogate with water	0.00e+00	0.00e+00	1.10e-06	1.10e-06	1.70e-06
n-Decane	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.00e-05
n-Decane	TNT (ACC2)	0.00e+00			0.00e+00	3.70e-07
n-Decane	T45E7 Adapter Booster	1.20e-06	0.00e+00	0.00e+00	1.20e-06	1.40e-05
n-Decane	20 mm HEI Cartridge	4.90e-06	5.00e-06	9.50e-06	6.50e-06	2.90e-05
n-Decane	40 mm HEI Cartridge	5.00e-06	2.50e-06	8.20e-06	5.20e-06	4.20e-05
n-Heptane	Amatol surrogate	1.10e-06	3.70e-07	7.40e-07	7.50e-07	1.60e-06
n-Heptane	Amatol surrogate with water	5.90e-06	1.30e-05	7.40e-06	8.70e-06	1.20e-05
n-Heptane	Cartridge, Impulse, ARD 446-1	1.50e-06	1.50e-06	2.20e-06	1.80e-06	4.30e-06
n-Heptane	Cartridge, Impulse, BBU-36/B	1.60e-06	1.70e-06	1.10e-06	1.50e-06	4.70e-06
n-Heptane	Cartridge, Impulse, MK 107	1.00e-06	1.10e-06	1.00e-06	1.00e-06	1.90e-06
n-Heptane	Composition B surrogate	0.00e+00	3.70e-07	1.10e-06	7.30e-07	1.20e-06
n-Heptane	Detonating train	8.70e-07	1.50e-06	1.80e-06	1.40e-06	5.00e-06
n-Heptane	Flare, IR Countermeasure M206	3.30e-07	3.40e-07	6.80e-07	4.50e-07	1.00e-06
n-Heptane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	9.70e-07	4.80e-07	6.50e-07	1.10e-06
n-Heptane	Fuze, Tail Bomb FMU-54 A/B	5.90e-07	5.90e-07	0.00e+00	5.90e-07	1.50e-06
n-Heptane	Gas Generator, GGU-2/A	5.90e-07	5.90e-07	1.20e-06	8.00e-07	2.80e-06
n-Heptane	HBX surrogate	7.30e-07	0.00e+00	3.70e-07	5.50e-07	3.30e-06
n-Heptane	Mine, Claymore, M18A1	2.90e-06	3.40e-06	4.70e-06	3.70e-06	5.60e-06
n-Heptane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	1.10e-06	3.50e-07	5.80e-07	1.00e-06
n-Heptane	Signal, Illumination, Red Star M158	1.10e-06	7.00e-07	1.00e-06	9.30e-07	1.60e-06
n-Heptane	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	4.30e-06
n-Heptane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	4.20e-06

n-Heptane	Tritonal surrogate with water	2.30e-06	1.80e-06	5.60e-06	3.20e-06	9.50e-06
n-Heptane	TNT (ACC1)	4.60e-07	1.40e-06	0.00e+00	9.50e-07	5.50e-06
n-Heptane	TNT (ACC2)	3.70e-07			3.70e-07	1.50e-06
n-Heptane	T45E7 Adapter Booster	3.60e-06	1.80e-06	4.60e-06	3.30e-06	8.00e-06
n-Heptane	20 mm HEI Cartridge	2.10e-06	5.00e-06	8.90e-06	5.30e-06	1.50e-05
n-Heptane	40 mm HEI Cartridge	5.00e-06	0.00e+00	0.00e+00	5.00e-06	2.20e-05
n-Hexane	Amatol surrogate	0.00e+00	3.70e-07	7.40e-07	5.60e-07	9.90e-07
n-Hexane	Amatol surrogate with water	7.10e-06	1.50e-05	1.10e-05	1.10e-05	1.60e-05
n-Hexane	Cartridge, Impulse, ARD 446-1	1.50e-06	1.50e-06	1.50e-06	1.50e-06	4.00e-06
n-Hexane	Cartridge, Impulse, BBU-36/B	1.60e-06	1.40e-06	2.20e-06	1.70e-06	5.40e-06
n-Hexane	Cartridge, Impulse, MK 107	2.60e-07	7.90e-07	5.20e-07	5.30e-07	1.40e-06
n-Hexane	Composition B surrogate	0.00e+00	7.40e-07	3.60e-07	5.50e-07	1.20e-06
n-Hexane	Detonating train	1.50e-06	1.50e-06	2.40e-06	1.80e-06	5.80e-06
n-Hexane	Flare, IR Countermeasure M206	6.60e-07	6.80e-07	6.80e-07	6.80e-07	1.20e-06
n-Hexane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	9.70e-07	4.80e-07	6.50e-07	1.10e-06
n-Hexane	Fuze, Tail Bomb FMU-54 A/B	3.00e-07	5.90e-07	0.00e+00	4.40e-07	1.30e-06
n-Hexane	Gas Generator, GGU-2/A	1.20e-06	1.20e-06	6.10e-07	9.90e-07	3.20e-06
n-Hexane	HBX surrogate	7.30e-07	0.00e+00	3.70e-07	5.50e-07	4.70e-06
n-Hexane	Mine, Claymore, M18A1	2.00e-06	1.50e-06	4.70e-07	1.30e-06	3.20e-06
n-Hexane	Signal, Illumination, Red Star AN-M43A2	6.90e-07	1.10e-06	6.90e-07	8.10e-07	1.30e-06
n-Hexane	Signal, Illumination, Red Star M158	1.40e-06	1.10e-06	6.90e-07	1.10e-06	1.90e-06
n-Hexane	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	7.00e-06
n-Hexane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	6.80e-06
n-Hexane	Tritonal surrogate with water	1.90e-06	1.50e-06	4.50e-06	2.60e-06	1.30e-05
n-Hexane	TNT (ACC1)	1.40e-06	4.80e-07	0.00e+00	9.30e-07	3.30e-06
n-Hexane	TNT (ACC2)	0.00e+00			0.00e+00	1.10e-06
n-Hexane	T45E7 Adapter Booster	3.00e-06	4.70e-06	9.80e-06	5.80e-06	9.90e-06
n-Hexane	20 mm HEI Cartridge	1.40e-06	3.60e-06	5.40e-06	3.50e-06	1.30e-05
n-Hexane	40 mm HEI Cartridge	1.90e-05	0.00e+00	0.00e+00	1.90e-05	3.50e-05
n-Nonane	Amatol surrogate	3.70e-07	3.70e-07	0.00e+00	3.70e-07	3.70e-07
n-Nonane	Amatol surrogate with water	2.20e-06	4.40e-06	3.00e-06	3.20e-06	3.70e-06
n-Nonane	Cartridge, Impulse, ARD 446-1	2.60e-07	7.70e-07	7.50e-07	5.90e-07	1.40e-06
n-Nonane	Cartridge, Impulse, BBU-36/B	2.70e-06	3.60e-06	3.30e-06	3.20e-06	6.90e-06
n-Nonane	Cartridge, Impulse, MK 107	0.00e+00	2.60e-07	7.90e-07	5.20e-07	9.60e-07
n-Nonane	Composition B surrogate	2.20e-06	3.70e-07	0.00e+00	1.30e-06	1.20e-06
n-Nonane	Detonating train	5.80e-07	9.00e-07	9.00e-07	7.90e-07	2.00e-06
n-Nonane	Flare, IR Countermeasure M206	6.60e-07	6.80e-07	6.80e-07	6.80e-07	9.00e-07
n-Nonane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	4.80e-07	0.00e+00	4.90e-07	7.30e-07
n-Nonane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	1.20e-06	1.20e-06	9.40e-07
n-Nonane	Gas Generator, GGU-2/A	5.90e-07	5.90e-07	0.00e+00	5.90e-07	1.20e-06
n-Nonane	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	5.20e-07

n-Nonane	Mine, Claymore, M18A1	4.90e-07	1.50e-06	1.90e-06	1.30e-06	1.80e-06
n-Nonane	Signal, Illumination, Red Star AN-M43A2	1.00e-06	3.50e-07	0.00e+00	7.00e-07	9.30e-07
n-Nonane	Signal, Illumination, Red Star M158	1.10e-06	7.00e-07	1.00e-06	9.30e-07	1.30e-06
n-Nonane	Tritonal surrogate	3.40e-06	0.00e+00	3.60e-07	1.20e-06	1.60e-06
n-Nonane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	5.50e-07
n-Nonane	Tritonal surrogate with water	0.00e+00	7.30e-07	7.50e-07	7.40e-07	1.50e-06
n-Nonane	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.40e-06
n-Nonane	TNT (ACC2)	0.00e+00			0.00e+00	3.70e-07
n-Nonane	T45E7 Adapter Booster	1.80e-06	5.90e-07	1.70e-06	1.40e-06	2.50e-06
n-Nonane	20 mm HEI Cartridge	7.00e-07	0.00e+00	6.80e-07	6.90e-07	3.60e-06
n-Nonane	40 mm HEI Cartridge	1.70e-06	1.70e-06	2.50e-06	1.90e-06	4.80e-06
n-Octane	Amatol surrogate	0.00e+00	3.70e-07	3.70e-07	3.70e-07	6.20e-07
n-Octane	Amatol surrogate with water	3.30e-06	7.00e-06	4.40e-06	4.90e-06	5.80e-06
n-Octane	Cartridge, Impulse, ARD 446-1	5.20e-07	1.00e-06	0.00e+00	7.70e-07	1.40e-06
n-Octane	Cartridge, Impulse, BBU-36/B	1.40e-06	2.80e-07	1.90e-06	1.20e-06	4.00e-06
n-Octane	Cartridge, Impulse, MK 107	5.30e-07	5.30e-07	2.60e-07	4.40e-07	7.70e-07
n-Octane	Composition B surrogate	3.70e-07	3.70e-07	3.60e-07	3.70e-07	7.40e-07
n-Octane	Detonating train	0.00e+00	1.50e-06	0.00e+00	1.50e-06	2.70e-06
n-Octane	Flare, IR Countermeasure M206	1.00e-06	3.40e-07	0.00e+00	6.70e-07	7.80e-07
n-Octane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	4.80e-07	0.00e+00	4.90e-07	9.70e-07
n-Octane	Fuze, Tail Bomb FMU-54 A/B	3.00e-07	3.00e-07	6.10e-07	4.00e-07	1.10e-06
n-Octane	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	1.20e-06	1.20e-06	1.80e-06
n-Octane	HBX surrogate	1.10e-06	0.00e+00	3.70e-07	7.30e-07	1.80e-06
n-Octane	Mine, Claymore, M18A1	2.00e-06	7.80e-06	1.20e-05	7.20e-06	9.10e-06
n-Octane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	3.50e-07	0.00e+00	3.50e-07	5.80e-07
n-Octane	Signal, Illumination, Red Star M158	1.40e-06	1.10e-06	6.90e-07	1.10e-06	1.40e-06
n-Octane	Tritonal surrogate	3.70e-07	0.00e+00	3.60e-07	3.70e-07	1.70e-06
n-Octane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	1.50e-06
n-Octane	Tritonal surrogate with water	1.50e-06	1.50e-06	2.20e-06	1.70e-06	3.70e-06
n-Octane	TNT (ACC1)	0.00e+00	2.90e-06	0.00e+00	2.90e-06	1.00e-05
n-Octane	TNT (ACC2)	0.00e+00			0.00e+00	7.40e-07
n-Octane	T45E7 Adapter Booster	2.40e-06	0.00e+00	1.20e-06	1.80e-06	8.80e-06
n-Octane	20 mm HEI Cartridge	4.90e-06	7.90e-06	1.60e-05	9.50e-06	2.50e-05
n-Octane	40 mm HEI Cartridge	2.50e-06	8.20e-07	7.40e-06	3.60e-06	2.90e-05
n-Pentane	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	6.20e-07
n-Pentane	Amatol surrogate with water	1.30e-05	2.30e-05	1.50e-05	1.70e-05	2.40e-05
n-Pentane	Cartridge, Impulse, ARD 446-1	7.80e-07	1.30e-06	1.30e-06	1.10e-06	4.00e-06
n-Pentane	Cartridge, Impulse, BBU-36/B	1.10e-06	1.10e-06	1.40e-06	1.20e-06	5.20e-06
n-Pentane	Cartridge, Impulse, MK 107	0.00e+00	2.60e-07	2.60e-07	2.60e-07	1.50e-06
n-Pentane	Composition B surrogate	3.70e-07	0.00e+00	3.60e-07	3.70e-07	7.40e-07
n-Pentane	Detonating train	5.80e-07	1.20e-06	1.20e-06	1.00e-06	6.10e-06

n-Pentane	Flare, IR Countermeasure M206	0.00e+00	6.80e-07	3.40e-07	5.10e-07	1.50e-06
n-Pentane	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	1.50e-06	4.80e-07	9.70e-07	1.90e-06
n-Pentane	Fuze, Tail Bomb FMU-54 A/B	3.00e-07	5.90e-07	0.00e+00	4.40e-07	3.70e-06
n-Pentane	Gas Generator, GGU-2/A	1.20e-06	1.20e-06	0.00e+00	1.20e-06	4.80e-06
n-Pentane	HBX surrogate	7.30e-07	0.00e+00	7.40e-07	7.40e-07	2.30e-06
n-Pentane	Mine, Claymore, M18A1	4.40e-06	8.80e-06	1.40e-05	9.10e-06	1.30e-05
n-Pentane	Signal, Illumination, Red Star AN-M43A2	3.50e-07	7.00e-07	6.90e-07	5.80e-07	1.20e-06
n-Pentane	Signal, Illumination, Red Star M158	7.00e-07	7.00e-07	3.50e-07	5.80e-07	2.10e-06
n-Pentane	Tritonal surrogate	0.00e+00	0.00e+00	7.30e-07	7.30e-07	3.80e-06
n-Pentane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	3.30e-06
n-Pentane	Tritonal surrogate with water	1.10e-06	0.00e+00	6.70e-06	3.90e-06	5.50e-06
n-Pentane	TNT (ACC1)	1.80e-06	4.80e-06	0.00e+00	3.30e-06	1.10e-05
n-Pentane	TNT (ACC2)	3.70e-07			3.70e-07	1.90e-06
n-Pentane	T45E7 Adapter Booster	3.60e-06	1.80e-06	9.80e-06	5.00e-06	1.60e-05
n-Pentane	20 mm HEI Cartridge	5.60e-06	1.20e-05	2.20e-05	1.30e-05	3.20e-05
n-Pentane	40 mm HEI Cartridge	1.30e-05	0.00e+00	0.00e+00	1.30e-05	5.20e-05
p-Ethyltoluene	Amatol surrogate	0.00e+00	6.00e-06	9.30e-06	7.60e-06	1.10e-05
p-Ethyltoluene	Amatol surrogate with water	2.00e-05	4.00e-05	3.70e-05	3.20e-05	3.80e-05
p-Ethyltoluene	Cartridge, Impulse, BBU-36/B	4.90e-06	5.60e-07	1.40e-06	2.30e-06	9.40e-06
p-Ethyltoluene	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	Composition B surrogate	7.40e-07	7.40e-07	1.50e-06	9.80e-07	3.30e-06
p-Ethyltoluene	Detonating train	8.70e-07	1.50e-06	1.20e-06	1.20e-06	8.20e-06
p-Ethyltoluene	Flare, IR Countermeasure M206	0.00e+00	3.40e-07	6.80e-07	5.10e-07	2.20e-06
p-Ethyltoluene	Fuze, Tail Bomb FMU-139 A/B	2.00e-06	4.80e-07	9.70e-07	1.10e-06	2.30e-06
p-Ethyltoluene	Fuze, Tail Bomb FMU-54 A/B	5.90e-07	5.90e-07	4.60e-06	1.90e-06	4.70e-06
p-Ethyltoluene	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	6.80e-06
p-Ethyltoluene	HBX surrogate	7.30e-07	0.00e+00	0.00e+00	7.30e-07	5.50e-06
p-Ethyltoluene	Mine, Claymore, M18A1	1.50e-05	7.30e-06	2.80e-05	1.70e-05	1.90e-05
p-Ethyltoluene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	7.00e-07	0.00e+00	7.00e-07	1.60e-06
p-Ethyltoluene	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.70e-06
p-Ethyltoluene	Tritonal surrogate	7.40e-06	4.10e-06	1.50e-06	4.30e-06	9.20e-06
p-Ethyltoluene	Tritonal surrogate with calcium stearate		0.00e+00	7.30e-07	7.30e-07	4.60e-06
p-Ethyltoluene	Tritonal surrogate with water	3.90e-05	1.50e-05	2.80e-05	2.70e-05	3.40e-05
p-Ethyltoluene	TNT (ACC1)	4.60e-07	1.90e-06	0.00e+00	1.20e-06	7.70e-06
p-Ethyltoluene	TNT (ACC2)	0.00e+00			0.00e+00	2.60e-06
p-Ethyltoluene	T45E7 Adapter Booster	1.10e-05	9.40e-06	1.20e-05	1.10e-05	1.10e-05
p-Ethyltoluene	20 mm HEI Cartridge	0.00e+00	1.10e-05	1.60e-05	1.40e-05	2.60e-05
p-Ethyltoluene	40 mm HEI Cartridge	7.50e-06	4.10e-06	4.10e-06	5.20e-06	2.60e-05
p-Ethyltoluene	Amatol surrogate	3.70e-07	0.00e+00	0.00e+00	3.70e-07	1.60e-06
p-Ethyltoluene	Amatol surrogate with water	2.20e-06	2.20e-06	1.90e-06	2.10e-06	4.10e-06
p-Ethyltoluene	Cartridge, Impulse, ARD 446-1	1.10e-06	1.10e-06	1.10e-06	1.10e-06	4.20e-06

