

# **BACKGROUND DOCUMENT**

## **REPORT ON REVISIONS TO 5<sup>TH</sup> EDITION AP-42 CHAPTER 15 - ORDNANCE DETONATION**

**EMISSION FACTORS DEVELOPED BASED ON PHASE VIII TESTING  
CONDUCTED AT DUGWAY PROVING GROUND, UTAH**

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## **NOTICE**

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**TABLE OF CONTENTS**

	<u>Page</u>
<b>1.0 INTRODUCTION.....</b>	<b>1</b>
<b>2.0 COMPOUNDS MEASURED AND EMISSION MEASUREMENT METHODS.....</b>	<b>2</b>
2.1 Carbon Monoxide, Carbon Dioxide, Oxides of Nitrogen, and Sulfur Dioxide .....	4
2.2 Total Suspended Particulate .....	4
2.3 Particulate Matter with an Aerodynamic Diameter Less than or Equal to 10 or 2.5 Microns ..	5
2.4 Metals .....	5
2.5 Hydrochloric Acid, Chlorine, and Ammonia .....	5
2.6 Volatile Organic Compounds .....	5
2.7 Semivolatile Organic Compounds.....	6
2.8 Dioxin and Furan Compounds .....	6
2.9 Aldehyde and Carbonyl Compounds.....	6
2.10 Energetic Materials.....	6
2.11 Hydrogen Cyanide .....	7
2.12 Perchlorate.....	7
2.13 Tracer Compound.....	7
<b>3.0 TEST DATA ANALYSIS AND RATING .....</b>	<b>7</b>
3.1 EPA Guidance Regarding Test Data Quality Ratings .....	7
3.2 Analysis of Test Data .....	8
3.3 Test Data Quality Ratings .....	13
<b>4.0 EMISSION FACTOR CALCULATIONS.....</b>	<b>16</b>
4.1 Incorporation of Analytical Detection-Limits to the Test Data.....	17
4.2 Determination of Background Concentration .....	17
4.3 Determination of Test Compound Concentration .....	17
4.4 Determination of Background-Corrected Concentration .....	18
4.5 Determination of Dilution-Corrected Concentration.....	18
4.6 Determination of Mass of Compound Released.....	18
4.7 Determination of Emission Factors .....	18
4.8 Determination of Average Emission Factors .....	20
4.9 Determination of Total Emission Factors for DODIC H708 .....	20
<b>5.0 EMISSION FACTOR RATINGS.....</b>	<b>20</b>
5.1 Emission Factor Ratings Assigned – Based on Ordnance-Specific Test Data.....	21
5.2 Emission Factor Ratings Assigned – Based on All Available Test Data .....	21
<b>6.0 REFERENCES.....</b>	<b>31</b>

**TABLE OF CONTENTS (cont.)**

APPENDIX A: COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR  
ORDNANCE INCLUDED IN PHASE VIII TESTING AT DUGWAY  
PROVING GROUND, UTAH

APPENDIX B: NEW AP-42 SECTIONS FOR ORDNANCE INCLUDED IN PHASE VIII  
TESTING AT DUGWAY PROVING GROUND, UTAH

**LIST OF TABLES**

<b><u>No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
1	Ordnance for Which Emission Factors were Developed .....	1
2	Ordnance Net Explosive Weight.....	2
3	Sampling and Analytical Methods Used.....	3
4	Selected Sampling or Analytical Method for Compounds Measured Using Two Sampling or Analytical Methods.....	10
5	Compounds for Which Large Relative Percent Differences Were Noted Between Test Runs or Sample Trains .....	11
6	Compounds Found In the Method Blank at Levels Between 20 Percent and 50 Percent of Both Test Values.....	13
7	Compounds Found In the Method Blank at Levels Greater than 50 Percent of Both Test Values...	13
8	Downgraded Data Quality Ratings .....	14
9	Ordnance Categorization for Emission Factor Correlation Assessment.....	23

**LIST OF FIGURES**

<b><u>No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
1	Calculation of background-corrected concentration (BCC).....	19

## 1.0 INTRODUCTION

Due to the lack of credible data concerning emissions from training ordnance when used in their tactical configurations, the U.S. Army Environmental Command (USAEC) established a program to quantify emissions from the detonation of ordnance. This document presents background information concerning the development of air emission factors for four types of ordnance used during training exercises at U.S. Army installations. The air emission factors were developed from test data collected by USAEC. Ordnance for which emission factors have been developed and their corresponding AP-42 sections are identified in Table 1. To help readers easily find those emission factors of interest, the ordnance are organized according to their Department of Defense Identification Code (DODIC).

TABLE 1 ORDNANCE FOR WHICH EMISSION FACTORS WERE DEVELOPED

DODIC	Ordnance Description	AP-42 Section
B505	M662 40-mm Red Star Parachute Cartridge	15.2.15
H708	M73 35-mm Subcaliber Practice Rocket (warhead only)	15.6.6
K042	M88 Practice Canister Mine (Volcano)	15.7.8
MN68	M151 Booster Demolition Charge	15.9.41

The emission factors described in this document are based on data obtained during testing conducted at Dugway Proving Ground, Utah, as presented in the final test report titled *Sampling Results for AEC Phase VIII Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*<sup>1</sup> and the document titled *Detailed Test Plan for Phase VIII Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*.<sup>2</sup> These documents were supplemented by additional data provided by the testing contractor.<sup>3</sup> For each ordnance, two test runs were conducted. One or two items (depending upon the test run) were detonated per run for DODIC B505, eight items were detonated per run for DODIC H708, and four items were detonated per run for DODICs K042 and MN68. Source test protocols were developed by USAEC before any testing was conducted and were reviewed by the U.S. Environmental Protection Agency's (EPA's) Emission Measurement Center. The tests were conducted between November 14 and 18, 2005.

The compounds that were measured included carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), total suspended particulate (TSP), particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM-10), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns (PM-2.5), metals, hydrogen chloride (HCl), chlorine (Cl<sub>2</sub>), ammonia (NH<sub>3</sub>), volatile organic compounds (VOC), semivolatile organic compounds (SVOC), dioxins/furans (PCDD/PCDF), aldehydes and carbonyls, energetic materials, hydrogen cyanide, perchlorate, and sulfur hexafluoride (SF<sub>6</sub>). Within each of the AP-42 sections, only emission factors for criteria pollutants, carbon dioxide, hazardous air pollutants (as defined by §112(b)(1) of the *Clean Air Act* [CAA]), and toxic chemicals (as defined by §313 of the *Emergency Planning and Community Right-to-Know Act* [EPCRA]) are presented.

The emission factors were developed on a "per item" basis and on a "per net explosive weight (NEW)" basis. Users should choose the appropriate emission factor to estimate emissions based upon the data available; either factor is equally valid. The NEW of each ordnance tested is provided in the corresponding AP-42 section and in Table 2.