p-Ethyltoluene	Cartridge, Impulse, BBU-36/B	2.30e-06	1.20e-06	1.20e-06	1.60e-06	5.40e-06
p-Ethyltoluene	Cartridge, Impulse, MK 107	0.00e+00	1.10e-06	1.10e-06	1.10e-06	1.10e-06
p-Ethyltoluene	Composition B surrogate	7.40e-07	3.70e-07	1.10e-06	7.40e-07	2.60e-06
p-Ethyltoluene	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.90e-06
p-Ethyltoluene	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.50e-06
p-Ethyltoluene	Fuze, Tail Bomb FMU-139 A/B	2.10e-06	0.00e+00	0.00e+00	2.10e-06	2.10e-06
p-Ethyltoluene	Fuze, Tail Bomb FMU-54 A/B	1.30e-06	2.60e-06	1.30e-06	1.70e-06	2.90e-06
p-Ethyltoluene	Gas Generator, GGU-2/A	2.50e-06	5.10e-06	0.00e+00	3.80e-06	4.20e-06
p-Ethyltoluene	HBX surrogate	3.70e-07	0.00e+00	7.40e-07	5.60e-07	4.80e-06
p-Ethyltoluene	Mine, Claymore, M18A1	4.20e-06			4.20e-06	4.20e-06
p-Ethyltoluene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	1.50e-06	0.00e+00	1.50e-06	1.50e-06
p-Ethyltoluene	Signal, Illumination, Red Star M158	0.00e+00	1.50e-06	0.00e+00	1.50e-06	1.50e-06
p-Ethyltoluene	Tritonal surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	3.30e-06
p-Ethyltoluene	Tritonal surrogate with calcium stearate		3.70e-07	0.00e+00	3.70e-07	4.20e-06
p-Ethyltoluene	Tritonal surrogate with water	1.10e-06	0.00e+00	0.00e+00	1.10e-06	4.70e-06
p-Ethyltoluene	TNT (ACC1)	0.00e+00			0.00e+00	2.00e-06
p-Ethyltoluene	TNT (ACC2)	0.00e+00			0.00e+00	1.60e-06
p-Ethyltoluene	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
p-Ethyltoluene	20 mm HEI Cartridge	0.00e+00			0.00e+00	4.10e-06
p-Ethyltoluene	40 mm HEI Cartridge	0.00e+00			0.00e+00	9.50e-06
trans-2-Butene	Amatol surrogate	0.00e+00	0.00e+00	1.50e-06	1.50e-06	1.50e-06
trans-2-Butene	Amatol surrogate with water	2.40e-05	4.60e-05	3.40e-05	3.50e-05	3.50e-05
trans-2-Butene	Cartridge, Impulse, ARD 446-1	1.00e-05	7.70e-06	7.20e-06	8.30e-06	8.30e-06
trans-2-Butene	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Cartridge, Impulse, MK 107	1.00e-05	8.20e-06	7.10e-06	8.40e-06	8.40e-06
trans-2-Butene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Butene	Detonating train	4.70e-06	2.70e-06	4.80e-06	4.00e-06	4.00e-06
trans-2-Butene	Flare, IR Countermeasure M206	3.00e-06	2.70e-06	2.70e-06	2.80e-06	2.80e-06
trans-2-Butene	Fuze, Tail Bomb FMU-139 A/B	1.20e-05	1.30e-05	1.40e-05	1.30e-05	1.30e-05
trans-2-Butene	Fuze, Tail Bomb FMU-54 A/B	5.90e-06	9.50e-06	7.90e-06	7.80e-06	1.10e-05
trans-2-Butene	Gas Generator, GGU-2/A	1.40e-05	1.50e-05	1.60e-05	1.50e-05	1.50e-05
trans-2-Butene	HBX surrogate	4.00e-06	2.50e-06	7.10e-06	4.50e-06	4.50e-06
trans-2-Butene	Mine, Claymore, M18A1	1.50e-05	1.90e-05	2.10e-05	1.80e-05	1.80e-05
trans-2-Butene	Signal, Illumination, Red Star AN-M43A2	6.90e-06	9.10e-06	7.30e-06	7.80e-06	7.80e-06
trans-2-Butene	Signal, Illumination, Red Star M158	5.30e-06	6.00e-06	4.80e-06	5.40e-06	5.40e-06
trans-2-Butene	Tritonal surrogate	0.00e+00	1.90e-06	1.10e-06	1.50e-06	1.50e-06
trans-2-Butene	Tritonal surrogate with calcium stearate		2.90e-06	7.30e-07	1.80e-06	1.80e-06
trans-2-Butene	Tritonal surrogate with water	4.10e-05	2.80e-05	4.60e-05	3.80e-05	3.80e-05
trans-2-Butene	TNT (ACC1)	9.20e-07	9.60e-07	9.60e-07	9.50e-07	9.50e-07
trans-2-Butene	TNT (ACC2)	7.40e-07			7.40e-07	7.40e-07
trans-2-Butene	T45E7 Adapter Booster	2.60e-05	1.80e-05	1.60e-05	2.00e-05	2.00e-05

trans-2-Butene	20 mm HEI Cartridge	1.10e-05	7.20e-06	1.00e-05	9.50e-06	9.50e-06
trans-2-Butene	40 mm HEI Cartridge	2.50e-06	1.70e-06	1.60e-06	1.90e-06	1.90e-06
trans-2-Pentene	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Amatol surrogate with water	8.50e-06	1.70e-05	1.20e-05	1.20e-05	1.30e-05
trans-2-Pentene	Cartridge, Impulse, ARD 446-1	5.20e-07	7.70e-07	5.00e-07	6.00e-07	1.20e-06
trans-2-Pentene	Cartridge, Impulse, BBU-36/B	8.20e-07	5.60e-07	5.60e-07	6.40e-07	1.40e-06
trans-2-Pentene	Cartridge, Impulse, MK 107	2.60e-07	2.60e-07	2.60e-07	2.60e-07	2.60e-07
trans-2-Pentene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Detonating train	1.50e-06	9.00e-07	3.00e-07	8.80e-07	2.00e-06
trans-2-Pentene	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.40e-07
trans-2-Pentene	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	3.90e-06	9.70e-07	1.90e-06	1.90e-06
trans-2-Pentene	Fuze, Tail Bomb FMU-54 A/B	5.90e-07	1.20e-06	9.20e-07	9.00e-07	1.60e-06
trans-2-Pentene	Gas Generator, GGU-2/A	2.40e-06	1.20e-06	6.10e-07	1.40e-06	2.00e-06
trans-2-Pentene	HBX surrogate	3.70e-07	0.00e+00	0.00e+00	3.70e-07	3.80e-07
trans-2-Pentene	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	Signal, Illumination, Red Star AN-M43A2	3.50e-07	7.00e-07	3.50e-07	4.60e-07	4.60e-07
trans-2-Pentene	Signal, Illumination, Red Star M158	7.00e-07	1.40e-06	3.50e-07	8.20e-07	9.30e-07
trans-2-Pentene	Tritonal surrogate	3.70e-07	3.70e-07	0.00e+00	3.70e-07	8.60e-07
trans-2-Pentene	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-07	3.60e-07	7.30e-07
trans-2-Pentene	Tritonal surrogate with water	2.30e-06	3.30e-06	3.70e-06	3.10e-06	3.60e-06
trans-2-Pentene	TNT (ACC1)	4.60e-07	0.00e+00	0.00e+00	4.60e-07	4.60e-07
trans-2-Pentene	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
trans-2-Pentene	T45E7 Adapter Booster	4.20e-06	4.10e-06	4.00e-06	4.10e-06	4.10e-06
trans-2-Pentene	20 mm HEI Cartridge	0.00e+00	1.40e-06	1.40e-06	1.40e-06	1.40e-06
trans-2-Pentene	40 mm HEI Cartridge	5.00e-06	0.00e+00	0.00e+00	5.00e-06	1.10e-05
Acetylene	Amatol surrogate	1.90e-04	4.60e-05	5.40e-05	9.60e-05	9.70e-05
Acetylene	Amatol surrogate with water	7.60e-05	1.30e-04	2.20e-04	1.40e-04	1.40e-04
Acetylene	Cartridge, Impulse, ARD 446-1	2.80e-04	1.90e-04	1.80e-04	2.20e-04	3.20e-04
Acetylene	Cartridge, Impulse, BBU-36/B	1.50e-04	1.30e-04	1.70e-04	1.50e-04	3.00e-04
Acetylene	Cartridge, Impulse, MK 107	2.80e-04	2.50e-04	1.90e-04	2.40e-04	3.50e-04
Acetylene	Composition B surrogate	6.70e-06	8.90e-06	2.70e-05	1.40e-05	1.50e-05
Acetylene	Detonating train	1.80e-04	7.30e-05	1.40e-04	1.30e-04	2.10e-04
Acetylene	Flare, IR Countermeasure M206	2.60e-04	3.10e-04	2.80e-04	2.90e-04	2.90e-04
Acetylene	Fuze, Tail Bomb FMU-139 A/B	5.40e-04	6.60e-04	6.60e-04	6.20e-04	6.20e-04
Acetylene	Fuze, Tail Bomb FMU-54 A/B	3.00e-04	5.70e-04	5.00e-04	4.60e-04	6.10e-04
Acetylene	Gas Generator, GGU-2/A	5.50e-04	6.30e-04	7.30e-04	6.40e-04	6.40e-04
Acetylene	HBX surrogate	1.80e-05	1.80e-05	5.20e-05	2.90e-05	3.00e-05
Acetylene	Mine, Claymore, M18A1	7.70e-04	1.10e-03	1.10e-03	9.80e-04	9.80e-04
Acetylene	Signal, Illumination, Red Star AN-M43A2	2.80e-04	3.50e-04	2.90e-04	3.10e-04	3.10e-04
Acetylene	Signal, Illumination, Red Star M158	2.80e-04	2.80e-04	2.30e-04	2.70e-04	2.70e-04
Acetylene	Tritonal surrogate	2.00e-04	1.30e-04	4.30e-05	1.20e-04	1.30e-04

Acetylene	Tritonal surrogate with calcium stearate		2.10e-05	1.60e-05	1.90e-05	2.00e-05
Acetylene	Tritonal surrogate with water	4.30e-03	4.40e-03	4.50e-03	4.40e-03	4.40e-03
Acetylene	TNT (ACC1)	2.20e-05	1.60e-05	1.40e-05	1.70e-05	1.80e-05
Acetylene	TNT (ACC2)	1.60e-05			1.60e-05	1.70e-05
Acetylene	TNT (Sandia)	5.00e-06	2.40e-06	8.50e-06	5.30e-06	
Acetylene	T45E7 Adapter Booster	7.50e-04	4.50e-04	3.60e-04	5.20e-04	5.30e-04
Acetylene	20 mm HEI Cartridge	2.20e-04	1.30e-04	1.90e-04	1.80e-04	2.50e-04
Acetylene	40 mm HEI Cartridge	5.20e-05	4.30e-05	3.20e-05	4.20e-05	6.40e-05
Allylchloride	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Cartridge, Impulse, BBU-36/B	5.20e-06	1.10e-05	1.10e-05	9.30e-06	9.30e-06
Allylchloride	Cartridge, Impulse, MK 107	1.00e-05	2.90e-06	2.10e-06	5.10e-06	5.10e-06
Allylchloride	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Flare, IR Countermeasure M206	2.10e-05	1.60e-05	1.80e-05	1.80e-05	1.80e-05
Allylchloride	Fuze, Tail Bomb FMU-139 A/B	3.00e-05	3.30e-05	2.80e-05	3.00e-05	3.00e-05
Allylchloride	Fuze, Tail Bomb FMU-54 A/B	2.10e-05	8.30e-06	0.00e+00	1.50e-05	1.50e-05
Allylchloride	Gas Generator, GGU-2/A	9.20e-05	8.80e-05	1.60e-04	1.10e-04	1.10e-04
Allylchloride	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Signal, Illumination, Red Star AN-M43A2	1.60e-05	1.40e-05	2.30e-05	1.80e-05	1.80e-05
Allylchloride	Signal, Illumination, Red Star M158	2.20e-05	1.10e-05	1.40e-05	1.60e-05	1.60e-05
Allylchloride	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Allylchloride	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Aluminum	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Aluminum	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Aluminum	Cartridge, Impulse, ARD 446-1	3.90e-03	3.40e-03	4.30e-03	3.90e-03	6.00e-03
Aluminum	Cartridge, Impulse, BBU-36/B	8.40e-03	1.20e-02	1.30e-02	1.10e-02	2.30e-02
Aluminum	Cartridge, Impulse, MK 107	8.70e-03	9.70e-03	1.00e-02	9.50e-03	1.40e-02
Aluminum	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Aluminum	Detonating train	0.00e+00	9.20e-05	0.00e+00	0.00e+00	3.00e-04
Aluminum	Flare, IR Countermeasure M206	1.90e-02	1.40e-02	1.20e-02	1.50e-02	1.50e-02
Aluminum	Fuze, Tail Bomb FMU-139 A/B	4.00e-02	3.20e-02	3.20e-02	3.40e-02	3.50e-02
Aluminum	Fuze, Tail Bomb FMU-54 A/B	1.00e-02	1.30e-02	1.30e-02	1.20e-02	1.60e-02

Aluminum	Gas Generator, GGU-2/A	6.30e-03	5.60e-03	4.30e-03	5.40e-03	5.80e-03
Aluminum	HBX surrogate	6.10e-03	8.90e-03	1.10e-02	8.60e-03	8.60e-03
Aluminum	Mine, Claymore, M18A1	6.20e-03			6.20e-03	8.60e-04
Aluminum	Signal, Illumination, Red Star AN-M43A2	1.90e-02	1.70e-02	2.10e-02	1.90e-02	1.90e-02
Aluminum	Signal, Illumination, Red Star M158	2.80e-03	1.80e-03	1.80e-03	2.10e-03	2.70e-03
Aluminum	Tritonal surrogate	4.20e-02	1.80e-02	1.60e-02	2.50e-02	2.50e-02
Aluminum	Tritonal surrogate with calcium stearate		1.60e-02	1.70e-02	1.70e-02	1.70e-02
Aluminum	Tritonal surrogate with water	3.10e-03	7.00e-03	8.00e-03	6.00e-03	6.00e-03
Aluminum	TNT (ACC1)	0.00e+00			0.00e+00	0.00e+00
Aluminum	TNT (ACC2)	1.30e-03			1.30e-03	1.30e-03
Aluminum	T45E7 Adapter Booster	8.80e-03			8.80e-03	1.70e-03
Aluminum	20 mm HEI Cartridge	9.60e-04			9.60e-04	7.10e-05
Aluminum	40 mm HEI Cartridge	1.50e-02			1.50e-02	3.90e-03
Antimony	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Cartridge, Impulse, ARD 446-1	1.80e-04	1.60e-04	2.00e-04	1.80e-04	1.80e-04
Antimony	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Fuze, Tail Bomb FMU-139 A/B	2.90e-04	2.20e-04	1.50e-04	2.20e-04	2.20e-04
Antimony	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	TNT (Sandia)	3.20e-07	7.00e-07	1.00e-06	6.70e-07	
Antimony	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Antimony	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	[illegible] surrogate	0.00e+00	2.40e-05	3.20e-05	6.00e-06	8.00e-06
Barium	[illegible] with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	[illegible]	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.00e-06
Barium	[illegible]	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Barium	Cartridge, Impulse, MK 107	0.00e+00	2.50e-05	3.70e-05	1.60e-05	1.90e-04
Barium	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Flare, IR Countermeasure M206	1.50e-04	3.10e-04	2.60e-04	2.40e-04	2.40e-04
Barium	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	Mine, Claymore, M18A1	0.00e+00			0.00e+00	0.00e+00
Barium	Signal, Illumination, Red Star AN-M43A2	7.80e-05	7.70e-05	1.80e-04	1.10e-04	1.10e-04
Barium	Signal, Illumination, Red Star M158	2.10e-04	1.60e-04	1.40e-04	1.70e-04	2.60e-04
Barium	Tritonal surrogate	4.70e-04	0.00e+00	1.60e-04	1.60e-04	1.60e-04
Barium	Tritonal surrogate with calcium stearate		3.10e-04	4.10e-04	3.60e-04	3.60e-04
Barium	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Barium	TNT (ACC1)	1.10e-04			1.10e-04	1.10e-04
Barium	TNT (ACC2)	3.60e-04			3.60e-04	3.70e-04
Barium	TNT (Sandia)	7.90e-03	7.70e-03	8.90e-03	8.20e-03	
Barium	T45E7 Adapter Booster	6.10e-04			6.10e-04	6.10e-04
Barium	20 mm HEI Cartridge	0.00e+00			0.00e+00	0.00e+00
Barium	40 mm HEI Cartridge	0.00e+00			0.00e+00	0.00e+00
Benzene	Amatol surrogate	4.20e-05	1.00e-05	1.60e-05	2.30e-05	2.50e-05
Benzene	Amatol surrogate with water	1.90e-04	3.60e-04	2.70e-04	2.70e-04	2.80e-04
Benzene	Cartridge, Impulse, ARD 446-1	7.70e-05	6.30e-05	6.10e-05	6.70e-05	1.00e-04
Benzene	Cartridge, Impulse, BBU-36/B	2.10e-05	1.90e-05	2.30e-05	2.10e-05	4.70e-05
Benzene	Cartridge, Impulse, MK 107	6.90e-05	6.70e-05	5.50e-05	6.40e-05	9.60e-05
Benzene	Composition B surrogate	2.20e-06	2.20e-06	3.30e-06	2.60e-06	5.00e-06
Benzene	Detonating train	2.40e-05	2.30e-05	2.60e-05	2.50e-05	4.60e-05
Benzene	Flare, IR Countermeasure M206	4.60e-05	3.90e-05	5.00e-05	4.50e-05	4.80e-05
Benzene	Fuze, Tail Bomb FMU-139 A/B	1.10e-04	1.20e-04	1.30e-04	1.20e-04	1.20e-04
Benzene	Fuze, Tail Bomb FMU-54 A/B	6.40e-05	1.70e-04	1.00e-04	1.10e-04	1.50e-04
Benzene	Gas Generator, GGU-2/A	1.10e-04	1.30e-04	1.50e-04	1.30e-04	1.40e-04
Benzene	HBX surrogate	6.60e-06	4.50e-06	1.00e-05	7.20e-06	1.40e-05
Benzene	Mine, Claymore, M18A1	5.50e-04	9.40e-04	9.30e-04	8.10e-04	8.10e-04
Benzene	Signal, Illumination, Red Star AN-M43A2	3.00e-05	3.60e-05	3.50e-05	3.40e-05	3.60e-05
Benzene	Signal, Illumination, Red Star M158	3.00e-05	3.40e-05	2.60e-05	3.00e-05	3.30e-05
Benzene	Tritonal surrogate	1.20e-05	3.30e-06	1.50e-06	5.70e-06	1.60e-05
Benzene	Tritonal surrogate with calcium stearate		4.40e-06	1.80e-06	3.10e-06	1.40e-05
Benzene	Tritonal surrogate with water	2.90e-04	1.20e-04	2.10e-04	2.00e-04	2.20e-04
Benzene	TNT (ACC1)	4.60e-06	4.80e-06	2.90e-06	4.10e-06	8.80e-06
Benzene	TNT (ACC2)	4.10e-06			4.10e-06	7.40e-06
Benzene	TNT (Sandia)	1.40e-06	3.30e-06	4.20e-06	3.00e-06	