TABLE 2 ORDNANCE NET EXPLOSIVE WEIGHT

DODIC	Ordnance Description	NEW (lb/item) <sup>a</sup>
B505	M662 40-mm Red Star Parachute Cartridge	1.88 E-01
H708	M73 35-mm Subcaliber Practice Rocket (warhead only)	3.20 E-03
K042	M88 Practice Canister Mine (Volcano)	1.39 E-02
MN68	M151 Booster Demolition Charge	9.70 E-03

<sup>a</sup>NEW value obtained from References 1 and 4.

This document includes five sections in addition to this Introduction. Section 2 of this document identifies the compounds measured during the test program and describes the emission measurement methods used. Section 3 includes a discussion of the emission factor final test report and ratings for the test data contained therein. Section 4 describes the calculations and methodologies used to develop emission factors for each type of compound measured. Section 5 describes the methodology used to rate the emission factors and provides emission factor ratings for each type of compound measured. Section 6 includes a complete list of the references cited in this document.

There are two appendices included with this document. Appendix A identifies, by ordnance type, all of the compounds for which analyses were performed and the emission factors that were developed. [Note: Compounds present in the method blank at greater than 50 percent of test levels are excluded from Appendix A as described in Section 3.2.4.] Appendix A also identifies the minimum detection levels associated with all compounds that were not detected. Emission factors and minimum detection levels presented in Appendix A were determined from the most accurate method if two sampling or analytical methods were used to measure one compound. Appendix B presents the new AP-42 sections for the four ordnances that were tested.

In addition to this document, there are electronic databases available on the web (<http://www.epa.gov/ttn/chief/ap42/index.html>) that contain the data used in the development of the emission factors. The general procedures that were followed to develop these emission factors can be found at the same web address under the title *Procedures for Preparing Emission Factor Documents*<sup>5</sup> and *Draft Detailed Procedures for Preparing Emission Factors*.<sup>6</sup>

## 2.0 COMPOUNDS MEASURED AND EMISSION MEASUREMENT METHODS

The USAEC Phase VIII series testing was conducted in the Smoke Characterization Test Chamber (Smoke Chamber) located at Dugway Proving Ground, Utah. The Smoke Chamber is an aluminum-lined chamber with an interior volume of approximately 820 cubic feet. The chamber is approximately 7 feet wide, 20 feet long, and 6 feet tall for 2/3 of its length and 5 feet tall for the remainder. During sampling, fans inside the chamber keep the gases mixed while stainless steel probes extract gas samples from the chamber through 12 sample ports. Gases extracted from the chamber are replaced by ambient air that enters the chamber through six ½-inch diameter vent lines that are distributed along one side of the chamber. An electrical firing circuit is used to remotely detonate the ordnance and release the tracer gas.

A number of different test methods were employed to collect and analyze the emission data that were used to develop emission factors for detonation of ordnance. Table 3 identifies each emission test method used; bracketed information identifies the purpose of using the method. The emissions data were collected using EPA test methods published in Title 40 of the Code of Federal Regulations, Part 51

(40 CFR 51); 40 CFR 60; and in *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*.<sup>7</sup> Some of the sample analytical procedures used were from EPA Office of Solid Waste (OSW) publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*.<sup>8</sup> Where necessary, the test methods were adapted to reflect application to the unique testing of ordnance detonation in the Smoke Chamber.

TABLE 3 SAMPLING AND ANALYTICAL METHODS USED

Compound	Test Method
CO	40 CFR 60, Appendix A, EPA Method 10 - <i>Determination of Carbon Monoxide Emissions from Stationary Sources</i> [sampling and analysis]
CO <sub>2</sub>	40 CFR 60, Appendix A, EPA Method 3A - <i>Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)</i> [sampling and analysis]
NO <sub>x</sub>	40 CFR 60, Appendix A, EPA Method 7E - <i>Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)</i> [sampling and analysis]
SO <sub>2</sub>	40 CFR 60, Appendix A, EPA Method 6C - <i>Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)</i> [sampling and analysis]
TSP	40 CFR 60, Appendix A, EPA Method 5 - <i>Determination of Particulate Matter from Stationary Sources</i> [sampling and analysis]
PM-10 and PM-2.5	EPA Conditional Test Method 040 - <i>Method for the Determination of PM10 and PM2.5 Emissions (Constant Sampling Rate Procedures)</i> [sampling and analysis]
Metals	Metal sample was obtained from TSP sample [sampling] 40 CFR 60, Appendix A, EPA Method 29 - <i>Determination of Metals Emissions from Stationary Sources</i> [analysis] SW-846 Method 6010A - <i>Inductively Coupled Plasma-Atomic Emission Spectrometry</i> [analysis for metals except mercury] SW-846 Method 7470 - <i>Mercury in Liquid Waste (Manual Cold-Vapor Technique)</i> [analysis for mercury]
HCl, Cl <sub>2</sub> , and NH <sub>3</sub>	40 CFR 60, Appendix A, EPA Method 26 - <i>Determination of Hydrogen Chloride Emissions from Stationary Sources</i> [sampling and analysis for HCl and Cl <sub>2</sub> ] EPA Conditional Test Method 027 - <i>Procedure for Collection and Analysis of Ammonia in Stationary Sources</i> [sampling and analysis for NH <sub>3</sub> ]
VOC	EPA Compendium Method TO-12 - <i>Method for the Determination of Non-Methane Organic Compounds (NMOC) in Ambient Air Using Cryogenic Preconcentration and Direct Flame Ionization Detection (FID)</i> [sampling and analysis]
Speciated VOC	EPA Compendium Method TO-14 - <i>Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic Analysis</i> [sampling and analysis]
SVOC	SW-846 Method 0010 - <i>Modified Method 5 Sampling Train</i> [sampling] SW-846 Method 8270 - <i>Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)</i> [analysis]

TABLE 3 (cont.)

Compound	Test Method
Dioxins and Furans	40 CFR 60, Appendix A, EPA Method 23 - <i>Determination of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from Municipal Waste Combustors</i> [sampling]  SW-846 Method 8290 - <i>Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)</i> [analysis]
Aldehydes and Carbonyls	EPA Compendium Method TO-11A - <i>Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)</i> [sampling and analysis]
Energetic Materials	SW-846 Method 0010 - <i>Modified Method 5 Sampling Train</i> [sampling] SW-846 Method 8095 - <i>Explosives by Gas Chromatography</i> [analysis]
Hydrogen Cyanide	EPA Conditional Test Method 033 - <i>Sampling and Analysis for Hydrogen Cyanide Emissions from Stationary Sources</i> [sampling and analysis]
Perchlorate	Perchlorate sample was obtained from TSP sample [sampling]  EPA Method 314 - <i>Determination of Perchlorate in Drinking Water Using Ion Chromatography</i> [analysis]
Tracer Compound (SF <sub>6</sub> )	Grab sample [sampling] Gas Chromatograph/Electron Capture Detector [analysis]

The following sections identify and briefly describe the test methods used to measure each compound or group of compounds. During each test run, sample data were collected for 20 to 30 minutes; target minimum sampling times are identified below. Additional information regarding the operation of the Smoke Chamber and the test methods used is presented in Reference 1. EPA-approved methods were used by the laboratories that provided sampling and analysis data.

## 2.1 Carbon Monoxide, Carbon Dioxide, Oxides of Nitrogen, and Sulfur Dioxide

Real-time concentrations of CO, CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub> that resulted from the use of ordnance in the Smoke Chamber were measured using a continuous emissions measurement system (CEMS). CO sampling and analysis was conducted in accordance with 40 CFR Part 60, Appendix A, Method 10 - *Determination of Carbon Monoxide Emissions from Stationary Sources*. CO<sub>2</sub> sampling and analysis was conducted in accordance with 40 CFR Part 60, Appendix A, Method 3A - *Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources*. NO<sub>x</sub> sampling and analysis was conducted in accordance with 40 CFR Part 60, Appendix A, Method 7E - *Determination of Nitrogen Oxides Emissions from Stationary Sources*. SO<sub>2</sub> sampling and analysis was conducted in accordance with 40 CFR Part 60, Appendix A, Method 6C - *Determination of Sulfur Dioxide Emissions from Stationary Sources*. For each run, the target minimum sampling time was 20 minutes.

## 2.2 Total Suspended Particulate

The TSP concentration that resulted from the use of ordnance in the Smoke Chamber was determined using a sampling and analysis procedure based on 40 CFR 60, Appendix A, EPA Method 5 - *Determination of Particulate Matter from Stationary Sources*. During each run, duplicate samples were



obtained using samplers operating simultaneously. For each run, the target minimum sampling time was 20 minutes. The TSP concentration was computed by dividing the mass of TSP collected by the volume of air sampled, corrected to standard conditions.

### **2.3 Particulate Matter with an Aerodynamic Diameter Less than or Equal to 10 or 2.5 Microns**

The PM-10 and PM-2.5 concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using a modified sampling and analysis procedure based on EPA Conditional Test Method (CTM) 040 - *Method for the Determination of PM10 and PM2.5 Emissions (Constant Sampling Rate Procedures)*. The sample was collected two cyclones in series with a filter. Particles larger than 10 microns were removed in the first cyclone. Particles between 10 and 2.5 microns passed through the first cyclone but not the second. Particles smaller than 2.5 microns passed through the second cyclone and were captured on the filter. Each fraction was measured gravimetrically. The particulate concentrations were computed by dividing the mass of PM-10 and PM-2.5 collected by the volume of air sampled, corrected to standard conditions. A minimum sampling time was not targeted.

### **2.4 Metals**

Metal concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using particulate matter from one of the TSP samples collected as described in Section 2.2. After the TSP total weight gain was determined in the laboratory, the TSP filter was digested with concentrated hydrogen fluoride and nitric acid per 40 CFR 60, Appendix A, Method 29 - *Determination of Metals Emissions from Stationary Sources*. The digestate was then analyzed for metals (except mercury) using inductively coupled argon plasma (ICAP) emission spectroscopy in accordance with SW-846 Method 6010A - *Inductively Coupled Plasma-Atomic Emission Spectrometry*. Mercury was determined by cold vapor atomic absorption spectroscopy (CVAAS) in accordance with SW-846 Method 7470 - *Mercury in Liquid Waste (Manual Cold-Vapor Technique)*. The concentration of each target metal was computed by dividing the mass of metal collected by the volume of air sampled, corrected to standard conditions.

### **2.5 Hydrochloric Acid, Chlorine, and Ammonia**

Hydrochloric acid (HCl), chlorine (Cl<sub>2</sub>), and ammonia (NH<sub>3</sub>) concentrations that resulted from the use of ordnance in the Smoke Chamber were sampled in accordance with 40 CFR 60, Appendix A, Method 26 - *Determination of Hydrogen Chloride Emissions from Stationary Sources*. During each run, chamber gases were pulled through two sets of impingers in series containing dilute sulfuric acid and sodium hydroxide solutions. The HCl and NH<sub>3</sub> were absorbed in the sulfuric acid solution, while the Cl<sub>2</sub> passed through and was absorbed by the sodium hydroxide solution. HCl and Cl<sub>2</sub> were measured in accordance with 40 CFR 60, Appendix A, EPA Method 26. NH<sub>3</sub> was measured in accordance with EPA Conditional Test Method 027 - *Procedure for Collection and Analysis of Ammonia in Stationary Sources*. The concentrations of HCl, Cl<sub>2</sub>, and NH<sub>3</sub> were computed by dividing the mass collected by the volume of air sampled, corrected to standard conditions. A 20-minute minimum sampling time was targeted.

### **2.6 Volatile Organic Compounds**

VOC concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using two methods from the *Second Supplement to Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*: (1) Method TO-12 - *Method for the Determination of Non-methane Organic Compounds in Ambient Air using Cryogenic Preconcentration and Direct Flame Ionization Detection* and (2) Method TO-14 - *Determination of Volatile Organic Compounds in Ambient Air Using SUMMA Passivated Canister Sampling and Gas Chromatographic*

*Analysis.* For both procedures, air samples were collected in stainless steel 6-liter SUMMA<sup>®</sup> canisters. One canister was used for each test run and the target minimum sampling time was 10 minutes. Unknown compounds, if any, were tentatively identified using computerized mass spectral matching techniques of the highest non-target “peaks.”

## **2.7 Semivolatile Organic Compounds**

SVOC concentrations that resulted from the use of ordnance in the Smoke Chamber were determined based on procedures found in SW-846 Method 0010 - *Modified Method 5 Sampling Train*. During each run, duplicate samples were collected using two PS-1 samplers that contained special sampling inlets (i.e., aluminum sampling modules) designed to hold 100-mm diameter quartz fiber filters to collect particulate matter, followed by XAD-2 adsorbent resin cartridges for collection of vapor phase SVOCs. A 20-minute minimum sampling time was targeted. Following sampling, the filters and resin cartridges underwent solvent extraction and the mass of SVOC collected was quantitatively determined by GC/MS analysis following procedures in SW-846 Method 8270 - *Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)*. Unknown compounds, if any, were tentatively identified using computerized mass spectral matching techniques of the highest non-target “peaks.”

## **2.8 Dioxin and Furan Compounds**

Dioxin and furan compound concentrations that resulted from the use of ordnance in the Smoke Chamber were determined based on procedures found in 40 CFR 60, Appendix A, EPA Method 23 - *Determination of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans from Municipal Waste Combustors*. During each run, duplicate samples were obtained using two modified Method 5 sampling trains. The modified sampling trains used standard quartz filters, but the adsorbent cartridges contained XAD-2 resin sandwiched between polyurethane foam (PUF) plugs. A minimum sampling time of 20 minutes was targeted. After sampling, the filters and adsorbent cartridges underwent extraction with the appropriate solvent(s). The mass of dioxin and furan compounds collected was quantitatively determined following SW-846 Method 8290 - *Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)*.