Benzene	T45E7 Adapter Booster	1.60e-04	1.40e-04	8.00e-05	1.30e-04	1.30e-04
Benzene	20 mm HEI Cartridge	1.50e-04	8.90e-05	9.90e-05	1.10e-04	1.70e-04
Benzene	40 mm HEI Cartridge	2.80e-05	0.00e+00	0.00e+00	2.80e-05	4.90e-05
Cadmium	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Cartridge, Impulse, MK 107	1.00e-03	1.80e-03	1.40e-03	1.40e-03	1.40e-03
Cadmium	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Detonating train	1.10e-05	1.40e-05	7.00e-06	1.10e-05	1.10e-05
Cadmium	Flare, IR Countermeasure M206	4.90e-05	3.00e-05	2.30e-05	3.40e-05	3.50e-05
Cadmium	Fuze, Tail Bomb FMU-139 A/B	2.40e-03	2.10e-03	2.20e-03	2.30e-03	2.30e-03
Cadmium	Fuze, Tail Bomb FMU-54 A/B	1.80e-04	1.50e-04	5.90e-04	3.10e-04	4.10e-04
Cadmium	Gas Generator, GGU-2/A	4.50e-05	2.10e-04	4.90e-05	1.00e-04	1.00e-04
Cadmium	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Mine, Claymore, M18A1	2.40e-04			2.40e-04	2.40e-04
Cadmium	Signal, Illumination, Red Star AN-M43A2	1.30e-04	7.00e-05	6.10e-05	8.80e-05	9.00e-05
Cadmium	Signal, Illumination, Red Star M158	1.30e-03	9.40e-04	1.10e-03	1.10e-03	1.30e-03
Cadmium	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cadmium	TNT (ACC2)	4.00e-05			4.00e-05	4.00e-05
Cadmium	TNT (Sandia)	2.90e-06	2.50e-06	2.80e-06	2.70e-06	
Cadmium	T45E7 Adapter Booster	5.80e-03			5.80e-03	5.80e-03
Cadmium	20 mm HEI Cartridge	8.60e-04			8.60e-04	4.00e-04
Cadmium	40 mm HEI Cartridge	3.20e-05			3.20e-05	3.20e-05
Carbon tetrachloride	Amatol surrogate	3.70e-07	0.00e+00	0.00e+00	3.70e-07	2.10e-06
Carbon tetrachloride	Amatol surrogate with water	3.70e-07	3.70e-07	3.70e-07	3.70e-07	2.20e-06
Carbon tetrachloride	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Composition B surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	2.20e-06
Carbon tetrachloride	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.90e-06
Carbon tetrachloride	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	2.70e-06	0.00e+00	2.70e-06	2.70e-06
Carbon tetrachloride	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.20e-06
Carbon tetrachloride	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.30e-06
Carbon tetrachloride	HBX surrogate	0.00e+00	4.10e-07	3.70e-07	3.90e-07	2.30e-06
Carbon tetrachloride	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.90e-06

Carbon tetrachloride	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.90e-06
Carbon tetrachloride	Tritonal surrogate	0.00e+00	3.70e-07	0.00e+00	3.70e-07	2.00e-06
Carbon tetrachloride	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	1.80e-06
Carbon tetrachloride	Tritonal surrogate with water	3.70e-07	3.70e-07	7.50e-07	4.80e-07	2.40e-06
Carbon tetrachloride	TNT (ACC1)	0.00e+00			0.00e+00	2.50e-06
Carbon tetrachloride	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Carbon tetrachloride	T45E7 Adapter Booster	3.20e-06			3.20e-06	6.50e-06
Carbon tetrachloride	20 mm HEI Cartridge	7.60e-06			7.60e-06	1.60e-05
Carbon tetrachloride	40 mm HEI Cartridge	4.50e-06			4.50e-06	1.20e-05
Chloroform	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.70e-07
Chloroform	Amatol surrogate with water	3.70e-07	3.70e-07	0.00e+00	3.70e-07	7.40e-07
Chloroform	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.70e-07
Chloroform	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Gas Generator, GGU-2/A	2.50e-06	2.50e-06	2.60e-06	2.60e-06	2.60e-06
Chloroform	HBX surrogate	3.70e-07	4.10e-07	3.70e-07	3.80e-07	7.60e-07
Chloroform	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	Tritonal surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	7.40e-07
Chloroform	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	3.70e-07
Chloroform	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chloroform	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Cartridge, Impulse, BBU-36/B	2.00e-05	0.00e+00	2.50e-05	2.20e-05	2.20e-05
Chromium	Cartridge, Impulse, MK 107	4.30e-05	2.90e-05	2.80e-05	3.30e-05	3.30e-05
Chromium	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Flare, IR Countermeasure M206	1.40e-04	1.70e-04	1.60e-04	1.60e-04	1.60e-04
Chromium	Fuze, Tail Bomb FMU-139 A/B	1.60e-04	1.20e-04	1.30e-04	1.40e-04	1.40e-04

Chromium	Fuze, Tail Bomb FMU-54 A/B	5.50e-05	3.50e-05	2.80e-05	3.90e-05	5.50e-05
Chromium	Gas Generator, GGU-2/A	5.30e-05	9.70e-05	1.40e-04	9.60e-05	9.60e-05
Chromium	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Mine, Claymore, M18A1	3.80e-05			3.80e-05	3.80e-05
Chromium	Signal, Illumination, Red Star AN-M43A2	6.60e-05	5.20e-05	5.30e-05	5.70e-05	5.80e-05
Chromium	Signal, Illumination, Red Star M158	1.30e-04	1.50e-04	1.50e-04	1.50e-04	1.50e-04
Chromium	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Chromium	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	9.10e-06
Chromium	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.20e-06
Chromium	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.00e-06
Chromium	TNT (ACC2)	2.30e-05			2.30e-05	2.50e-05
Chromium	TNT (Sandia)	1.30e-06	3.50e-06	2.50e-06	2.40e-06	
Chromium	T45E7 Adapter Booster	9.40e-05			9.40e-05	9.40e-05
Chromium	20 mm HEI Cartridge	3.50e-05			3.50e-05	3.50e-05
Chromium	40 mm HEI Cartridge	8.80e-05			8.80e-05	8.80e-05
Copper	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	9.50e-05
Copper	Cartridge, Impulse, BBU-36/B	8.80e-04	1.40e-03	1.40e-03	1.20e-03	2.90e-03
Copper	Cartridge, Impulse, MK 107	1.30e-03	1.50e-03	1.50e-03	1.40e-03	2.40e-03
Copper	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Detonating train	0.00e+00	4.70e-04	0.00e+00	0.00e+00	2.60e-04
Copper	Flare, IR Countermeasure M206	6.50e-05	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Fuze, Tail Bomb FMU-139 A/B	7.70e-03	6.60e-03	5.90e-03	6.80e-03	6.80e-03
Copper	Fuze, Tail Bomb FMU-54 A/B	4.40e-04	4.50e-04	6.40e-04	5.10e-04	8.60e-04
Copper	Gas Generator, GGU-2/A	6.60e-04	7.00e-04	5.50e-04	6.40e-04	7.10e-04
Copper	HBX surrogate	1.90e-03	4.50e-03	3.10e-03	3.20e-03	3.20e-03
Copper	Mine, Claymore, M18A1	4.70e-03			4.70e-03	7.10e-04
Copper	Signal, Illumination, Red Star AN-M43A2	6.90e-04	2.00e-04	2.30e-04	3.70e-04	3.90e-04
Copper	Signal, Illumination, Red Star M158	0.00e+00	1.80e-03	0.00e+00	0.00e+00	0.00e+00
Copper	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Copper	Tritonal surrogate with calcium stearate		1.00e-04	0.00e+00	4.40e-05	7.50e-05
Copper	Tritonal surrogate with water	9.20e-04	7.70e-04	9.60e-04	8.80e-04	9.10e-04
Copper	TNT (ACC1)	3.00e-04			3.00e-04	0.00e+00
Copper	TNT (ACC2)	5.00e-04			5.00e-04	5.20e-04
Copper	T45E7 Adapter Booster	2.70e-03			2.70e-03	3.20e-04
Copper	20 mm HEI Cartridge	2.60e-02			2.60e-02	1.20e-02
Copper	40 mm HEI Cartridge	8.90e-03			8.90e-03	2.30e-03
Cyclohexane	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Amatol surrogate with water	7.40e-07	0.00e+00	0.00e+00	7.40e-07	1.50e-06
Cyclohexane	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Cyclohexane	Cartridge, Impulse, BBU-36/B	0.00e+00	5.60e-07	0.00e+00	5.60e-07	1.70e-06
Cyclohexane	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Detonating train	8.70e-07	0.00e+00	6.00e-07	7.30e-07	1.80e-06
Cyclohexane	Flare, IR Countermeasure M206	3.30e-07	0.00e+00	0.00e+00	3.30e-07	3.30e-07
Cyclohexane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	0.00e+00	0.00e+00	4.90e-07	4.90e-07
Cyclohexane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	5.80e-07
Cyclohexane	Mine, Claymore, M18A1	2.00e-06	4.90e-07	1.40e-06	1.30e-06	1.80e-06
Cyclohexane	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	7.40e-07
Cyclohexane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	7.30e-07
Cyclohexane	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.80e-06
Cyclohexane	TNT (ACC1)	2.30e-06	9.60e-07	0.00e+00	1.60e-06	3.00e-06
Cyclohexane	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclohexane	T45E7 Adapter Booster	1.80e-06	1.20e-06	4.00e-06	2.30e-06	4.70e-06
Cyclohexane	20 mm HEI Cartridge	7.00e-07	0.00e+00	6.80e-07	6.90e-07	6.50e-06
Cyclohexane	40 mm HEI Cartridge	7.50e-06	0.00e+00	0.00e+00	7.50e-06	1.60e-05
Cyclopentane	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Amatol surrogate with water	2.20e-06	4.40e-06	2.20e-06	3.00e-06	3.50e-06
Cyclopentane	Cartridge, Impulse, ARD 446-1	0.00e+00	2.60e-07	0.00e+00	2.60e-07	7.50e-07
Cyclopentane	Cartridge, Impulse, BBU-36/B	2.70e-07	2.80e-07	2.80e-07	2.80e-07	9.00e-07
Cyclopentane	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Detonating train	0.00e+00	0.00e+00	3.00e-07	3.00e-07	6.10e-07
Cyclopentane	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	HBX surrogate	0.00e+00	0.00e+00	1.10e-06	1.10e-06	7.50e-07
Cyclopentane	Mine, Claymore, M18A1	0.00e+00	9.80e-07	4.70e-07	7.20e-07	7.20e-07
Cyclopentane	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	Tritonal surrogate	3.70e-07	3.70e-07	3.60e-07	3.70e-07	7.40e-07
Cyclopentane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	5.50e-07
Cyclopentane	Tritonal surrogate with water	0.00e+00	1.50e-06	7.50e-07	1.10e-06	1.90e-06
Cyclopentane	TNT (ACC1)	4.60e-07	4.80e-07	0.00e+00	4.70e-07	4.70e-07
Cyclopentane	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentane	T45E7 Adapter Booster	0.00e+00	5.90e-07	5.80e-07	5.80e-07	9.70e-07

Cyclopentane	20 mm HEI Cartridge	0.00e+00	7.20e-07	6.80e-07	7.00e-07	1.60e-06
Cyclopentane	40 mm HEI Cartridge	1.70e-06	0.00e+00	0.00e+00	1.70e-06	3.30e-06
Cyclopentene	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Amatol surrogate with water	4.10e-06	2.00e-05	0.00e+00	1.20e-05	1.20e-05
Cyclopentene	Cartridge, Impulse, ARD 446-1	2.10e-06	5.10e-06	2.00e-06	3.10e-06	3.10e-06
Cyclopentene	Cartridge, Impulse, BBU-36/B	2.70e-06	0.00e+00	2.80e-06	2.70e-06	2.70e-06
Cyclopentene	Cartridge, Impulse, MK 107	1.00e-06	7.90e-07	1.00e-06	9.70e-07	9.70e-07
Cyclopentene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	Detonating train	3.80e-06	3.90e-06	3.30e-06	3.70e-06	3.70e-06
Cyclopentene	Flare, IR Countermeasure M206	6.60e-07	6.80e-07	1.00e-06	7.90e-07	7.90e-07
Cyclopentene	Fuze, Tail Bomb FMU-139 A/B	9.70e-07	9.70e-07	4.80e-07	8.10e-07	8.10e-07
Cyclopentene	Fuze, Tail Bomb FMU-54 A/B	1.20e-06	1.50e-06	1.20e-06	1.30e-06	1.30e-06
Cyclopentene	Gas Generator, GGU-2/A	4.10e-06	1.80e-06	4.90e-06	3.60e-06	3.60e-06
Cyclopentene	HBX surrogate	3.70e-07	4.10e-07	0.00e+00	3.90e-07	5.70e-07
Cyclopentene	Mine, Claymore, M18A1	4.90e-07	0.00e+00	0.00e+00	4.90e-07	4.90e-07
Cyclopentene	Signal, Illumination, Red Star AN-M43A2	1.00e-06	1.70e-06	1.00e-06	1.30e-06	1.30e-06
Cyclopentene	Signal, Illumination, Red Star M158	3.50e-06	2.10e-06	1.70e-06	2.50e-06	2.50e-06
Cyclopentene	Tritonal surrogate	0.00e+00	0.00e+00	7.30e-07	7.30e-07	7.30e-07
Cyclopentene	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-07	3.60e-07	3.60e-07
Cyclopentene	Tritonal surrogate with water	0.00e+00	0.00e+00	2.60e-06	2.60e-06	2.60e-06
Cyclopentene	TNT (ACC1)	4.60e-07	0.00e+00	0.00e+00	4.60e-07	4.60e-07
Cyclopentene	TNT (ACC2)	3.70e-07			3.70e-07	3.70e-07
Cyclopentene	T45E7 Adapter Booster	4.20e-06	4.10e-06	2.90e-06	3.70e-06	3.70e-06
Cyclopentene	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Cyclopentene	40 mm HEI Cartridge	8.30e-07	0.00e+00	0.00e+00	8.30e-07	1.70e-06
CO	Amatol surrogate	9.80e-03	8.60e-03	1.10e-02	9.70e-03	
CO	Amatol surrogate with water	1.90e-01	3.10e-01	1.90e-01	2.30e-01	
CO	Cartridge, Impulse, ARD 446-1	1.40e-02	1.20e-02	1.30e-02	1.30e-02	
CO	Cartridge, Impulse, BBU-36/B	8.10e-03	8.10e-03	9.00e-03	8.40e-03	
CO	Cartridge, Impulse, MK 107	1.40e-02	1.50e-02	1.30e-02	1.40e-02	
CO	Composition B surrogate	3.40e-03	4.70e-03	4.40e-03	4.20e-03	
CO	Detonating train	1.30e-02	7.90e-03	7.40e-03	9.40e-03	
CO	Flare, IR Countermeasure M206	7.40e-03	9.50e-03	7.90e-03	8.30e-03	
CO	Fuze, Tail Bomb FMU-139 A/B	2.10e-02	2.40e-02	2.50e-02	2.30e-02	
CO	Fuze, Tail Bomb FMU-54 A/B	1.50e-02	2.40e-02	1.70e-02	1.80e-02	
CO	Gas Generator, GGU-2/A	2.70e-02	2.80e-02	3.00e-02	2.80e-02	
CO	HBX surrogate	4.40e-03	4.20e-03	7.00e-03	5.20e-03	
CO	Mine, Claymore, M18A1	2.90e-02	3.20e-02	3.00e-02	3.00e-02	
CO	Signal, Illumination, Red Star AN-M43A2	1.70e-02	2.10e-02	2.80e-02	2.20e-02	
CO	Signal, Illumination, Red Star M158	1.10e-02	1.10e-02	1.20e-02	1.20e-02	
CO	[illegible]	5.60e-03	5.60e-03	2.90e-03	4.70e-03	

CO	Tritonal surrogate with calcium stearate		3.30e-03	2.00e-03	2.70e-03	
CO	Tritonal surrogate with water	2.80e-01	2.40e-01	2.80e-01	2.70e-01	
CO	TNT (ACC1)	9.50e-03	1.30e-02	9.30e-03	1.00e-02	
CO	TNT (ACC2)	6.70e-03			6.70e-03	
CO	T45E7 Adapter Booster	3.10e-02	3.10e-02	2.60e-02	2.90e-02	
CO	20 mm HEI Cartridge	1.20e-01	9.10e-02	1.10e-01	1.10e-01	
CO	40 mm HEI Cartridge	2.30e-02	2.30e-02	1.80e-02	2.10e-02	
CO2	Amatol surrogate	5.10e-01	7.80e-01	8.00e-01	7.00e-01	
CO2	Amatol surrogate with water	2.30e-01	4.50e-01	2.40e-01	3.10e-01	
CO2	Cartridge, Impulse, ARD 446-1	4.80e-01	4.60e-01	5.00e-01	4.80e-01	
CO2	Cartridge, Impulse, BBU-36/B	5.00e-01	4.80e-01	5.30e-01	5.00e-01	
CO2	Cartridge, Impulse, MK 107	8.40e-01	8.50e-01	8.60e-01	8.50e-01	
CO2	Composition B surrogate	1.10e+00	1.20e+00	1.10e+00	1.10e+00	
CO2	Detonating train	5.70e-01	1.10e+00	1.10e+00	9.10e-01	
CO2	Flare, IR Countermeasure M206	7.70e-01	8.10e-01	8.50e-01	8.10e-01	
CO2	Fuze, Tail Bomb FMU-139 A/B	1.50e+00	1.40e+00	1.50e+00	1.40e+00	
CO2	Fuze, Tail Bomb FMU-54 A/B	9.20e-01	9.10e-01	9.80e-01	9.40e-01	
CO2	Gas Generator, GGU-2/A	4.40e-01	4.30e-01	4.80e-01	4.50e-01	
CO2	HBX surrogate	9.70e-01	9.40e-01	1.10e+00	1.00e+00	
CO2	Mine, Claymore, M18A1	4.90e+00	5.10e+00	5.00e+00	5.00e+00	
CO2	Signal, Illumination, Red Star AN-M43A2	1.00e+00	1.10e+00	1.10e+00	1.10e+00	
CO2	Signal, Illumination, Red Star M158	5.00e-01	5.30e-01	5.10e-01	5.10e-01	
CO2	Tritonal surrogate	5.00e-01	2.20e-01	1.20e+00	6.40e-01	
CO2	Tritonal surrogate with calcium stearate		1.30e+00	1.30e+00	1.30e+00	
CO2	Tritonal surrogate with water	2.50e-01	3.30e-01	2.60e-01	2.80e-01	
CO2	TNT (ACC1)	1.40e+00	1.50e+00	1.50e+00	1.50e+00	
CO2	TNT (ACC2)	1.40e+00			1.40e+00	
CO2	TNT (Sandia)	1.30e+00			1.30e+00	
CO2	T45E7 Adapter Booster	5.10e+00	4.60e+00	4.70e+00	4.80e+00	
CO2	20 mm HEI Cartridge	2.30e+00	2.20e+00	1.90e+00	2.10e+00	
CO2	40 mm HEI Cartridge	9.10e-01	8.70e-01	8.80e-01	8.90e-01	
Diethyl phthalate	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.40e-05
Diethyl phthalate	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.80e-06
Diethyl phthalate	Cartridge, Impulse, BBU-36/B	4.40e-05	6.70e-04	4.90e-04	4.00e-04	7.80e-04
Diethyl phthalate	Cartridge, Impulse, MK 107	3.00e-04	0.00e+00	0.00e+00	3.00e-04	4.40e-04
Diethyl phthalate	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Fuze, Tail Bomb FMU-139 A/B	1.40e-03	1.70e-03	1.50e-03	1.50e-03	1.50e-03
Diethyl phthalate	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Diethyl phthalate	Gas Generator, GGU-2/A	2.30e-04	0.00e+00	1.60e-03	8.90e-04	0.00e+00
Diethyl phthalate	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Signal, Illumination, Red Star M158	0.00e+00	7.70e-05	0.00e+00	7.70e-05	7.70e-05
Diethyl phthalate	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.40e-06
Diethyl phthalate	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Diethyl phthalate	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethane	Amatol surrogate	0.00e+00	2.20e-06	6.00e-06	4.10e-06	5.20e-06
Ethane	Amatol surrogate with water	8.70e-04	1.50e-03	1.00e-03	1.10e-03	1.10e-03
Ethane	Cartridge, Impulse, ARD 446-1	3.00e-05	1.20e-05	2.90e-05	2.40e-05	3.90e-05
Ethane	Cartridge, Impulse, BBU-36/B	1.40e-06	5.60e-07	8.40e-06	3.40e-06	1.30e-05
Ethane	Cartridge, Impulse, MK 107	5.30e-07	2.60e-06	1.60e-06	1.60e-06	9.50e-06
Ethane	Composition B surrogate	1.90e-06	0.00e+00	7.30e-07	1.30e-06	4.70e-06
Ethane	Detonating train	1.70e-06	1.80e-06	9.60e-06	4.40e-06	1.40e-05
Ethane	Flare, IR Countermeasure M206	1.00e-06	0.00e+00	1.00e-06	1.00e-06	7.60e-06
Ethane	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	9.20e-06	0.00e+00	9.80e-06	1.90e-05
Ethane	Fuze, Tail Bomb FMU-54 A/B	9.80e-06	1.20e-05	0.00e+00	1.10e-05	1.90e-05
Ethane	Gas Generator, GGU-2/A	2.50e-05	3.70e-05	3.00e-05	3.00e-05	3.90e-05
Ethane	HBX surrogate	0.00e+00	1.60e-06	1.50e-06	1.60e-06	4.90e-06
Ethane	Mine, Claymore, M18A1	8.80e-06	1.50e-06	5.60e-06	5.30e-06	7.20e-06
Ethane	Signal, Illumination, Red Star AN-M43A2	9.00e-06	0.00e+00	9.00e-06	9.00e-06	1.30e-05
Ethane	Signal, Illumination, Red Star M158	1.50e-05	2.40e-05	0.00e+00	2.00e-05	2.60e-05
Ethane	Tritonal surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	2.60e-06
Ethane	Tritonal surrogate with calcium stearate		7.40e-07	0.00e+00	7.40e-07	4.40e-06
Ethane	Tritonal surrogate with water	5.00e-05	1.10e-04	2.10e-04	1.20e-04	1.30e-04
Ethane	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.70e-06
Ethane	TNT (ACC2)	7.40e-07			7.40e-07	4.10e-06
Ethane	T45E7 Adapter Booster	2.80e-05	2.40e-05	2.40e-05	2.50e-05	3.90e-05
Ethane	20 mm HEI Cartridge	1.10e-04	7.60e-05	9.90e-05	9.40e-05	1.40e-04
Ethane	40 mm HEI Cartridge	2.90e-05	3.60e-05	2.50e-05	3.00e-05	4.60e-05
Ethyl chloride	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Ethyl chloride	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Detonating train	0.00e+00	6.90e-07	6.90e-07	6.90e-07	6.90e-07
Ethyl chloride	Flare, IR Countermeasure M206	3.90e-06	3.20e-06	2.40e-06	3.10e-06	3.10e-06
Ethyl chloride	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Gas Generator, GGU-2/A	2.70e-06	4.10e-06	7.10e-06	4.70e-06	4.70e-06
Ethyl chloride	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethyl chloride	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Ethylbenzene	Amatol surrogate	7.50e-07	1.10e-06	1.90e-06	1.20e-06	4.00e-06
Ethylbenzene	Amatol surrogate with water	1.20e-05	2.20e-05	1.50e-05	1.60e-05	2.10e-05
Ethylbenzene	Cartridge, Impulse, ARD 446-1	1.00e-06	2.10e-06	2.70e-06	1.90e-06	8.10e-06
Ethylbenzene	Cartridge, Impulse, BBU-36/B	2.70e-06	2.50e-06	1.90e-06	2.40e-06	1.00e-05
Ethylbenzene	Cartridge, Impulse, MK 107	7.90e-07	1.10e-06	1.00e-06	9.70e-07	2.90e-06
Ethylbenzene	Composition B surrogate	1.10e-06	1.90e-06	2.90e-06	2.00e-06	5.30e-06
Ethylbenzene	Detonating train	2.90e-07	6.00e-07	9.00e-07	6.00e-07	9.30e-06
Ethylbenzene	Flare, IR Countermeasure M206	2.70e-06	1.70e-06	2.70e-06	2.40e-06	4.10e-06
Ethylbenzene	Fuze, Tail Bomb FMU-139 A/B	3.40e-06	3.40e-06	2.90e-06	3.20e-06	4.50e-06
Ethylbenzene	Fuze, Tail Bomb FMU-54 A/B	1.50e-06	3.30e-06	2.40e-06	2.40e-06	6.00e-06
Ethylbenzene	Gas Generator, GGU-2/A	5.90e-07	1.80e-06	1.20e-06	1.20e-06	9.10e-06
Ethylbenzene	HBX surrogate	1.50e-06	1.60e-06	2.20e-06	1.80e-06	8.80e-06
Ethylbenzene	Mine, Claymore, M18A1	3.10e-05	4.10e-05	4.20e-05	3.80e-05	3.90e-05
Ethylbenzene	Signal, Illumination, Red Star AN-M43A2	6.90e-07	3.50e-07	3.50e-07	4.60e-07	1.90e-06
Ethylbenzene	Signal, Illumination, Red Star M158	7.00e-07	7.00e-07	0.00e+00	7.00e-07	2.20e-06
Ethylbenzene	Tritonal surrogate	1.50e-06	2.60e-06	3.30e-06	2.50e-06	1.10e-05
Ethylbenzene	Tritonal surrogate with calcium stearate		7.40e-07	2.60e-06	1.60e-06	9.90e-06
Ethylbenzene	Tritonal surrogate with water	8.20e-06	3.30e-06	7.50e-06	6.30e-06	1.50e-05
Ethylbenzene	TNT (ACC1)	4.60e-07	4.80e-07	0.00e+00	4.70e-07	2.70e-06
Ethylbenzene	TNT (ACC2)	0.00e+00			0.00e+00	3.30e-06
Ethylbenzene	T45E7 Adapter Booster	1.00e-05	7.70e-06	9.80e-06	9.20e-06	1.00e-05
Ethylbenzene	20 mm HEI Cartridge	2.80e-06	5.00e-06	6.10e-06	4.60e-06	1.00e-05
Ethylbenzene	40 mm HEI Cartridge	2.50e-06	0.00e+00	0.00e+00	2.50e-06	9.60e-06

Ethylene	Amatol surrogate	4.40e-05	2.00e-05	2.90e-05	3.10e-05	3.20e-05
Ethylene	Amatol surrogate with water	7.30e-04	1.30e-03	8.80e-04	9.80e-04	9.80e-04
Ethylene	Cartridge, Impulse, ARD 446-1	3.90e-04	3.10e-04	3.10e-04	3.30e-04	4.90e-04
Ethylene	Cartridge, Impulse, BBU-36/B	2.60e-04	2.50e-04	3.00e-04	2.70e-04	5.30e-04
Ethylene	Cartridge, Impulse, MK 107	2.00e-04	1.80e-04	1.60e-04	1.80e-04	2.60e-04
Ethylene	Composition B surrogate	1.20e-05	1.20e-05	1.70e-05	1.40e-05	1.50e-05
Ethylene	Detonating train	4.20e-04	4.10e-04	3.50e-04	3.90e-04	6.00e-04
Ethylene	Flare, IR Countermeasure M206	1.30e-04	7.70e-05	1.40e-04	1.20e-04	1.20e-04
Ethylene	Fuze, Tail Bomb FMU-139 A/B	2.40e-04	4.00e-04	3.80e-04	3.40e-04	3.40e-04
Ethylene	Fuze, Tail Bomb FMU-54 A/B	1.60e-04	2.60e-04	1.70e-04	1.90e-04	2.60e-04
Ethylene	Gas Generator, GGU-2/A	6.00e-04	5.80e-04	6.70e-04	6.10e-04	6.20e-04
Ethylene	HBX surrogate	2.80e-05	2.50e-05	4.30e-05	3.20e-05	3.30e-05
Ethylene	Mine, Claymore, M18A1	1.80e-04	2.30e-04	3.00e-04	2.40e-04	2.40e-04
Ethylene	Signal, Illumination, Red Star AN-M43A2	2.10e-04	2.20e-04	2.20e-04	2.20e-04	2.20e-04
Ethylene	Signal, Illumination, Red Star M158	2.30e-04	3.50e-04	1.00e-04	2.30e-04	2.30e-04
Ethylene	Tritonal surrogate	2.70e-05	1.30e-05	2.50e-05	2.20e-05	2.30e-05
Ethylene	Tritonal surrogate with calcium stearate		3.20e-05	1.80e-05	2.50e-05	2.60e-05
Ethylene	Tritonal surrogate with water	1.20e-03	9.00e-04	1.30e-03	1.10e-03	1.10e-03
Ethylene	TNT (ACC1)	3.00e-05	2.90e-05	8.60e-06	2.20e-05	2.30e-05
Ethylene	TNT (ACC2)	1.60e-05			1.60e-05	1.60e-05
Ethylene	T45E7 Adapter Booster	6.50e-04	5.60e-04	4.90e-04	5.70e-04	5.70e-04
Ethylene	20 mm HEI Cartridge	3.30e-04	2.40e-04	3.00e-04	2.90e-04	4.00e-04
Ethylene	40 mm HEI Cartridge	8.90e-05	9.00e-05	6.50e-05	8.10e-05	1.10e-04
Lead	Amatol surrogate	0.00e+00	3.20e-05	9.70e-05	3.30e-05	3.30e-05
Lead	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Cartridge, Impulse, ARD 446-1	3.60e-04	2.10e-04	3.60e-04	3.10e-04	3.10e-04
Lead	Cartridge, Impulse, BBU-36/B	1.20e-05	1.00e-04	8.80e-05	6.80e-05	6.80e-05
Lead	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Detonating train	2.80e-05	2.20e-04	2.90e-04	1.80e-04	1.80e-04
Lead	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Fuze, Tail Bomb FMU-139 A/B	2.80e-03	2.40e-03	2.50e-03	2.60e-03	2.60e-03
Lead	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Gas Generator, GGU-2/A	4.10e-04	4.10e-04	2.80e-04	3.70e-04	3.70e-04
Lead	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Mine, Claymore, M18A1	0.00e+00			0.00e+00	0.00e+00
Lead	Signal, Illumination, Red Star AN-M43A2	2.10e-04	0.00e+00	2.80e-05	7.00e-05	7.00e-05
Lead	Signal, Illumination, Red Star M158	7.00e-05	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Lead	Tritonal surrogate	1.90e-03	7.20e-04	6.70e-04	1.10e-03	1.10e-03
Lead	Tritonal surrogate with calcium stearate		9.10e-04	9.30e-04	9.20e-04	9.20e-04
Lead	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Lead	TNT (ACC1)	0.00e+00			0.00e+00	0.00e+00
Lead	TNT (ACC2)	9.00e-06			9.00e-06	9.00e-06
Lead	TNT (Sandia)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	
Lead	T45E7 Adapter Booster	1.80e-04			1.80e-04	1.80e-04
Lead	20 mm HEI Cartridge	7.00e-04			7.00e-04	8.00e-06
Lead	40 mm HEI Cartridge	3.70e-04			3.70e-04	3.70e-04
Methyl chloride	Amatol surrogate	1.10e-06	7.50e-07	3.70e-07	7.50e-07	7.50e-07
Methyl chloride	Amatol surrogate with water	2.20e-06	1.80e-06	2.60e-06	2.20e-06	2.20e-06
Methyl chloride	Cartridge, Impulse, ARD 446-1	1.90e-06	9.20e-07	9.00e-07	1.20e-06	2.00e-06
Methyl chloride	Cartridge, Impulse, BBU-36/B	4.90e-07	1.50e-06	1.00e-06	1.00e-06	3.00e-06
Methyl chloride	Cartridge, Impulse, MK 107	1.90e-06	4.80e-07	4.70e-07	9.60e-07	1.60e-06
Methyl chloride	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloride	Detonating train	1.10e-06	5.30e-07	5.30e-07	7.00e-07	1.90e-06
Methyl chloride	Flare, IR Countermeasure M206	1.20e-06	6.00e-07	1.20e-06	1.00e-06	1.60e-06
Methyl chloride	Fuze, Tail Bomb FMU-139 A/B	4.50e-06	6.10e-06	3.50e-06	4.70e-06	5.30e-06
Methyl chloride	Fuze, Tail Bomb FMU-54 A/B	1.10e-06	2.20e-06	6.20e-06	3.10e-06	4.90e-06
Methyl chloride	Gas Generator, GGU-2/A	5.30e-06	7.60e-06	3.60e-05	1.60e-05	1.70e-05
Methyl chloride	HBX surrogate	3.70e-07	4.10e-07	1.10e-06	6.30e-07	1.00e-06
Methyl chloride	Mine, Claymore, M18A1	4.40e-06			4.40e-06	4.40e-06
Methyl chloride	Signal, Illumination, Red Star AN-M43A2	1.90e-06	1.20e-06	1.80e-06	1.70e-06	2.10e-06
Methyl chloride	Signal, Illumination, Red Star M158	0.00e+00	1.30e-06	1.30e-06	1.30e-06	1.10e-06
Methyl chloride	Tritonal surrogate	7.40e-07	3.70e-07	0.00e+00	5.60e-07	5.60e-07
Methyl chloride	Tritonal surrogate with calcium stearate		3.70e-07	3.60e-07	3.70e-07	3.70e-07
Methyl chloride	Tritonal surrogate with water	3.70e-06	3.70e-06	4.10e-06	3.80e-06	3.80e-06
Methyl chloride	TNT (ACC1)	0.00e+00			0.00e+00	1.70e-06
Methyl chloride	TNT (ACC2)	0.00e+00			0.00e+00	6.70e-07
Methyl chloride	T45E7 Adapter Booster	2.20e-06			2.20e-06	3.20e-06
Methyl chloride	20 mm HEI Cartridge	1.30e-06			1.30e-06	3.50e-06
Methyl chloride	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloroform	Amatol surrogate	3.70e-07	3.70e-07	0.00e+00	3.70e-07	1.70e-06
Methyl chloroform	Amatol surrogate with water	3.70e-07	0.00e+00	3.70e-07	3.70e-07	1.70e-06
Methyl chloroform	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	1.20e-06	1.20e-06	1.80e-06
Methyl chloroform	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.60e-06
Methyl chloroform	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.80e-06
Methyl chloroform	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methyl chloroform	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.20e-06
Methyl chloroform	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.60e-06
Methyl chloroform	Fuze, Tail Bomb FMU-139 A/B	1.20e-05	1.80e-05	1.80e-05	1.60e-05	1.90e-05
Methyl chloroform	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.90e-06
Methyl chloroform	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	2.90e-06
Methyl chloroform	HBX surrogate	3.70e-07	4.10e-07	3.70e-07	3.80e-07	1.90e-06