## **2.9 Aldehyde and Carbonyl Compounds**

Aldehyde and carbonyl compound concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using EPA Compendium Method TO-11A - *Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)*, but using modified sampling and analytical procedures. 2,4-Dinitrophenylhydrazine (DNPH) laden cartridge tubes were used as a direct probe to trap and derivatize aldehyde and carbonyl compounds. A minimum sampling time of 20 minutes was targeted. Analysis was by HPLC with ultraviolet (UV) absorption detection.

## **2.10 Energetic Materials**

Energetic compound concentrations that resulted from the use of ordnance in the Smoke Chamber were determined based on procedures found in SW-846 Method 0010 - *Modified Method 5 Sampling Train*. Samples were collected using combination quartz filter/adsorbent cartridges. The adsorbent cartridges contained XAD-2 polymeric resin beads. A minimum sampling time of 20 minutes was targeted. After sampling, the filters and adsorbent cartridge were extracted with isoamyl acetate. The effluent was then analyzed following the procedures outlined in SW-846 Method 8095 - *Explosives by Gas Chromatography*.

## 2.11 Hydrogen Cyanide

Hydrogen cyanide (HCN) concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using EPA CTM 033 - *Sampling and Analysis for Hydrogen Cyanide Emissions from Stationary Sources*. The sample gas was drawn through a heated quartz-fiber filter and two impingers containing 0.1 normal sodium hydroxide (NaOH). A minimum sampling time of 20 minutes was targeted. The pH of the impingers was measured after sampling to ensure that all cyanide was retained. The impinger solution and extracted filter were analyzed by ion chromatography.

## 2.12 Perchlorate

Perchlorate concentrations that resulted from the use of ordnance in the Smoke Chamber were determined using particulate matter from one of the TSP samples collected as described in Section 2.2. After the TSP total weight gain was determined in the laboratory, the perchlorates were leached from the filter by shaking small strips of the filter in reagent water for 1 hour. Ion chromatography was then used to analyze the digestate in accordance with EPA Method 314 - *Determination of Perchlorate in Drinking Water Using Ion Chromatography*.

## 2.13 Tracer Compound

Sulfur hexafluoride (SF<sub>6</sub>) was used as a tracer compound during each run to estimate the amount of sample dilution that occurred as a result of ambient air entering the Smoke Chamber during the run. Grab samples were collected four times during each run using evacuated 1-L canisters. A minimum sampling time of 2 minutes was targeted for each canister. The canisters were analyzed for the tracer compound using a GC with an electron capture detector.

## 3.0 TEST DATA ANALYSIS AND RATING

### 3.1 EPA Guidance Regarding Test Data Quality Ratings

Prior to inclusion of emission factors in AP-42, the reliability of the underlying emission test data must be appraised in accordance with the rating system specified in Reference 5. Under this rating system, test data are assigned a rating from A to D, where an “A” rating is assigned to the highest quality data. The criteria used to assign a specific data quality rating are summarized below.

- A** Tests are performed by using an EPA reference test method, or when not applicable, a sound methodology. Tests are reported in enough detail for adequate validation and raw data are provided that can be used to duplicate the emission results presented in the report.
- B** Tests are performed by a generally sound methodology, but lacking enough detail for adequate validation. Data are insufficient to completely duplicate the emission result presented in the report.
- C** Tests are based on an unproven or new methodology, or are lacking a significant amount of background information.
- D** Tests are based on a generally unacceptable method, but the method may provide an order-of-magnitude value for the source.

Four specific criteria are identified in Reference 5 for consideration to assist in the assignment of a test data quality rating. These four criteria are:

1. Source operation. If the manner in which the source was operated is well documented in the report and the source was operating within typical parameters during the test, an “A” rating should be assigned. If the report stated parameters that were typical, but lacked detailed information, a “B” rating should be assigned. If there is reason to believe the operation was not typical, a “C” or “D” rating should be assigned.
2. Test methods and sampling procedures. In developing the ratings, the estimated accuracy and precision of the test method as well as the adequacy of the documentation should be considered. In general, if a current EPA reference test method, appropriate for the source, was followed, the rating should be higher (“A” or “B”). If other methods were used, an assessment should be made of their validity. If it is judged that the method was likely to be inaccurate or biased, a lower rating (“C” or “D”) should be given. A complete report should indicate whether any procedures deviated from standard methods and explain any deviations. If deviations were reported, an evaluation should be made of whether these were likely to influence the test results.
3. Process information. During testing, many variations in the process can occur without warning and sometimes without being noticed. Such variations can induce wide deviations in sampling results. If a large variation between test run results cannot be explained by information contained in the site final test report or from test reports of other sources, the data are suspect and should be given a lower rating or excluded. However, it should be recognized that a process may have highly variable emissions and a lower rating may not be appropriate solely on the basis of wide deviations in sampling results.
4. Analysis and calculations. Ideally, final test reports should contain original raw data sheets and other documentation such as gas parameters (dry cubic feet per minute, oxygen percentage), calculation sheets, or example calculations describing how the calculated emission results were obtained. If there are data sheets, the nomenclature and equations used should be compared to those specified by EPA to establish equivalency. The depth of review of the calculations should be dictated by the reviewers’ confidence in the ability and conscientiousness of the tester, based on such factors as consistency of results and completeness of other areas of the final test report. Reports may indicate that raw data sheets were available, but were not included. If the final test report is of high quality based on the other criteria, the quality rating should not be lowered due to a lack of data sheets.

An overall test data quality rating should be assigned based upon the ratings assigned for each of the four criteria.

### **3.2 Analysis of Test Data**

Data included in the final test report<sup>1</sup> were rated in accordance with the rating system described above. Results for each of the four criteria are presented in the following sections.

#### **3.2.1 Source Operations**

The manner by which the ordnance were deployed (i.e., used) is documented in the final test report. With the exception of the adaptations discussed below that were made to facilitate testing in the test chamber, each ordnance that was tested was deployed in a manner similar to that which would occur in the field. DODIC B505 was initiated using a blasting cap that was also used during the background run so that emissions associated with the initiator could be subtracted from the total emissions associated with the initiator and ordnance. In addition, DODIC H708 was disassembled prior to testing so that only the warhead was tested. The tests appear to have replicated typical ordnance operating parameters; consequently, the test data should be assigned an “A” rating based on this criterion.

### 3.2.2 Test Methods and Sampling Procedures

The test methods and sampling procedures were evaluated as being appropriate and consistent with EPA test methods or sound methodology. Except as noted below, no problems of any significance were identified; consequently, the test data should be assigned an “A” rating based on this criterion.

#### 3.2.2.1 CEMS-Measured Data

Although summaries of the CEMS data were provided for the tests,<sup>1</sup> raw CEMS data were not provided for the tests or for the pre- and post-test quality control (QC) activities. Furthermore, none of the calibration gas certifications were supplied. There was no evidence of bias in the data; however, based on the issues noted above, the test data for the CEMS-measured compounds (i.e., CO, CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub>) should be assigned a “B” rating based on this criterion.