Methyl chloroform	Mine, Claymore, M18A1	2.30e-06			2.30e-06	4.60e-06
Methyl chloroform	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.60e-06
Methyl chloroform	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.70e-06
Methyl chloroform	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	1.60e-06
Methyl chloroform	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	1.80e-06
Methyl chloroform	Tritonal surrogate with water	3.70e-07	0.00e+00	3.70e-07	3.70e-07	1.70e-06
Methyl chloroform	TNT (ACC1)	0.00e+00			0.00e+00	6.60e-06
Methyl chloroform	TNT (ACC2)	0.00e+00			0.00e+00	1.80e-06
Methyl chloroform	T45E7 Adapter Booster	0.00e+00			0.00e+00	5.60e-06
Methyl chloroform	20 mm HEI Cartridge	3.30e-06			3.30e-06	1.40e-05
Methyl chloroform	40 mm HEI Cartridge	0.00e+00			0.00e+00	2.10e-05
Methylcyclohexane	Amatol surrogate	7.50e-07	2.20e-06	4.50e-06	2.50e-06	4.40e-06
Methylcyclohexane	Amatol surrogate with water	4.50e-06	1.20e-05	7.40e-06	8.00e-06	1.10e-05
Methylcyclohexane	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Cartridge, Impulse, BBU-36/B	5.40e-07	2.80e-07	0.00e+00	4.10e-07	1.60e-06
Methylcyclohexane	Cartridge, Impulse, MK 107	7.90e-07	0.00e+00	2.60e-07	5.20e-07	9.60e-07
Methylcyclohexane	Composition B surrogate	2.20e-06	3.00e-06	1.80e-06	2.30e-06	4.10e-06
Methylcyclohexane	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	3.40e-07	3.40e-07	6.80e-07
Methylcyclohexane	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	HBX surrogate	4.40e-06	7.00e-06	7.10e-06	6.10e-06	1.00e-05
Methylcyclohexane	Mine, Claymore, M18A1	5.40e-06	5.90e-06	4.70e-06	5.30e-06	6.30e-06
Methylcyclohexane	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Methylcyclohexane	Signal, Illumination, Red Star M158	3.50e-07	0.00e+00	0.00e+00	3.50e-07	7.00e-07
Methylcyclohexane	Tritonal surrogate	4.80e-06	5.90e-06	1.00e-05	7.00e-06	1.40e-05
Methylcyclohexane	Tritonal surrogate with calcium stearate		0.00e+00	4.40e-06	4.40e-07	6.20e-06
Methylcyclohexane	Tritonal surrogate with water	4.90e-06	5.10e-06	9.40e-06	6.50e-06	1.10e-05
Methylcyclohexane	TNT (ACC1)	9.20e-06	9.60e-07	0.00e+00	5.10e-06	4.30e-06
Methylcyclohexane	TNT (ACC2)	0.00e+00			0.00e+00	3.70e-07
Methylcyclohexane	T45E7 Adapter Booster	2.40e-06	2.90e-06	3.50e-06	2.90e-06	4.10e-06
Methylcyclohexane	20 mm HEI Cartridge	1.40e-06	2.90e-06	4.10e-06	2.80e-06	5.80e-06
Methylcyclohexane	40 mm HEI Cartridge	2.50e-06	0.00e+00	0.00e+00	2.50e-06	1.40e-05
Methylcyclopentane	Amatol surrogate	0.00e+00	0.00e+00	3.70e-07	1.90e-07	5.00e-07
Methylcyclopentane	Amatol surrogate with water	4.80e-06	1.20e-05	3.00e-06	6.60e-06	8.90e-06
Methylcyclopentane	Cartridge, Impulse, ARD 446-1	1.00e-06	2.60e-07	5.00e-07	6.00e-07	1.70e-06
Methylcyclopentane	Cartridge, Impulse, BBU-36/B	0.00e+00	1.10e-06	0.00e+00	1.10e-06	1.90e-06
Methylcyclopentane	Cartridge, Impulse, MK 107	0.00e+00	5.30e-07	0.00e+00	5.30e-07	7.70e-07
Methylcyclopentane	Composition B surrogate	0.00e+00	0.00e+00	3.60e-07	3.60e-07	4.90e-07
Methylcyclopentane	Detonating train	2.90e-07	0.00e+00	0.00e+00	2.90e-07	1.70e-06

Methylcyclopentane	Flare, IR Countermeasure M206	0.00e+00	3.40e-07	0.00e+00	3.40e-07	4.50e-07
Methylcyclopentane	Fuze, Tail Bomb FMU-139 A/B	4.90e-07	0.00e+00	0.00e+00	4.90e-07	4.90e-07
Methylcyclopentane	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	3.00e-07	0.00e+00	3.00e-07	8.00e-07
Methylcyclopentane	Gas Generator, GGU-2/A	2.40e-06	5.90e-07	0.00e+00	1.50e-06	1.80e-06
Methylcyclopentane	HBX surrogate	3.70e-07	8.20e-07	7.40e-07	6.40e-07	2.40e-06
Methylcyclopentane	Mine, Claymore, M18A1	1.40e-05	1.50e-05	1.80e-05	1.60e-05	1.70e-05
Methylcyclopentane	Signal, Illumination, Red Star AN-M43A2	0.00e+00	3.50e-07	0.00e+00	3.50e-07	7.00e-07
Methylcyclopentane	Signal, Illumination, Red Star M158	1.10e-06	0.00e+00	0.00e+00	1.10e-06	8.20e-07
Methylcyclopentane	Tritonal surrogate	7.40e-07	3.70e-07	0.00e+00	5.60e-07	3.50e-06
Methylcyclopentane	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	2.90e-06
Methylcyclopentane	Tritonal surrogate with water	0.00e+00	0.00e+00	7.50e-07	7.50e-07	4.70e-06
Methylcyclopentane	TNT (ACC1)	9.20e-07	4.80e-07	0.00e+00	7.00e-07	1.60e-06
Methylcyclopentane	TNT (ACC2)	3.70e-07			3.70e-07	7.40e-07
Methylcyclopentane	T45E7 Adapter Booster	1.20e-06	2.90e-06	4.60e-06	2.90e-06	4.70e-06
Methylcyclopentane	20 mm HEI Cartridge	7.00e-07	2.90e-06	4.80e-06	2.80e-06	7.70e-06
Methylcyclopentane	40 mm HEI Cartridge	9.10e-06	0.00e+00	0.00e+00	9.10e-06	1.60e-05
Methylenechloride	Amatol surrogate	1.50e-04	2.00e-04	1.10e-04	1.50e-04	2.00e-04
Methylenechloride	Amatol surrogate with water	2.10e-04	2.00e-04	2.20e-04	2.10e-04	2.60e-04
Methylenechloride	Cartridge, Impulse, ARD 446-1	1.30e-05	3.20e-05	1.10e-04	5.00e-05	1.90e-04
Methylenechloride	Cartridge, Impulse, BBU-36/B	8.20e-06	3.00e-04	2.10e-04	1.70e-04	1.10e-03
Methylenechloride	Cartridge, Impulse, MK 107	6.30e-04	3.10e-05	2.00e-05	2.30e-04	9.30e-04
Methylenechloride	Composition B surrogate	0.00e+00	3.70e-07	2.80e-04	1.40e-04	1.90e-06
Methylenechloride	Detonating train	0.00e+00	5.00e-05	3.50e-05	4.20e-05	5.60e-04
Methylenechloride	Flare, IR Countermeasure M206	4.80e-04	3.80e-04	3.80e-04	4.10e-04	1.90e-03
Methylenechloride	Fuze, Tail Bomb FMU-139 A/B	1.20e-04	1.60e-04	5.50e-05	1.10e-04	8.60e-04
Methylenechloride	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	7.10e-04	7.80e-04	7.40e-04	2.40e-03
Methylenechloride	Gas Generator, GGU-2/A	2.80e-04	7.00e-05	2.30e-03	8.70e-04	2.90e-03
Methylenechloride	HBX surrogate	0.00e+00	0.00e+00	2.70e-04	2.70e-04	2.80e-04
Methylenechloride	Mine, Claymore, M18A1	1.10e-04			1.10e-04	1.10e-04
Methylenechloride	Signal, Illumination, Red Star AN-M43A2	0.00e+00	8.10e-06	0.00e+00	8.10e-06	3.30e-04
Methylenechloride	Signal, Illumination, Red Star M158	1.00e-04	9.60e-05	1.00e-04	1.00e-04	3.20e-04
Methylenechloride	Tritonal surrogate	3.40e-06	4.80e-05	2.50e-06	1.80e-05	1.80e-05
Methylenechloride	Tritonal surrogate with calcium stearate		6.30e-06	3.10e-04	1.60e-04	1.60e-04
Methylenechloride	Tritonal surrogate with water	0.00e+00	8.80e-06	1.10e-06	5.00e-06	6.70e-06
Methylenechloride	TNT (ACC1)	1.80e-04			1.80e-04	2.40e-04
Methylenechloride	TNT (ACC2)	0.00e+00			0.00e+00	2.70e-04
Methylenechloride	T45E7 Adapter Booster	5.00e-04			5.00e-04	5.90e-04
Methylenechloride	20 mm HEI Cartridge	4.50e-04			4.50e-04	9.00e-04
Methylenechloride	40 mm HEI Cartridge	8.70e-04			8.70e-04	1.40e-03
NO	[illegible]	2.20e-04	1.40e-02	1.70e-02	1.80e-02	
NO	[illegible]	7.60e-03	7.50e-03	8.00e-03	7.70e-03	

NO	Cartridge, Impulse, ARD 446-1	6.50e-03	6.20e-03	6.50e-03	6.40e-03	
NO	Cartridge, Impulse, BBU-36/B	5.30e-03	3.50e-03	3.30e-03	4.00e-03	
NO	Cartridge, Impulse, MK 107	1.70e-02	1.40e-02	1.30e-02	1.50e-02	
NO	Composition B surrogate	9.20e-03	8.90e-03	9.70e-03	9.30e-03	
NO	Detonating train	6.80e-03	3.60e-03	4.30e-03	4.90e-03	
NO	Flare, IR Countermeasure M206	4.90e-03	6.00e-03	5.10e-03	5.30e-03	
NO	Fuze, Tail Bomb FMU-139 A/B	9.80e-03	1.00e-02	9.80e-03	9.90e-03	
NO	Fuze, Tail Bomb FMU-54 A/B	7.30e-03	6.90e-03	6.90e-03	7.00e-03	
NO	Gas Generator, GGU-2/A	1.50e-03	1.30e-03	1.90e-03	1.60e-03	
NO	HBX surrogate	9.30e-03	9.80e-03	1.00e-02	9.90e-03	
NO	Signal, Illumination, Red Star AN-M43A2	1.20e-02	1.50e-02	1.10e-02	1.30e-02	
NO	Signal, Illumination, Red Star M158	2.60e-03	2.70e-03	2.70e-03	2.60e-03	
NO	Tritonal surrogate	1.30e-03	1.70e-02	5.90e-03	8.20e-03	
NO	Tritonal surrogate with calcium stearate		6.50e-03	6.70e-03	6.60e-03	
NO	Tritonal surrogate with water	4.30e-03	3.90e-03	3.80e-03	4.00e-03	
NO	TNT (ACC2)	9.20e-03			9.20e-03	
NO	TNT (Sandia)	9.80e-03	1.00e-02	9.20e-03	9.70e-03	
NO2	Amatol surrogate	3.40e-04	1.80e-04	4.20e-04	1.20e-04	
NO2	Amatol surrogate with water	2.00e-04	2.10e-04	2.90e-04	2.40e-04	
NO2	Cartridge, Impulse, ARD 446-1	1.90e-03	1.60e-03	1.70e-03	1.70e-03	
NO2	Cartridge, Impulse, BBU-36/B	1.50e-03	1.70e-03	1.30e-03	1.50e-03	
NO2	Cartridge, Impulse, MK 107	7.70e-04	5.40e-04	5.30e-04	6.10e-04	
NO2	Composition B surrogate	1.10e-04	1.70e-04	3.00e-04	1.90e-04	
NO2	Detonating train	8.10e-03	3.30e-03	1.90e-03	4.40e-03	
NO2	Flare, IR Countermeasure M206	2.60e-03	3.10e-03	2.80e-03	2.80e-03	
NO2	Fuze, Tail Bomb FMU-139 A/B	1.70e-02	1.70e-02	1.70e-02	1.70e-02	
NO2	Fuze, Tail Bomb FMU-54 A/B	2.40e-03	2.50e-03	2.60e-03	2.50e-03	
NO2	Gas Generator, GGU-2/A	2.60e-03	2.40e-03	2.30e-03	2.40e-03	
NO2	HBX surrogate	5.90e-05	4.00e-05	3.40e-05	4.40e-05	
NO2	Signal, Illumination, Red Star AN-M43A2	9.80e-04	1.30e-03	1.00e-03	1.10e-03	
NO2	Signal, Illumination, Red Star M158	1.40e-03	1.60e-03	1.60e-03	1.50e-03	
NO2	Tritonal surrogate	2.50e-04	1.90e-04	1.80e-05	1.50e-04	
NO2	Tritonal surrogate with calcium stearate		3.00e-05	5.90e-05	4.50e-05	
NO2	Tritonal surrogate with water	2.60e-04	1.50e-04	3.90e-04	2.70e-04	
NO2	TNT (ACC2)	6.60e-05			6.60e-05	
NO2	TNT (Sandia)	3.90e-04	9.60e-04	9.20e-04	7.60e-04	
OCDD	Signal, Illumination, Red Star AN-M43A2	8.30e-10	1.60e-09	2.90e-09	1.80e-09	1.80e-09
Propane	Amatol surrogate	1.10e-06	7.50e-07	1.10e-06	1.00e-06	1.40e-06
Propane	Amatol surrogate with water	1.40e-04	2.40e-04	1.70e-04	1.90e-04	1.90e-04
Propane	Cartridge, Impulse, ARD 446-1	6.20e-06	5.40e-06	5.50e-06	5.70e-06	1.00e-05
Propane	Cartridge, Impulse, BBU-36/B	2.70e-06	3.90e-06	3.90e-06	3.50e-06	8.50e-06

Propane	Cartridge, Impulse, MK 107	0.00e+00	1.30e-06	1.60e-06	1.40e-06	5.20e-06
Propane	Composition B surrogate	7.40e-07	0.00e+00	7.30e-07	7.40e-07	1.40e-06
Propane	Detonating train	4.70e-06	4.50e-06	4.80e-06	4.70e-06	1.10e-05
Propane	Flare, IR Countermeasure M206	0.00e+00	6.80e-07	2.00e-06	1.40e-06	3.90e-06
Propane	Fuze, Tail Bomb FMU-139 A/B	4.40e-06	3.40e-06	3.90e-06	3.90e-06	7.90e-06
Propane	Fuze, Tail Bomb FMU-54 A/B	8.90e-07	1.80e-06	1.80e-06	1.50e-06	6.00e-06
Propane	Gas Generator, GGU-2/A	7.70e-06	7.10e-06	8.50e-06	7.70e-06	1.10e-05
Propane	HBX surrogate	1.50e-06	4.10e-07	7.40e-07	8.70e-07	2.20e-06
Propane	Mine, Claymore, M18A1	3.40e-06	4.40e-06	2.80e-06	3.60e-06	9.80e-06
Propane	Signal, Illumination, Red Star AN-M43A2	1.70e-06	3.50e-06	2.40e-06	2.60e-06	4.60e-06
Propane	Signal, Illumination, Red Star M158	6.00e-06	5.30e-06	3.10e-06	4.80e-06	8.00e-06
Propane	Tritonal surrogate	0.00e+00	7.40e-07	7.30e-07	7.30e-07	1.20e-06
Propane	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-07	3.60e-07	2.20e-06
Propane	Tritonal surrogate with water	5.20e-05	5.00e-05	6.30e-05	5.50e-05	5.70e-05
Propane	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	9.50e-07
Propane	TNT (ACC2)	3.70e-07			3.70e-07	1.50e-06
Propane	T45E7 Adapter Booster	1.50e-05	8.20e-06	8.60e-06	1.10e-05	2.10e-05
Propane	20 mm HEI Cartridge	9.10e-06	6.50e-06	2.40e-05	1.30e-05	2.30e-05
Propane	40 mm HEI Cartridge	1.70e-06	5.00e-06	4.90e-06	3.80e-06	1.50e-05
Propene	Amatol surrogate	6.70e-06	3.40e-06	6.30e-06	5.50e-06	5.80e-06
Propene	Amatol surrogate with water	2.60e-04	4.90e-04	3.40e-04	3.60e-04	3.60e-04
Propene	Cartridge, Impulse, ARD 446-1	6.70e-05	5.50e-05	5.70e-05	6.00e-05	8.70e-05
Propene	Cartridge, Impulse, BBU-36/B	4.30e-05	4.60e-05	5.80e-05	4.90e-05	9.70e-05
Propene	Cartridge, Impulse, MK 107	2.80e-05	2.60e-05	2.40e-05	2.60e-05	3.80e-05
Propene	Composition B surrogate	3.70e-06	1.10e-06	4.40e-06	3.10e-06	4.10e-06
Propene	Detonating train	7.50e-05	7.10e-05	7.10e-05	7.30e-05	1.10e-04
Propene	Flare, IR Countermeasure M206	2.20e-05	2.00e-05	2.60e-05	2.20e-05	2.30e-05
Propene	Fuze, Tail Bomb FMU-139 A/B	5.90e-05	6.30e-05	5.50e-05	5.90e-05	5.90e-05
Propene	Fuze, Tail Bomb FMU-54 A/B	3.80e-05	5.20e-05	3.90e-05	4.30e-05	4.30e-05
Propene	Gas Generator, GGU-2/A	6.90e-05	6.80e-05	7.80e-05	7.20e-05	7.30e-05
Propene	HBX surrogate	8.40e-06	7.80e-06	1.20e-05	9.40e-06	9.90e-06
Propene	Mine, Claymore, M18A1	2.10e-05	2.70e-05	2.60e-05	2.40e-05	2.50e-05
Propene	Signal, Illumination, Red Star AN-M43A2	3.20e-05	3.90e-05	3.40e-05	3.50e-05	3.50e-05
Propene	Signal, Illumination, Red Star M158	6.00e-05	5.80e-05	5.00e-05	5.60e-05	5.60e-05
Propene	Tritonal surrogate	2.60e-06	1.50e-06	5.40e-06	3.20e-06	3.60e-06
Propene	Tritonal surrogate with calcium stearate		8.10e-06	4.00e-06	6.10e-06	6.60e-06
Propene	Tritonal surrogate with water	1.70e-04	1.20e-04	1.80e-04	1.60e-04	1.60e-04
Propene	TNT (ACC1)	7.80e-06	8.10e-06	5.80e-06	7.20e-06	7.70e-06
Propene	TNT (ACC2)	4.10e-06			4.10e-06	4.10e-06
Propene	T45E7 Adapter Booster	2.00e-04	1.60e-04	1.30e-04	1.60e-04	1.60e-04
Propene	20 mm HEI Cartridge	6.20e-05	4.00e-05	5.00e-05	5.10e-05	7.20e-05

Propene	40 mm HEI Cartridge	1.80e-05	1.70e-05	1.20e-05	1.60e-05	2.40e-05
PETN	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
PETN	Cartridge, Impulse, BBU-36/B	0.00e+00	9.30e-04	2.30e-04	5.80e-04	5.80e-04
PETN	Cartridge, Impulse, MK 107	2.30e-05	1.10e-04	1.80e-05	5.10e-05	7.60e-05
PETN	Detonating train	5.60e-04	7.30e-04	4.10e-04	5.60e-04	8.80e-04
PETN	Flare, IR Countermeasure M206	2.40e-06	1.90e-06	4.00e-07	1.60e-06	2.10e-06
PETN	Fuze, Tail Bomb FMU-139 A/B	2.60e-05	1.50e-05	8.90e-06	1.70e-05	1.90e-05
PETN	Fuze, Tail Bomb FMU-54 A/B	1.20e-05	1.10e-05	5.80e-06	9.60e-06	1.40e-05
PETN	Gas Generator, GGU-2/A	1.10e-04	2.90e-05	1.10e-05	4.90e-05	6.30e-05
PETN	Signal, Illumination, Red Star AN-M43A2	1.70e-05	8.20e-06	1.10e-05	1.20e-05	1.20e-05
PETN	Signal, Illumination, Red Star M158	1.30e-05	5.60e-06	6.10e-06	8.40e-06	8.40e-06
PETN	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
PM10	Amatol surrogate	1.50e-02	2.10e-02	2.00e-02	1.90e-02	
PM10	Amatol surrogate with water	2.40e-02	3.10e-02	4.00e-02	3.20e-02	
PM10	Cartridge, Impulse, ARD 446-1	8.30e-02	1.20e-01	8.60e-02	8.30e-02	
PM10	Cartridge, Impulse, BBU-36/B	1.60e-01	1.90e-01	1.90e-01	1.80e-01	
PM10	Cartridge, Impulse, MK 107	2.40e-01	2.60e-01	2.50e-01	2.50e-01	
PM10	Composition B surrogate	1.00e-02	1.10e-02	1.50e-02	1.20e-02	
PM10	Detonating train	3.60e-02	4.00e-02	3.20e-02	3.60e-02	
PM10	Flare, IR Countermeasure M206	4.90e-01	5.90e-01	5.80e-01	5.50e-01	
PM10	Fuze, Tail Bomb FMU-139 A/B	6.50e-01	5.60e-01	5.90e-01	6.00e-01	
PM10	Fuze, Tail Bomb FMU-54 A/B	3.10e-01	3.40e-01	3.40e-01	3.30e-01	
PM10	Gas Generator, GGU-2/A	9.80e-02	9.20e-02	8.90e-02	9.30e-02	
PM10	HBX surrogate	6.80e-02	3.70e-02	4.40e-01	1.80e-01	
PM10	Mine, Claymore, M18A1	2.40e-01	2.30e-01	2.10e-01	2.30e-01	
PM10	Signal, Illumination, Red Star AN-M43A2	4.30e-01	4.50e-01	4.80e-01	4.50e-01	
PM10	Signal, Illumination, Red Star M158	9.20e-02	8.30e-02	7.20e-02	8.20e-02	
PM10	Tritonal surrogate	6.30e-01	2.50e-01	2.20e-01	3.70e-01	
PM10	Tritonal surrogate with calcium stearate		2.30e-01	3.00e-01	2.60e-01	
PM10	Tritonal surrogate with water	1.10e-01	2.20e-01	2.30e-01	1.90e-01	
PM10	TNT (ACC1)	7.20e-02	7.30e-02	7.50e-02	7.30e-02	
PM10	TNT (ACC2)	9.30e-02			9.30e-02	
PM10	T45E7 Adapter Booster	2.40e-01	2.70e-01	2.70e-01	2.60e-01	
PM10	40 mm HEI Cartridge	4.70e-01	4.80e-01	4.50e-01	4.70e-01	
RDX	Cartridge, Impulse, ARD 446-1	2.30e-03	1.20e-02	1.10e-02	8.40e-04	1.20e-03
RDX	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.10e-04
RDX	Cartridge, Impulse, MK 107	1.70e-04	1.80e-04	1.50e-04	1.70e-04	2.40e-04
RDX	Detonating train	1.10e-02	7.90e-03	3.70e-03	7.40e-03	1.20e-02
RDX	Flare, IR Countermeasure M206	8.70e-05	5.40e-05	3.80e-05	6.00e-05	6.20e-05
RDX	Fuze, Tail Bomb FMU-139 A/B	3.50e-04	3.80e-04	3.00e-04	3.40e-04	3.40e-04
RDX	Fuze, Tail Bomb FMU-54 A/B	9.70e-05	9.20e-05	8.00e-05	9.00e-05	1.30e-04

RDX	Gas Generator, GGU-2/A	2.10e-04	1.10e-04	1.00e-04	1.40e-04	1.60e-04
RDX	Mine, Claymore, M18A1	1.00e-05	6.50e-07	1.90e-05	9.90e-06	1.20e-05
RDX	Signal, Illumination, Red Star AN-M43A2	1.50e-04	2.00e-04	2.30e-04	1.90e-04	1.90e-04
RDX	Signal, Illumination, Red Star M158	5.20e-05	5.40e-05	6.00e-05	5.50e-05	6.70e-05
RDX	TNT (ACC1)	1.40e-06	1.30e-06	9.70e-07	1.20e-06	2.10e-06
RDX	TNT (ACC2)	9.60e-06			9.60e-06	1.00e-05
RDX	T45E7 Adapter Booster	2.50e-04	2.90e-04	1.80e-04	2.40e-04	2.80e-04
RDX	20 mm HEI Cartridge	1.30e-05	1.50e-05	7.10e-06	1.20e-05	3.00e-05
RDX	40 mm HEI Cartridge	2.60e-05	3.30e-05	5.20e-05	3.70e-05	3.20e-05
Styrene	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Cartridge, Impulse, ARD 446-1	6.70e-06	4.10e-06	5.20e-06	5.40e-06	5.40e-06
Styrene	Cartridge, Impulse, BBU-36/B	2.40e-06	2.80e-06	5.60e-06	3.60e-06	3.60e-06
Styrene	Cartridge, Impulse, MK 107	9.50e-06	9.50e-06	9.20e-06	9.40e-06	1.40e-05
Styrene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Detonating train	4.10e-06	3.00e-06	5.10e-06	4.10e-06	4.10e-06
Styrene	Flare, IR Countermeasure M206	7.60e-06	4.10e-06	9.50e-06	7.10e-06	7.80e-06
Styrene	Fuze, Tail Bomb FMU-139 A/B	3.20e-05	2.70e-05	3.00e-05	2.90e-05	3.10e-05
Styrene	Fuze, Tail Bomb FMU-54 A/B	5.60e-06	9.80e-06	7.90e-06	7.80e-06	1.10e-05
Styrene	Gas Generator, GGU-2/A	7.70e-06	8.80e-06	8.50e-06	8.30e-06	9.10e-06
Styrene	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Mine, Claymore, M18A1	2.10e-03	1.40e-03	1.50e-03	1.70e-03	1.70e-03
Styrene	Signal, Illumination, Red Star AN-M43A2	6.20e-06	4.90e-06	2.40e-06	4.50e-06	5.40e-06
Styrene	Signal, Illumination, Red Star M158	2.10e-06	3.50e-06	1.00e-06	2.20e-06	2.60e-06
Styrene	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Styrene	TNT (ACC2)	1.50e-06			1.50e-06	1.50e-06
Styrene	T45E7 Adapter Booster	2.30e-04	7.40e-05	3.70e-05	1.20e-04	1.30e-04
Styrene	20 mm HEI Cartridge	0.00e+00	3.60e-06	0.00e+00	3.60e-06	3.60e-06
Styrene	40 mm HEI Cartridge	4.20e-05	0.00e+00	0.00e+00	4.20e-05	4.20e-05
SO2	Amatol surrogate	3.20e-04	2.10e-04	2.50e-04	2.60e-04	
SO2	Amatol surrogate with water	1.10e-04	1.70e-04	1.10e-04	1.30e-04	
SO2	Cartridge, Impulse, ARD 446-1	2.30e-04	2.30e-04	2.60e-04	2.40e-04	
SO2	Cartridge, Impulse, BBU-36/B	3.80e-04	4.00e-04	4.20e-04	4.00e-04	
SO2	Cartridge, Impulse, MK 107	3.00e-04	2.40e-04	2.30e-04	2.60e-04	
SO2	Composition B surrogate	1.40e-04	1.40e-04	1.10e-04	1.30e-04	
SO2	Detonating train	6.70e-04	3.20e-04	3.70e-04	4.60e-04	
SO2	Flare, IR Countermeasure M206	5.80e-04	1.20e-03	1.30e-03	1.00e-03	
SO2	Fuze, Tail Bomb FMU-139 A/B	1.40e-03	1.30e-03	1.40e-03	1.40e-03	

SO2	Fuze, Tail Bomb FMU-54 A/B	4.80e-04	3.60e-04	3.80e-04	4.10e-04	
SO2	Gas Generator, GGU-2/A	3.40e-04	4.50e-04	3.90e-04	4.00e-04	
SO2	HBX surrogate	1.00e-04	1.10e-03	1.90e-03	1.10e-03	
SO2	Signal, Illumination, Red Star AN-M43A2	1.30e-02	1.30e-02	1.30e-02	1.30e-02	
SO2	Signal, Illumination, Red Star M158	2.70e-04	2.40e-05	4.10e-05	1.10e-04	
SO2	Tritonal surrogate	1.20e-04	2.80e-04	7.80e-05	1.60e-04	
SO2	Tritonal surrogate with calcium stearate		1.80e-04	6.70e-05	1.20e-04	
SO2	Tritonal surrogate with water	2.60e-05	5.70e-05	5.90e-05	4.70e-05	
SO2	TNT (ACC2)	1.40e-04			1.40e-04	
SO2	TNT (Sandia)	1.90e-04	1.20e-04	1.10e-04	1.40e-04	
Tetrachloroethylene	Amatol surrogate	3.70e-07	3.70e-07	0.00e+00	3.70e-07	3.70e-07
Tetrachloroethylene	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Cartridge, Impulse, ARD 446-1	2.20e-05	5.90e-05	2.80e-05	3.60e-05	8.30e-05
Tetrachloroethylene	Cartridge, Impulse, BBU-36/B	3.20e-06	1.60e-06	0.00e+00	2.40e-06	6.40e-06
Tetrachloroethylene	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Composition B surrogate	2.10e-05	1.90e-05	1.40e-05	1.80e-05	3.50e-05
Tetrachloroethylene	Detonating train	1.20e-05	1.20e-05	1.00e-05	1.10e-05	3.40e-05
Tetrachloroethylene	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Gas Generator, GGU-2/A	7.00e-06	7.00e-06	3.60e-06	5.90e-06	5.90e-06
Tetrachloroethylene	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Mine, Claymore, M18A1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	Tritonal surrogate	1.90e-06	3.30e-06	2.90e-06	2.70e-06	4.10e-06
Tetrachloroethylene	Tritonal surrogate with calcium stearate		3.70e-07	3.60e-07	3.70e-07	7.30e-07
Tetrachloroethylene	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Tetrachloroethylene	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	
Titanium	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00