#### 3.2.2.2 Compounds Sampled or Analyzed Using More than One Test Method or Analytical Method

Twelve compounds were either sampled or analyzed using two methods; these compounds are identified in Table 4. For each of these compounds, emission factors were calculated based upon the data measured using the more appropriate test or analytical method; data measured using the less appropriate method were ignored. The more appropriate method was identified by reviewing the methods and the target compound lists associated with each method. If a specific compound appeared on the target compound list for one method but not the other, the method targeting the compound was selected. If a specific compound appeared on the target compound lists for both methods, the method judged to provide the most accurate data was selected.

For compounds analyzed using both the TO-11A (aldehydes) and TO-14 (VOC) methods, the TO-11A method analysis was judged to be more accurate and was selected. For compounds analyzed using both the SW8270 (SVOC) and TO-14 (VOC) methods, the TO-14 method analysis was judged to be more accurate and was selected. [Note: Naphthalene was analyzed using both SW8270 (SVOC) and TO-14 (VOC), but only appears on the target compound list for SW8270; therefore, this method analysis was selected.] For compounds analyzed using both the SW8270 (SVOC) and SW8095 (energetics) methods, the SW8095 method analysis was judged to be more accurate and was selected.

Occasionally, the compound measurement from the less accurate method was chosen because the compound had poor precision between test runs for the sampling method that would have been more accurate under normal circumstances. These cases are noted in the footnotes to Table 4.

#### 3.2.2.3 Tentatively Identified Compounds

During the analysis of the VOC and SVOC data, the highest nontarget “peaks” were tentatively identified using computerized mass spectral matching techniques. Emission factors were developed for these tentatively identified compounds (TICs) if all of the following criteria were met.

1. The TIC corresponded to a unique compound (e.g., ethylbenzene). Emission factors were not developed if the TIC corresponded to a class of compounds (e.g., unknown alcohol).
2. The TIC was not identified using another analysis method that provided higher confidence data. Emission factors were developed based upon the higher confidence analysis method if such data were available.
3. The TIC was not present in the method blank. Emission factors were not developed if the TIC was found in the corresponding method blank.

TABLE 4 SELECTED SAMPLING OR ANALYTICAL METHOD FOR COMPOUNDS MEASURED USING TWO SAMPLING OR ANALYTICAL METHODS

Compound	Selected Method	Other Method Employed
1,2-Dichlorobenzene	TO-14 (VOC)	SW8270 (SVOC)
1,3-Dichlorobenzene	TO-14 (VOC)	SW8270 (SVOC)
1,4-Dichlorobenzene	TO-14 (VOC)	SW8270 (SVOC)
1,3-Dinitrobenzene	SW8095 (Energetics)	SW8270 (SVOC)
2,4-Dinitrotoluene	SW8095 (Energetics)	SW8270 (SVOC)
2,6-Dinitrotoluene <sup>a</sup>	SW8095 (Energetics)	SW8270 (SVOC)
Hexachlorobutadiene	TO-14 (VOC)	SW8270 (SVOC)
Naphthalene	SW8270 (SVOC)	TO-14 (VOC)
Nitrobenzene	SW8095 (Energetics)	SW8270 (SVOC)
1,2,4-Trichlorobenzene	TO-14 (VOC)	SW8270 (SVOC)
Acetone <sup>b</sup>	TO-11A (Aldehydes)	TO-14 (VOC)
1,3,5-Trinitrobenzene	SW8095 (Energetics)	SW8270 (SVOC)

<sup>a</sup> For DODIC H708, data collected from the SVOC sampling method were used to develop emission factors because this compound was present in the energetics method blank at a level greater than 20 percent of the test values.

<sup>b</sup> For DODIC H708, data collected from the VOC sampling method were used to develop emission factors because this compound had a relative percent difference greater than 100 percent between aldehyde test samples.

The number of VOC that were tentatively identified as unique compounds, were not identified using a higher confidence method, and were not present in the method blank varied from zero to five compounds per ordnance. The number of SVOC that were tentatively identified as unique compounds, were not identified using a higher confidence method, and were not present in the method blank varied from one to five compounds per ordnance. Emission factors were developed for all of these TICs, but because of the uncertainty in the true identity of the TICs, the test data were assigned a “C” rating.

### 3.2.3 Process Information

Ordnances are manufactured to tight tolerances and are expected to deploy in a very repeatable fashion. Consequently, the test data should be assigned an “A” rating based upon this criterion. However, large relative percent differences (i.e., greater than 100 percent) between test runs or sample trains were noted for several compounds. Specific instances in which these differences were noted are identified in Table 5. The equation below illustrates calculation of relative percent difference:

$$\text{relative percent difference} = \frac{\text{test 1 concentration} - \text{test 2 concentration}}{\text{average of test 1 and test 2 concentrations}} \times 100\%$$

Due to the large relative percent differences between test runs or sample trains, the test data specifically identified in Table 5 were assigned a “C” rating. The remainder of the data should be assigned an “A” rating based on this criterion.

TABLE 5 COMPOUNDS FOR WHICH LARGE RELATIVE PERCENT DIFFERENCES WERE NOTED BETWEEN TEST RUNS OR SAMPLE TRAINS

Compound	Applicable DODIC
Sulfur dioxide	B505, MN68
Total nonmethane hydrocarbons	B505
Ammonia	H708, K042
Benzene	B505
Cadmium	H708
Ethylbenzene	H708
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	B505, H708, MN68
1,2,3,4,6,7,8-Heptachlorodibenzofuran	H708, MN68
1,2,3,4,7,8,9-Heptachlorodibenzofuran	MN68
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	MN68
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	B505, H708, MN68
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	MN68
1,2,3,4,7,8-Hexachlorodibenzofuran	MN68
1,2,3,6,7,8-Hexachlorodibenzofuran	B505, MN68
1,2,3,7,8,9-Hexachlorodibenzofuran	MN68
2,3,4,6,7,8-Hexachlorodibenzofuran	B505, MN68
Hexane	B505, H708
Methylene chloride	B505, MN68
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	H708
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	B505, H708, MN68
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	B505, MN68
1,2,3,7,8-Pentachlorodibenzofuran	B505
2,3,4,7,8-Pentachlorodibenzofuran	MN68
Pyridine	B505
2,3,7,8-Tetrachlorodibenzo-p-dioxin	B505
2,3,7,8-Tetrachlorodibenzofuran	B505
Toluene	B505, H708
1,2,4-Trimethylbenzene	B505
m-Xylene, p-Xylene	B505, H708
o-Xylene	B505, H708
Zinc	B505
Acetone	MN68
4-Amino-2,6-dinitrotoluene	H708

TABLE 5 (cont.)