Titanium	Fuze, Tail Bomb FMU-139 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Gas Generator, GGU-2/A	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Mine, Claymore, M18A1	1.30e-04			1.30e-04	0.00e+00
Titanium	Signal, Illumination, Red Star AN-M43A2	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Titanium	TNT (ACC1)	0.00e+00			0.00e+00	0.00e+00
Titanium	TNT (ACC2)	0.00e+00			0.00e+00	0.00e+00
Titanium	T45E7 Adapter Booster	8.70e-05			8.70e-05	8.70e-05
Titanium	20 mm HEI Cartridge	0.00e+00			0.00e+00	0.00e+00
Titanium	40 mm HEI Cartridge	0.00e+00			0.00e+00	0.00e+00
Toluene	Amatol surrogate	1.10e-05	3.70e-06	5.20e-06	6.70e-06	2.00e-05
Toluene	Amatol surrogate with water	8.10e-05	1.60e-04	1.20e-04	1.20e-04	1.60e-04
Toluene	Cartridge, Impulse, ARD 446-1	1.50e-05	1.50e-05	2.00e-05	1.70e-05	5.40e-05
Toluene	Cartridge, Impulse, BBU-36/B	1.30e-05	7.90e-06	6.40e-06	9.10e-06	4.70e-05
Toluene	Cartridge, Impulse, MK 107	8.40e-06	9.70e-06	8.90e-06	9.00e-06	2.00e-05
Toluene	Composition B surrogate	4.80e-06	3.70e-06	9.50e-06	6.00e-06	2.10e-05
Toluene	Detonating train	1.70e-06	3.60e-06	7.20e-06	4.20e-06	5.70e-05
Toluene	Flare, IR Countermeasure M206	3.10e-05	2.30e-05	3.00e-05	2.80e-05	4.10e-05
Toluene	Fuze, Tail Bomb FMU-139 A/B	2.30e-05	2.20e-05	2.50e-05	2.30e-05	3.00e-05
Toluene	Fuze, Tail Bomb FMU-54 A/B	2.00e-05	4.30e-05	3.20e-05	3.20e-05	5.70e-05
Toluene	Gas Generator, GGU-2/A	5.90e-06	1.90e-05	1.30e-05	1.30e-05	5.40e-05
Toluene	HBX surrogate	4.80e-06	8.20e-07	4.50e-06	3.30e-06	5.30e-05
Toluene	Mine, Claymore, M18A1	1.90e-04	2.50e-04	3.10e-04	2.50e-04	2.60e-04
Toluene	Signal, Illumination, Red Star AN-M43A2	2.90e-05	2.90e-05	3.00e-05	3.00e-05	4.30e-05
Toluene	Signal, Illumination, Red Star M158	2.50e-05	2.40e-05	2.70e-05	2.50e-05	3.90e-05
Toluene	Tritonal surrogate	1.90e-06	0.00e+00	1.80e-06	1.80e-06	6.30e-05
Toluene	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	6.40e-05
Toluene	Tritonal surrogate with water	1.10e-04	3.40e-05	7.90e-05	7.30e-05	1.60e-04
Toluene	TNT (ACC1)	6.50e-06	3.80e-06	0.00e+00	5.10e-06	1.20e-05
Toluene	TNT (ACC2)	1.50e-06			1.50e-06	2.10e-05
Toluene	T45E7 Adapter Booster	5.50e-05	4.50e-05	5.60e-05	5.20e-05	7.40e-05
Toluene	20 mm HEI Cartridge	2.80e-05	3.40e-05	2.90e-05	3.00e-05	6.40e-05
Toluene	40 mm HEI Cartridge	2.60e-05	0.00e+00	0.00e+00	2.60e-05	6.40e-05
Total Alkanes (Paraffins)	[illegible]	1.00e-05	1.60e-05	2.10e-05	1.60e-05	4.10e-05
Total Alkanes (Paraffins)	[illegible]	1.10e-03	1.10e-03	1.40e-03	1.20e-03	1.40e-03
Total Alkanes (Paraffins)	[illegible]	5.20e-05	4.10e-05	6.10e-05	5.10e-05	1.30e-04

Total Alkanes (Paraffins)	Cartridge, Impulse, BBU-36/B	3.30e-05	3.60e-05	4.60e-05	3.80e-05	1.40e-04
Total Alkanes (Paraffins)	Cartridge, Impulse, MK 107	2.90e-06	1.00e-05	7.60e-06	6.90e-06	3.90e-05
Total Alkanes (Paraffins)	Composition B surrogate	1.30e-05	6.30e-06	1.50e-05	1.10e-05	4.30e-05
Total Alkanes (Paraffins)	Detonating train	1.80e-05	2.80e-05	3.80e-05	2.80e-05	1.50e-04
Total Alkanes (Paraffins)	Flare, IR Countermeasure M206	8.00e-06	0.00e+00	1.20e-05	9.90e-06	3.80e-05
Total Alkanes (Paraffins)	Fuze, Tail Bomb FMU-139 A/B	1.30e-05	2.60e-05	5.30e-06	1.50e-05	4.20e-05
Total Alkanes (Paraffins)	Fuze, Tail Bomb FMU-54 A/B	2.20e-05	2.30e-05	0.00e+00	2.20e-05	8.90e-05
Total Alkanes (Paraffins)	Gas Generator, GGU-2/A	4.50e-05	5.80e-05	2.70e-05	4.30e-05	1.70e-04
Total Alkanes (Paraffins)	HBX surrogate	2.50e-05	8.20e-07	1.70e-05	1.40e-05	1.50e-04
Total Alkanes (Paraffins)	Mine, Claymore, M18A1	6.50e-05	6.80e-05	8.10e-05	7.10e-05	1.20e-04
Total Alkanes (Paraffins)	Signal, Illumination, Red Star AN-M43A2	2.30e-05	9.10e-06	1.20e-05	1.50e-05	3.60e-05
Total Alkanes (Paraffins)	Signal, Illumination, Red Star M158	3.70e-05	4.10e-05	4.10e-06	2.70e-05	6.70e-05
Total Alkanes (Paraffins)	Tritonal surrogate	3.70e-06	0.00e+00	1.60e-05	1.00e-05	2.10e-04
Total Alkanes (Paraffins)	Tritonal surrogate with calcium stearate		0.00e+00	0.00e+00	0.00e+00	2.00e-04
Total Alkanes (Paraffins)	Tritonal surrogate with water	1.40e-04	1.60e-04	3.70e-04	2.20e-04	5.40e-04
Total Alkanes (Paraffins)	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	7.50e-05
Total Alkanes (Paraffins)	TNT (ACC2)	3.30e-06			3.30e-06	4.00e-05
Total Alkanes (Paraffins)	TNT (Sandia)	1.20e-05	8.50e-06	5.40e-06	8.60e-06	
Total Alkanes (Paraffins)	T45E7 Adapter Booster	5.60e-05	6.70e-05	1.40e-04	8.70e-05	2.10e-04
Total Alkanes (Paraffins)	20 mm HEI Cartridge	1.20e-04	1.40e-04	2.40e-04	1.70e-04	3.90e-04
Total Alkanes (Paraffins)	40 mm HEI Cartridge	1.60e-04	0.00e+00	0.00e+00	1.60e-04	4.70e-04
Total Alkenes (Olefins)	Amatol surrogate	2.50e-04	7.20e-05	9.60e-05	1.40e-04	1.40e-04
Total Alkenes (Olefins)	Amatol surrogate with water	1.30e-03	1.40e-03	1.70e-03	1.50e-03	1.50e-03
Total Alkenes (Olefins)	Cartridge, Impulse, ARD 446-1	8.10e-04	6.20e-04	6.10e-04	6.80e-04	1.00e-03
Total Alkenes (Olefins)	Cartridge, Impulse, BBU-36/B	5.10e-04	5.00e-04	6.20e-04	5.40e-04	1.10e-03
Total Alkenes (Olefins)	Cartridge, Impulse, MK 107	5.60e-04	4.90e-04	4.10e-04	4.80e-04	7.10e-04
Total Alkenes (Olefins)	Composition B surrogate	2.50e-05	2.30e-05	5.30e-05	3.40e-05	3.80e-05
Total Alkenes (Olefins)	Detonating train	7.70e-04	6.40e-04	6.60e-04	6.90e-04	1.10e-03
Total Alkenes (Olefins)	Flare, IR Countermeasure M206	4.40e-04	4.30e-04	4.80e-04	4.50e-04	4.60e-04
Total Alkenes (Olefins)	Fuze, Tail Bomb FMU-139 A/B	9.20e-04	1.20e-03	1.20e-03	1.10e-03	1.10e-03
Total Alkenes (Olefins)	Fuze, Tail Bomb FMU-54 A/B	5.40e-04	9.30e-04	7.50e-04	7.40e-04	9.90e-04
Total Alkenes (Olefins)	Gas Generator, GGU-2/A	1.30e-03	1.40e-03	1.60e-03	1.40e-03	1.50e-03
Total Alkenes (Olefins)	HBX surrogate	8.00e-05	6.70e-05	1.30e-04	9.40e-05	9.90e-05
Total Alkenes (Olefins)	Mine, Claymore, M18A1	1.00e-03	1.40e-03	1.50e-03	1.30e-03	1.30e-03
Total Alkenes (Olefins)	Signal, Illumination, Red Star AN-M43A2	5.50e-04	6.50e-04	5.90e-04	6.00e-04	6.00e-04
Total Alkenes (Olefins)	Signal, Illumination, Red Star M158	6.40e-04	7.80e-04	4.50e-04	6.20e-04	6.30e-04
Total Alkenes (Olefins)	Tritonal surrogate	2.40e-04	1.50e-04	8.30e-05	1.60e-04	1.70e-04
Total Alkenes (Olefins)	Tritonal surrogate with calcium stearate		7.60e-05	4.70e-05	6.10e-05	6.90e-05
Total Alkenes (Olefins)	Tritonal surrogate with water	5.90e-03	5.50e-03	6.10e-03	5.90e-03	5.90e-03
Total Alkenes (Olefins)	TNT (ACC1)	7.70e-05	6.50e-05	3.90e-05	6.00e-05	6.40e-05
Total Alkenes (Olefins)	TNT (ACC2)	4.20e-05			4.20e-05	4.40e-05

Total Alkenes (Olefins)	TNT (Sandia)	5.00e-06	1.70e-05	1.70e-05	1.30e-05	
Total Alkenes (Olefins)	T45E7 Adapter Booster	1.80e-03	1.30e-03	1.10e-03	1.40e-03	1.40e-03
Total Alkenes (Olefins)	20 mm HEI Cartridge	6.80e-04	4.60e-04	6.10e-04	5.80e-04	8.20e-04
Total Alkenes (Olefins)	40 mm HEI Cartridge	2.00e-04	1.50e-04	1.10e-04	1.50e-04	2.40e-04
Total Aromatics	Amatol surrogate	5.80e-05	2.80e-05	4.20e-05	4.30e-05	8.30e-05
Total Aromatics	Amatol surrogate with water	3.30e-04	3.70e-04	4.80e-04	3.90e-04	4.70e-04
Total Aromatics	Cartridge, Impulse, ARD 446-1	1.00e-04	9.50e-05	1.00e-04	1.00e-04	2.40e-04
Total Aromatics	Cartridge, Impulse, BBU-36/B	7.40e-05	6.20e-05	5.70e-05	6.40e-05	2.10e-04
Total Aromatics	Composition B surrogate	1.70e-05	1.80e-05	3.60e-05	2.40e-05	7.10e-05
Total Aromatics	Detonating train	3.40e-05	4.00e-05	4.40e-05	3.90e-05	2.00e-04
Total Aromatics	Flare, IR Countermeasure M206	9.10e-05	7.00e-05	9.70e-05	8.60e-05	1.20e-04
Total Aromatics	Fuze, Tail Bomb FMU-139 A/B	1.80e-04	1.80e-04	2.00e-04	1.90e-04	2.10e-04
Total Aromatics	Fuze, Tail Bomb FMU-54 A/B	9.90e-05	2.40e-04	1.70e-04	1.70e-04	2.70e-04
Total Aromatics	Gas Generator, GGU-2/A	1.20e-04	1.70e-04	1.80e-04	1.60e-04	2.80e-04
Total Aromatics	HBX surrogate	0.00e+00	1.10e-05	3.10e-05	2.10e-05	1.50e-04
Total Aromatics	Mine, Claymore, M18A1	3.10e-03	3.00e-03	3.10e-03	3.00e-03	3.10e-03
Total Aromatics	Signal, Illumination, Red Star AN-M43A2	7.00e-05	7.80e-05	6.80e-05	7.20e-05	1.00e-04
Total Aromatics	Signal, Illumination, Red Star M158	6.30e-05	6.70e-05	5.80e-05	6.30e-05	9.60e-05
Total Aromatics	Tritonal surrogate	3.40e-05	2.20e-05	2.30e-05	2.70e-05	1.70e-04
Total Aromatics	Tritonal surrogate with calcium stearate		0.00e+00	1.40e-05	1.40e-05	1.60e-04
Total Aromatics	Tritonal surrogate with water	4.70e-04	1.80e-04	3.60e-04	3.40e-04	5.20e-04
Total Aromatics	TNT (ACC1)	1.70e-05	1.50e-05	0.00e+00	1.60e-05	6.10e-05
Total Aromatics	TNT (ACC2)	3.00e-06			3.00e-06	6.00e-05
Total Aromatics	TNT (Sandia)	2.70e-06	9.90e-06	1.20e-05	8.20e-06	
Total Aromatics	T45E7 Adapter Booster	5.10e-04	3.20e-04	2.50e-04	3.60e-04	4.20e-04
Total Aromatics	20 mm HEI Cartridge	2.10e-04	2.10e-04	2.30e-04	2.10e-04	3.80e-04
Total Aromatics	40 mm HEI Cartridge	1.00e-04	0.00e+00	0.00e+00	1.00e-04	2.60e-04
Total HpCDD	Signal, Illumination, Red Star AN-M43A2	2.60e-10	5.70e-10	1.00e-09	6.10e-10	6.10e-10
Total Non-methane Hydrocarbons	Amatol surrogate	7.50e-04	3.40e-04	2.60e-04	4.50e-04	5.90e-04
Total Non-methane Hydrocarbons	Amatol surrogate with water	3.60e-03	3.80e-03	4.00e-03	3.80e-03	4.20e-03
Total Non-methane Hydrocarbons	Cartridge, Impulse, ARD 446-1	1.10e-03	9.10e-04	9.10e-04	9.80e-04	1.70e-03
Total Non-methane Hydrocarbons	Cartridge, Impulse, BBU-36/B	7.50e-04	7.10e-04	8.40e-04	7.70e-04	1.70e-03
Total Non-methane Hydrocarbons	Cartridge, Impulse, MK 107	7.30e-04	6.50e-04	5.60e-04	6.40e-04	1.00e-03
Total Non-methane Hydrocarbons	Composition B surrogate	5.50e-05	1.30e-04	1.50e-04	1.10e-04	3.00e-04
Total Non-methane Hydrocarbons	Detonating train	9.20e-04	8.10e-04	8.30e-04	8.50e-04	1.60e-03
Total Non-methane Hydrocarbons	Flare, IR Countermeasure M206	5.80e-04	5.60e-04	6.90e-04	6.10e-04	7.10e-04
Total Non-methane Hydrocarbons	Fuze, Tail Bomb FMU-139 A/B	1.20e-03	1.50e-03	1.50e-03	1.40e-03	1.50e-03
Total Non-methane Hydrocarbons	Fuze, Tail Bomb FMU-54 A/B	7.10e-04	1.30e-03	9.80e-04	9.90e-04	1.50e-03
Total Non-methane Hydrocarbons	Gas Generator, GGU-2/A	1.60e-03	1.70e-03	2.00e-03	1.80e-03	2.10e-03
Total Non-methane Hydrocarbons	HBX surrogate	2.00e-04	7.70e-05	2.70e-04	1.80e-04	5.80e-04
Total Non-methane Hydrocarbons	Mine, Claymore, M18A1	4.70e-03	4.80e-03	5.20e-03	4.90e-03	5.10e-03

Total Non-methane Hydrocarbons	Signal, Illumination, Red Star AN-M43A2	6.80e-04	8.50e-04	7.10e-04	7.40e-04	8.40e-04
Total Non-methane Hydrocarbons	Signal, Illumination, Red Star M158	7.90e-04	9.50e-04	5.70e-04	7.70e-04	8.80e-04
Total Non-methane Hydrocarbons	Tritonal surrogate	3.90e-04	2.60e-04	1.80e-04	2.80e-04	7.50e-04
Total Non-methane Hydrocarbons	Tritonal surrogate with calcium stearate		2.80e-05	5.10e-05	4.00e-05	5.40e-04
Total Non-methane Hydrocarbons	Tritonal surrogate with water	7.00e-03	6.50e-03	7.90e-03	7.10e-03	7.80e-03
Total Non-methane Hydrocarbons	TNT (ACC1)	0.00e+00	2.80e-05	0.00e+00	2.80e-05	5.50e-04
Total Non-methane Hydrocarbons	TNT (ACC2)	4.00e-05			4.00e-05	2.10e-04
Total Non-methane Hydrocarbons	T45E7 Adapter Booster	2.70e-03	1.60e-03	1.40e-03	1.90e-03	2.60e-03
Total Non-methane Hydrocarbons	20 mm HEI Cartridge	1.30e-03	9.20e-04	1.30e-03	1.20e-03	2.60e-03
Total Non-methane Hydrocarbons	40 mm HEI Cartridge	6.50e-04	0.00e+00	9.00e-06	3.30e-04	2.40e-03
Total Unidentified Hydrocarbons	Amatol surrogate	4.40e-04	2.30e-04	1.00e-04	2.50e-04	3.30e-04
Total Unidentified Hydrocarbons	Amatol surrogate with water	8.10e-04	8.50e-04	4.30e-04	7.00e-04	8.00e-04
Total Unidentified Hydrocarbons	Cartridge, Impulse, ARD 446-1	1.50e-04	1.50e-04	1.30e-04	1.40e-04	2.80e-04
Total Unidentified Hydrocarbons	Cartridge, Impulse, BBU-36/B	1.30e-04	1.20e-04	1.20e-04	1.20e-04	3.10e-04
Total Unidentified Hydrocarbons	Cartridge, Impulse, MK 107	7.20e-05	6.00e-05	6.50e-05	6.60e-05	1.30e-04
Total Unidentified Hydrocarbons	Composition B surrogate	3.70e-07	8.60e-05	5.00e-05	4.50e-05	1.50e-04
Total Unidentified Hydrocarbons	Detonating train	1.00e-04	1.00e-04	8.20e-05	9.60e-05	2.40e-04
Total Unidentified Hydrocarbons	Flare, IR Countermeasure M206	3.80e-05	6.50e-05	9.50e-05	6.60e-05	9.00e-05
Total Unidentified Hydrocarbons	Fuze, Tail Bomb FMU-139 A/B	9.60e-05	1.30e-04	8.30e-05	1.00e-04	1.40e-04
Total Unidentified Hydrocarbons	Fuze, Tail Bomb FMU-54 A/B	5.10e-05	8.00e-05	7.00e-05	6.70e-05	1.20e-04
Total Unidentified Hydrocarbons	Gas Generator, GGU-2/A	1.40e-04	1.20e-04	1.80e-04	1.50e-04	2.10e-04
Total Unidentified Hydrocarbons	HBX surrogate	7.30e-05	0.00e+00	8.40e-05	7.90e-05	1.80e-04
Total Unidentified Hydrocarbons	Mine, Claymore, M18A1	5.10e-04	4.00e-04	5.60e-04	4.90e-04	6.30e-04
Total Unidentified Hydrocarbons	Signal, Illumination, Red Star AN-M43A2	3.30e-05	1.10e-04	4.20e-05	6.10e-05	1.00e-04
Total Unidentified Hydrocarbons	Signal, Illumination, Red Star M158	4.10e-05	6.80e-05	5.80e-05	5.60e-05	9.10e-05
Total Unidentified Hydrocarbons	Tritonal surrogate	1.20e-04	9.60e-05	5.40e-05	9.00e-05	2.00e-04
Total Unidentified Hydrocarbons	Tritonal surrogate with calcium stearate		0.00e+00	3.60e-06	3.60e-06	1.20e-04
Total Unidentified Hydrocarbons	Tritonal surrogate with water	4.70e-04	6.00e-04	1.10e-03	7.10e-04	8.70e-04
Total Unidentified Hydrocarbons	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	3.50e-04
Total Unidentified Hydrocarbons	T45E7 Adapter Booster	3.10e-04	0.00e+00	0.00e+00	3.10e-04	5.70e-04
Total Unidentified Hydrocarbons	20 mm HEI Cartridge	3.00e-04	1.20e-04	2.40e-04	2.20e-04	1.00e-03
Total Unidentified Hydrocarbons	40 mm HEI Cartridge	1.80e-04	0.00e+00	2.00e-04	1.90e-04	1.40e-03
Vinyl chloride	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Cartridge, Impulse, BBU-36/B	6.10e-07	2.50e-06	1.90e-06	1.70e-06	1.70e-06
Vinyl chloride	Cartridge, Impulse, MK 107	2.40e-06	0.00e+00	0.00e+00	2.40e-06	2.40e-06
Vinyl chloride	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Detonating train	1.30e-06	0.00e+00	0.00e+00	1.30e-06	1.30e-06
Vinyl chloride	Flare, IR Countermeasure M206	1.50e-06	1.50e-06	1.50e-06	1.50e-06	1.50e-06
Vinyl chloride	Fuze, Tail Bomb FMU-139 A/B	2.20e-06	2.20e-06	1.10e-06	1.80e-06	1.80e-06