Compound	Applicable DODIC
Ethanol	B505
n-Heptane	B505
Isobutane	B505
Methyl ethyl ketone	B505, MN68
2-Methylpentane	B505
i-Pentane	H708
n-Pentane	B505
Propane	H708
Tetrahydrofuran	B505

#### 3.2.4 Analysis and Calculations

The test report,<sup>1</sup> detailed test plan,<sup>2</sup> and analytical data supporting the test report<sup>3</sup> were reviewed to determine whether they contained all of the original raw data, other documentation, and example calculations. Although the test report did not contain raw field data, the data were made available upon request. The test report also lacked certain calibration data. However, the missing information was judged insufficient to result in a downgrade of the test data quality rating.

The raw data and sample calculations presented in the final test report, detailed test plan, and analytical data supporting the test report were reviewed to determine if the emission factors presented in the report could be duplicated. Where differences were found between the emission factors calculated using the Excel spreadsheets and those presented in the test report, an examination was made to determine the reason for the differences.

Several minor errors were noted in the calculation of the emission factors within the test report, particularly with respect to the incorporation of “0” values into the emission factors (see Section 4.4) and the net explosive weight assumed for each ordnance. The emission factors presented in AP-42 are based upon the corrected spreadsheets. Based upon the raw data, other documentation, and the Excel spreadsheet calculations, the test data should be assigned an “A” rating.

Emission factors developed for compounds present in the method blank at levels of 20 percent to 50 percent of both test values were assumed to be biased high. Several compounds met this criterion and are identified in Table 6. For these compounds, the test data were assigned a “B” rating.

When compounds were found in the method blank at levels greater than 50 percent of both test values, the data were assumed to be suspect and no emission factors were developed. The compounds that met this criterion are listed in Table 7.



TABLE 6 COMPOUNDS FOUND IN THE METHOD BLANK AT LEVELS BETWEEN 20 PERCENT AND 50 PERCENT OF BOTH TEST VALUES

Compound	Applicable DODIC
Total nonmethane hydrocarbons	H708
Chromium	B505
Lead	H708
Nickel	K042
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	K042
Zinc	B505, K042
Acetone	H708
Magnesium	B505

TABLE 7 COMPOUNDS FOUND IN THE METHOD BLANK AT LEVELS GREATER THAN 50 PERCENT OF BOTH TEST VALUES

Compound	Applicable DODIC
Aluminum	All DODICs
Antimony	B505, MN68
Arsenic	All DODICs
Barium	All DODICs
Beryllium	All DODICs
Chlorine	All DODICs
Chromium	H708
Copper	H708
Manganese	All DODICs
Methylene chloride	H708, MN68
Nickel	B505, H708
Phosphorus	All DODICs
Selenium	All DODICs
Zinc	H708, MN68
Magnesium	H708, K042, MN68

### 3.3 Test Data Quality Ratings

Upon completing the analysis described in the preceding section of this document, the test data quality ratings assigned as a result of the four criteria were reviewed. This review led to a downgrading of some of the test data from an “A” rating to either a “B” rating or a “C” rating. Table 8 identifies the data quality ratings for all compounds that did not receive an “A” rating.

TABLE 8 DOWNGRADED DATA QUALITY RATINGS

Compound	Data Quality Rating	Applicable DODIC
Carbon dioxide	B	All DODICs
Carbon monoxide	B	All DODICs
Oxides of nitrogen	B	All DODICs
Sulfur dioxide	B	H708, K765
Sulfur dioxide	C	B505, MN68
Total nonmethane hydrocarbons	B	H708
Total nonmethane hydrocarbons	C	B505
Ammonia	C	H708, K042
Benzene	C	B505
Biphenyl	C	MN68
Cadmium	C	H708
Chromium	B	B505
Ethylbenzene	C	H708
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	C	B505, H708, MN68
1,2,3,4,6,7,8-Heptachlorodibenzofuran	C	H708, MN68
1,2,3,4,7,8,9-Heptachlorodibenzofuran	C	MN68
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	C	MN68
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	C	B505, H708, MN68
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	C	MN68
1,2,3,4,7,8-Hexachlorodibenzofuran	C	MN68
1,2,3,6,7,8-Hexachlorodibenzofuran	C	B505, MN68
1,2,3,7,8,9-Hexachlorodibenzofuran	C	MN68
2,3,4,6,7,8-Hexachlorodibenzofuran	C	B505, MN68
Hexane	C	B505, H708
Lead	B	H708
Methylene chloride	C	B505, MN68
Nickel	B	K042
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	C	H708
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	B	K042
1,2,3,4,6,7,8,9-Octachlorodibenzofuran	C	B505, H708, MN68
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	C	B505, MN68
1,2,3,7,8-Pentachlorodibenzofuran	C	B505
2,3,4,7,8-Pentachlorodibenzofuran	C	MN68

TABLE 8 (cont.)

Compound	Data Quality Rating	Applicable DODIC
Pyridine	C	B505
2,3,7,8-Tetrachlorodibenzo-p-dioxin	C	B505
2,3,7,8-Tetrachlorodibenzofuran	C	B505
Toluene	C	B505, H708
1,2,4-Trimethylbenzene	C	B505
m-Xylene, p-Xylene	C	B505, H708
o-Xylene	C	B505, H708
Zinc	B	K042
Zinc	C	B505
Acetone	B	H708
Acetone	C	MN68
4-Amino-2,6-dinitrotoluene	C	H708
Benzonitrile	C	MN68
Bicyclo[4.2.0]octa-1,3,5-triene	C	MN68
1-Butanol, 3-methyl-, acetate	C	H708, K042
3-Buten-2-one	C	MN68
1-Buten-3-yne	C	K042
Cyclopentanone	C	B505
Cyclopropane, ethyl-	C	MN68
Disulfide, dimethyl	C	B505
1-Dodecene	C	MN68
Ethanol	C	B505
2,5-Furandione, dihydro-3-methyl-	C	K042
Furfural	C	K042
n-Heptane	C	B505
Isobutane	C	B505
Magnesium	B	B505
Methane, isocyano-	C	MN68
Methyl ethyl ketone	C	B505, MN68
2-Methylpentane	C	B505
i-Pentane	C	H708
n-Pentane	C	B505
Phenol, 2,4-bis(1-phenylethyl)-	C	B505

TABLE 8 (cont.)

Compound	Data Quality Rating	Applicable DODIC
Propane	C	H708
Propanenitrile	C	MN68
1-Propene, 2-methyl-	C	K042
1-Propyne	C	K042, MN68
Tetrahydrofuran	C	B505
Vinyl benzoate	C	MN68

#### 4.0 EMISSION FACTOR CALCULATIONS

The methodologies and procedures that were used to develop emission factors from the test data are described in this section. A similar approach was used to calculate emission factors for TSP, PM-10, PM-2.5, metals, HCl, Cl<sub>2</sub>, NH<sub>3</sub>, SVOC, dioxin/furan compounds, aldehydes and carbonyls, energetic materials, hydrogen cyanide, and perchlorate. The calculation steps that were performed for each sampling train and each run are summarized below.