Vinyl chloride	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	6.70e-07	6.90e-07	6.80e-07	6.80e-07
Vinyl chloride	Gas Generator, GGU-2/A	2.50e-05	2.80e-05	7.70e-05	4.40e-05	4.40e-05
Vinyl chloride	HBX surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Mine, Claymore, M18A1	1.10e-06			1.10e-06	1.10e-06
Vinyl chloride	Signal, Illumination, Red Star AN-M43A2	2.30e-06	2.30e-06	2.30e-06	2.30e-06	2.30e-06
Vinyl chloride	Signal, Illumination, Red Star M158	8.00e-07	1.60e-06	7.80e-07	1.10e-06	1.10e-06
Vinyl chloride	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Tritonal surrogate with calcium stearate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	TNT (ACC1)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	TNT (ACC2)	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	T45E7 Adapter Booster	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	20 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Vinyl chloride	40 mm HEI Cartridge	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Amatol surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Cartridge, Impulse, BBU-36/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Cartridge, Impulse, MK 107	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Detonating train	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Flare, IR Countermeasure M206	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Fuze, Tail Bomb FMU-139 A/B	8.20e-03	5.40e-03	5.00e-03	6.20e-03	6.30e-03
Zinc	Fuze, Tail Bomb FMU-54 A/B	0.00e+00	0.00e+00	0.00e+00	0.00e+00	8.20e-05
Zinc	Gas Generator, GGU-2/A	1.60e-04	2.40e-04	1.50e-04	1.80e-04	2.10e-04
Zinc	HBX surrogate	0.00e+00	2.10e-04	2.60e-04	1.40e-04	1.40e-04
Zinc	Mine, Claymore, M18A1	1.60e-03	0.00e+00	0.00e+00	1.60e-03	8.00e-05
Zinc	Signal, Illumination, Red Star AN-M43A2	5.80e-04	2.70e-04	1.80e-04	3.40e-04	3.50e-04
Zinc	Signal, Illumination, Red Star M158	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Tritonal surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	Tritonal surrogate with calcium stearate		1.60e-04	0.00e+00	7.00e-05	7.70e-05
Zinc	Tritonal surrogate with water	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
Zinc	TNT (ACC1)	0.00e+00			0.00e+00	0.00e+00
Zinc	TNT (ACC2)	1.00e-05			1.00e-05	2.00e-05
Zinc	T45E7 Adapter Booster	2.90e-03			2.90e-03	4.20e-04
Zinc	20 mm HEI Cartridge	1.60e-02			1.60e-02	7.40e-03
Zinc	40 mm HEI Cartridge	1.10e-03			1.10e-03	2.80e-04
1-Butene	Amatol surrogate	1.90e-06	0.00e+00	1.50e-06	1.70e-06	1.70e-06
1-Butene	Amatol surrogate with water	8.10e-05	1.50e-04	7.90e-05	1.00e-04	1.00e-04
1-Butene	Cartridge, Impulse, ARD 446-1	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Butene	Cartridge, Impulse, BBU-36/B	6.00e-06	6.40e-06	9.40e-06	7.30e-06	7.30e-06

1-Butene	Cartridge, Impulse, MK 107	1.10e-05	1.00e-05	8.60e-06	1.00e-05	1.00e-05
1-Butene	Composition B surrogate	7.40e-07	0.00e+00	1.80e-06	1.30e-06	1.10e-06
1-Butene	Detonating train	3.10e-05	0.00e+00	0.00e+00	3.10e-05	3.10e-05
1-Butene	Flare, IR Countermeasure M206	7.30e-06	6.20e-06	1.10e-05	8.10e-06	8.10e-06
1-Butene	Fuze, Tail Bomb FMU-139 A/B	1.70e-05	1.60e-05	1.60e-05	1.60e-05	1.60e-05
1-Butene	Fuze, Tail Bomb FMU-54 A/B	9.80e-06	1.30e-05	9.50e-06	1.10e-05	1.10e-05
1-Butene	Gas Generator, GGU-2/A	4.10e-05	3.90e-05	4.60e-05	4.20e-05	4.20e-05
1-Butene	HBX surrogate	8.00e-06	4.50e-06	6.30e-06	6.30e-06	6.30e-06
1-Butene	Mine, Claymore, M18A1	5.90e-06	9.80e-06	7.10e-06	7.60e-06	7.60e-06
1-Butene	Signal, Illumination, Red Star AN-M43A2	1.30e-05	1.20e-05	1.00e-05	1.20e-05	1.20e-05
1-Butene	Signal, Illumination, Red Star M158	2.40e-05	2.60e-05	1.90e-05	2.30e-05	2.30e-05
1-Butene	Tritonal surrogate	0.00e+00	1.50e-06	2.50e-06	2.00e-06	2.00e-06
1-Butene	Tritonal surrogate with calcium stearate		5.50e-06	1.80e-06	3.70e-06	3.70e-06
1-Butene	Tritonal surrogate with water	2.80e-05	1.90e-05	2.70e-05	2.50e-05	2.50e-05
1-Butene	TNT (ACC1)	1.80e-06	1.90e-06	1.90e-06	1.90e-06	1.90e-06
1-Butene	TNT (ACC2)	1.50e-06			1.50e-06	1.50e-06
1-Butene	T45E7 Adapter Booster	0.00e+00	4.50e-05	5.40e-05	4.90e-05	4.90e-05
1-Butene	20 mm HEI Cartridge	0.00e+00	2.20e-05	2.70e-05	2.40e-05	2.40e-05
1-Butene	40 mm HEI Cartridge	6.60e-06	5.00e-06	3.30e-06	5.00e-06	5.00e-06
1-Hexene	Amatol surrogate	2.60e-06	1.50e-06	1.90e-06	2.00e-06	2.00e-06
1-Hexene	Amatol surrogate with water	3.50e-05	7.40e-05	4.50e-05	5.10e-05	5.20e-05
1-Hexene	Cartridge, Impulse, ARD 446-1	1.90e-05	1.80e-05	1.70e-05	1.80e-05	1.80e-05
1-Hexene	Cartridge, Impulse, BBU-36/B	1.60e-05	1.80e-05	2.30e-05	1.90e-05	1.90e-05
1-Hexene	Cartridge, Impulse, MK 107	7.30e-06	6.60e-06	7.30e-06	7.10e-06	7.10e-06
1-Hexene	Composition B surrogate	1.50e-06	1.90e-06	1.50e-06	1.60e-06	1.60e-06
1-Hexene	Detonating train	2.30e-05	2.20e-05	2.80e-05	2.40e-05	2.40e-05
1-Hexene	Flare, IR Countermeasure M206	5.60e-06	5.50e-06	6.80e-06	6.00e-06	6.00e-06
1-Hexene	Fuze, Tail Bomb FMU-139 A/B	8.80e-06	9.20e-06	8.20e-06	8.70e-06	8.70e-06
1-Hexene	Fuze, Tail Bomb FMU-54 A/B	6.50e-06	8.60e-06	6.40e-06	7.20e-06	7.20e-06
1-Hexene	Gas Generator, GGU-2/A	1.20e-05	1.10e-05	1.20e-05	1.20e-05	1.20e-05
1-Hexene	HBX surrogate	2.20e-06	2.50e-06	3.30e-06	2.70e-06	3.00e-06
1-Hexene	Mine, Claymore, M18A1	2.40e-06	2.50e-06	2.40e-06	2.40e-06	2.40e-06
1-Hexene	Signal, Illumination, Red Star AN-M43A2	9.00e-06	1.10e-05	8.60e-06	9.50e-06	9.50e-06
1-Hexene	Signal, Illumination, Red Star M158	1.90e-05	1.80e-05	1.60e-05	1.70e-05	1.70e-05
1-Hexene	Tritonal surrogate	2.60e-06	1.10e-06	2.50e-06	2.10e-06	2.50e-06
1-Hexene	Tritonal surrogate with calcium stearate		2.90e-06	2.60e-06	2.80e-06	3.10e-06
1-Hexene	Tritonal surrogate with water	1.80e-05	1.90e-05	2.60e-05	2.10e-05	2.20e-05
1-Hexene	TNT (ACC1)	2.30e-06	2.40e-06	1.90e-06	2.20e-06	2.20e-06
1-Hexene	TNT (ACC2)	1.50e-06			1.50e-06	1.50e-06
1-Hexene	T45E7 Adapter Booster	3.40e-05	2.80e-05	2.30e-05	2.80e-05	2.80e-05
1-Hexene	20 mm HEI Cartridge	4.90e-06	4.30e-06	4.10e-06	4.40e-06	4.40e-06

1-Hexene	40 mm HEI Cartridge	1.70e-06	8.20e-07	1.60e-06	1.40e-06	4.10e-06
1-Pentene	Amatol surrogate	1.10e-06	1.90e-06	7.40e-07	1.20e-06	1.20e-06
1-Pentene	Amatol surrogate with water	3.30e-05	6.80e-05	4.80e-05	4.90e-05	5.00e-05
1-Pentene	Cartridge, Impulse, ARD 446-1	9.50e-06	8.70e-06	8.20e-06	8.90e-06	1.30e-05
1-Pentene	Cartridge, Impulse, BBU-36/B	9.00e-06	9.80e-06	1.20e-05	1.00e-05	1.00e-05
1-Pentene	Cartridge, Impulse, MK 107	4.50e-06	4.20e-06	4.50e-06	4.40e-06	4.40e-06
1-Pentene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1-Pentene	Detonating train	1.20e-05	1.40e-05	1.60e-05	1.40e-05	2.20e-05
1-Pentene	Flare, IR Countermeasure M206	4.00e-06	2.70e-06	3.70e-06	3.50e-06	3.50e-06
1-Pentene	Fuze, Tail Bomb FMU-139 A/B	5.80e-06	7.30e-06	5.30e-06	6.10e-06	6.10e-06
1-Pentene	Fuze, Tail Bomb FMU-54 A/B	5.30e-06	6.20e-06	3.60e-06	5.10e-06	7.00e-06
1-Pentene	Gas Generator, GGU-2/A	5.90e-06	5.30e-06	6.70e-06	6.00e-06	6.00e-06
1-Pentene	HBX surrogate	1.10e-06	1.60e-06	1.90e-06	1.50e-06	1.70e-06
1-Pentene	Mine, Claymore, M18A1	9.70e-07	1.50e-06	1.90e-06	1.40e-06	1.40e-06
1-Pentene	Signal, Illumination, Red Star AN-M43A2	0.00e+00	5.90e-06	5.20e-06	5.60e-06	5.60e-06
1-Pentene	Signal, Illumination, Red Star M158	9.80e-06	1.20e-05	8.60e-06	1.00e-05	1.00e-05
1-Pentene	Tritonal surrogate	1.50e-06	1.50e-06	1.50e-06	1.50e-06	1.70e-06
1-Pentene	Tritonal surrogate with calcium stearate		3.70e-07	1.50e-06	9.10e-07	9.10e-07
1-Pentene	Tritonal surrogate with water	1.50e-05	1.50e-05	2.40e-05	1.80e-05	1.80e-05
1-Pentene	TNT (ACC1)	1.80e-06	1.40e-06	9.60e-07	1.40e-06	1.40e-06
1-Pentene	TNT (ACC2)	7.40e-07			7.40e-07	7.40e-07
1-Pentene	T45E7 Adapter Booster	2.40e-05	1.90e-05	1.50e-05	1.90e-05	1.90e-05
1-Pentene	20 mm HEI Cartridge	2.80e-06	5.80e-06	2.00e-06	3.50e-06	5.90e-06
1-Pentene	40 mm HEI Cartridge	1.70e-06	0.00e+00	8.20e-07	1.20e-06	3.30e-06
1,3-Butadiene	Amatol surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Amatol surrogate with water	3.70e-06	8.90e-06	6.30e-06	6.30e-06	6.30e-06
1,3-Butadiene	Cartridge, Impulse, ARD 446-1	8.80e-06	6.70e-06	4.70e-06	6.70e-06	6.70e-06
1,3-Butadiene	Cartridge, Impulse, BBU-36/B	2.70e-06	2.50e-06	3.10e-06	2.80e-06	6.30e-06
1,3-Butadiene	Cartridge, Impulse, MK 107	2.10e-06	2.10e-06	1.80e-06	2.00e-06	2.00e-06
1,3-Butadiene	Composition B surrogate	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00
1,3-Butadiene	Detonating train	5.50e-06	8.70e-06	1.30e-05	9.00e-06	9.00e-06
1,3-Butadiene	Flare, IR Countermeasure M206	3.70e-06	2.70e-06	2.70e-06	3.00e-06	3.00e-06
1,3-Butadiene	Fuze, Tail Bomb FMU-139 A/B	2.70e-05	1.70e-05	1.90e-05	2.10e-05	2.10e-05
1,3-Butadiene	Fuze, Tail Bomb FMU-54 A/B	3.30e-06	4.70e-06	5.50e-06	4.50e-06	4.50e-06
1,3-Butadiene	Gas Generator, GGU-2/A	2.20e-05	2.60e-05	3.30e-05	2.70e-05	2.70e-05
1,3-Butadiene	HBX surrogate	1.50e-06	8.20e-07	1.90e-06	1.40e-06	1.40e-06
1,3-Butadiene	Mine, Claymore, M18A1	3.90e-06	2.50e-06	1.90e-06	2.70e-06	2.70e-06
1,3-Butadiene	Signal, Illumination, Red Star AN-M43A2	2.40e-06	2.10e-06	1.00e-06	1.90e-06	1.90e-06
1,3-Butadiene	Signal, Illumination, Red Star M158	1.30e-05	1.30e-05	1.10e-05	1.20e-05	1.20e-05
1,3-Butadiene	Tritonal surrogate	3.70e-07	0.00e+00	1.50e-06	9.10e-07	9.10e-07
1,3-Butadiene	Tritonal surrogate with calcium stearate		1.80e-06	7.30e-07	1.30e-06	1.30e-06

1,3-Butadiene	Tritonal surrogate with water	1.70e-05	3.90e-05	3.30e-05	3.00e-05	3.00e-05
1,3-Butadiene	TNT (ACC1)	3.20e-06	9.60e-07	9.60e-07	1.70e-06	1.70e-06
1,3-Butadiene	TNT (ACC2)	3.70e-07			3.70e-07	3.70e-07
1,3-Butadiene	T45E7 Adapter Booster	4.30e-05	1.50e-05	1.30e-05	2.30e-05	2.30e-05
1,3-Butadiene	20 mm HEI Cartridge	5.60e-06	4.30e-06	5.40e-06	5.10e-06	5.10e-06
1,3-Butadiene	40 mm HEI Cartridge	4.20e-06	8.20e-07	8.20e-07	1.90e-06	1.90e-06