1. For compounds for which more than one test sample was obtained, analytical detection limits were incorporated into the test data.
2. The background compound concentration was calculated by dividing the mass of compound detected during the background run by the background run sample volume.
3. The test compound concentration was calculated by dividing the mass of compound detected during the test run by the test run sample volume.
4. A background-corrected concentration was calculated by subtracting the background concentration from the test concentration.
5. A dilution-corrected concentration was calculated by dividing the background-corrected concentration by the dilution correction factor.
6. The mass of compound released during the test run was calculated by multiplying the dilution-corrected concentration by the volume of the test chamber.
7. Emission factors for each sample and sampling train or test run were calculated by dividing the mass of compound released by the number of ordnance detonated during the test run or by the NEW detonated during the test run, as appropriate.
8. Average emission factors were calculated for each compound.

Because concentration data (i.e., parts per million by volume [ppmv] or parts per billion by volume [ppbv]) were recorded for VOC and CEMS-measured compounds, it was not necessary to calculate background and test concentrations as described in steps 2 and 3. Detection limits were applied directly to test compound concentrations of VOC and CEMS-measured compounds, as described in step 1. As appropriate, ppmv and ppbv values were converted to mg/m<sup>3</sup>. Emission factors for VOC and CEMS-measured compounds were then estimated in accordance with steps 4 through 8 described above.

The following sections describe each of the eight emission factor calculation steps listed above in more detail. In addition, Section 4.9 discusses the calculation of total emission factors for DODIC H708, the propelling rocket of which was previously tested as described in the final test report titled *Report No. 9 for the Firing Point Emission Study, Phase II*<sup>9</sup> and for which emission factors were previously estimated as described in *Background Document, Report on Revisions to 5<sup>th</sup> Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Firing Point Emission Study Phase II Series 9 Testing Conducted at Aberdeen Proving Ground, Maryland*.<sup>10</sup>

#### 4.1 Incorporation of Analytical Detection-Limits to the Test Data

In many cases, more than one test sample was obtained for a specific compound (i.e., more than one sample was obtained for a given test run or more than one test run was conducted). When multiple samples were obtained for the same compound, a comparison was made of all the sample data collected. Based upon the results of the comparison, the following adjustments were made to the test data:

1. If all of the samples indicated that a compound was “not detected,” the sample data were not adjusted.
2. If all of the samples indicated that a compound was detected, the sample data were not adjusted.
3. If one or more of the samples indicated that a compound was detected and one or more of the samples indicated that a compound was not detected, the “not detected” values were replaced with a value equal to one half of the compound’s analytical detection limit. The assumption inherent to this adjustment was that the measured presence of a compound in one or more samples was indicative of the compound’s presence in all samples. The analytical detection limits for each sample were obtained from the test report.

#### 4.2 Determination of Background Concentration

For TSP, PM-10, PM-2.5, metals, HCl, Cl<sub>2</sub>, NH<sub>3</sub>, SVOC, dioxin/furan compounds, aldehydes and carbonyls, energetic materials, hydrogen cyanide, and perchlorate compounds, the background compound concentration (BC) was calculated by dividing the mass of compound detected during the background run (Bkgd mass) by the background run sample volume (Bkgd V). This calculation is illustrated by the following equation:

$$BC = \frac{Bkgd\ mass}{Bkgd\ V}$$

For VOC compounds, the background run data were used directly. Background data for CEMS-measured compounds were recorded for each test run between the time the CEMS began sampling and the time of detonation. The background concentrations were assumed to equal representative values over the sampling period.

#### 4.3 Determination of Test Compound Concentration

For TSP, PM-10, PM-2.5, metals, HCl, Cl<sub>2</sub>, NH<sub>3</sub>, SVOC, dioxin/furan compounds, aldehydes and carbonyls, energetic materials, hydrogen cyanide, and perchlorate compounds, the test compound concentration (TC) was calculated by dividing the mass of compound measured during the test run (Test mass) by the test run sample volume (Test V). This calculation is illustrated by the following equation:

$$TC = \frac{Test\ mass}{Test\ V}$$

For VOC compounds, the test run data were used directly. For CEMS-measured compounds, the test compound concentration was determined as the arithmetic mean of the test data collected from the initial steady-state point until the end of the test.

#### 4.4 Determination of Background-Corrected Concentration

For all compounds, the calculation of the background-corrected concentration (BCC) was dependent on whether the background (BC) and test (TC) concentrations were detected and whether they were less than, equal to, or greater than one another. The procedures used to calculate the background-corrected concentration for each sampling train and compound are described below and are displayed graphically in Figure 1.

1. If the test concentration was not detected (ND), the background-corrected concentration equaled ND.
2. If the test concentration was detected and the background concentration was not detected, the background-corrected concentration equaled the test concentration.
3. If the test and background concentrations were detected and the test concentration was less than or equal to the background concentration, the background-corrected concentration equaled 0.
4. If the test and background concentrations were detected and the test concentration was greater than the background concentration, the background concentration was subtracted from the test concentration. This calculation is illustrated by the following equation:

$$BCC = TC - BC$$

#### 4.5 Determination of Dilution-Corrected Concentration

The dilution-corrected concentration (DCC) was calculated by dividing the background-corrected concentration by the applicable dilution correction factor (DCF). This calculation is illustrated by the following equation:

$$DCC = \frac{BCC}{DCF}$$

#### 4.6 Determination of Mass of Compound Released

The mass of compound released was calculated by multiplying the dilution-corrected concentration by the volume of the test chamber. This calculation is illustrated by the following equation:

$$\text{Mass compound released} = DCC \times \text{Test chamber volume}$$

#### 4.7 Determination of Emission Factors

Once the mass of compound released was calculated, two emission factors were developed for each sample or sampling train and for each test run: the mass of compound released per item (i.e., per single ordnance) and the mass of compound released per pound NEW. The NEW for all ordnance were determined from References 1 and 4.

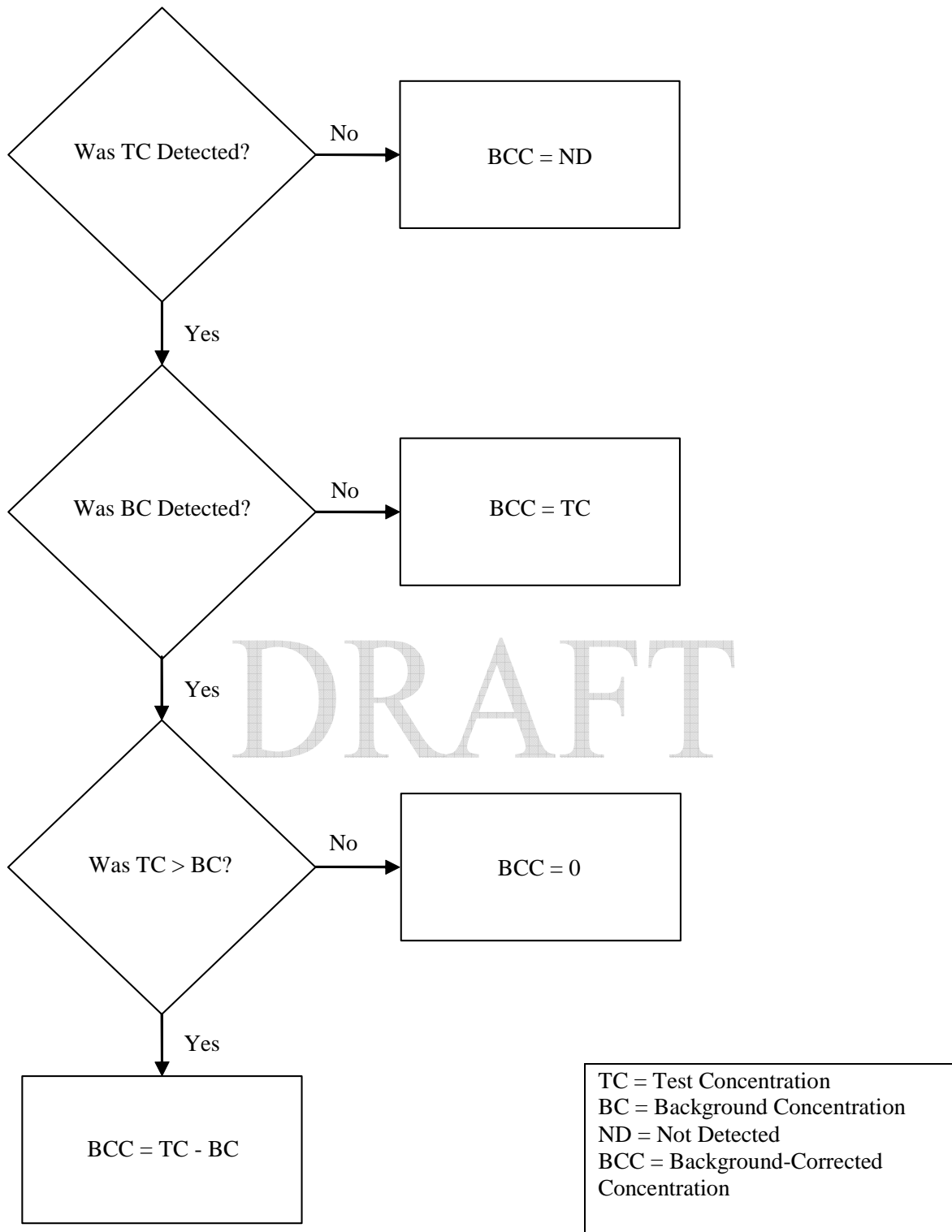


Figure 1 Calculation of background-corrected concentration (BCC).

#### 4.8 Determination of Average Emission Factors

Steps 1 through 7, as described in Sections 4.1 through 4.7, are applicable to individual samples or sampling trains within individual test runs. The final step in the emission factor calculation process was to calculate average emission factors for each compound in terms of mass released per item and mass released per pound NEW. The average emission factors for each compound were calculated as the arithmetic mean of the individual samples associated with the compound. If all samples indicated that the compound was not detected (ND), then the average emission factor was assigned a value of ND. [Note: The minimum detection levels associated with the compounds that were not detected are presented in Appendix A.] Total dioxin/furan emission factors were calculated by summing the average emission factors for all dioxin/furan compounds.

#### 4.9 Determination of Total Emission Factors for DODIC H708

Under the current test series, emissions generated by the use of the warhead associated with DODIC H708 were quantified.<sup>1</sup> However, as described in References 9 and 10, emissions generated by the use of the propelling rocket associated with DODIC H708 were previously quantified. Total emissions factors, in terms of pounds of emissions per item, were calculated by summing the emission factors for the use of the propelling rocket with the emission factors for the use of the warhead. Total emissions factors, in terms of pounds of emissions per pound NEW, were calculated by dividing the total emissions per item by the sum of the NEWs for the propelling rocket and the warhead. The emission factors developed for this test series are presented in Appendix A, along with the total emission factors developed for the ordnance.

### 5.0 EMISSION FACTOR RATINGS

The emission factors were appraised in accordance with the rating system specified in Reference 5. Under this rating system, emission factors are assigned a rating from A to E, where an “A” rating is assigned to the highest quality factors. The criteria used to assign a specific emission factor rating are summarized below.

- A** Excellent. The emission factor was developed primarily from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population was sufficiently specific to minimize variability.
- B** Above average. The emission factor was developed primarily from A- or B-rated test data from a moderate number of facilities. Although no specific bias was evident, it was not clear if the facilities tested represented a random sample of the industry. As with the “A” rating, the source category population was sufficiently specific to minimize variability.
- C** Average. The emission factor was developed primarily from A-, B- and/or C-rated test data from a reasonable number of facilities. Although no specific bias was evident, it was not clear if the facilities tested represented a random sample of the industry. As with the “A” rating, the source category population was sufficiently specific to minimize variability.
- D** Below average. The emission factor was developed primarily from A-, B-, and C-rated test data from a small number of facilities, and there may have been reason to suspect that these facilities did not represent a random sample of the industry. There also may have been evidence of variability within the source category population.
- E** Poor. The emission factor was developed from C- and D-rated test data from a very limited number of facilities, and there may have been reason to suspect that the facilities tested did not



represent a random sample of the industry. There also may have been evidence of variability within the source category population.

Two analyses were conducted to assign ratings to the ordnance emission factors. First, an analysis was conducted on an ordnance-specific basis. Second, an analysis was conducted using all available ordnance emission factor data. The second analysis was conducted to determine whether a sufficient correlation existed between emission factors for different but similar ordnance to allow the number of test data points to be increased to the point that higher emission factor ratings could be assigned than were possible when using the ordnance-specific approach. Both analyses are described below.

### **5.1 Emission Factor Ratings Assigned – Based on Ordnance-Specific Test Data**

As previously described, emission factor ratings are dependent upon the test data quality, the number of test data points, the amount of variability present within a source category population, and the randomness of the source category sample. The following test data facts pertain to these rating criteria:

1. As described in Section 3 of this Background Document, the ordnance test data was primarily rated A or B. The test data for a few compounds was rated C.
2. Two tests were conducted or two sampling trains were used per ordnance.
3. Ordnance are manufactured to very tight tolerance levels so there is little variability within a specific type of ordnance.
4. There was no evidence that suggested the tested items within each type of ordnance were specially selected.

Emission factor ratings were assigned based upon these facts. The rationale used to accept or reject specific emission factor ratings follow.

- A: Rejected. The number of test data points was deemed to be insufficient to assign an A emission factor rating.
- B: Rejected. The number of test data points was deemed to be insufficient to assign a B emission factor rating.
- C: Accepted for most ordnance. The emission factors were developed using A- and B-rated test data, there is little variability among items, and there was no evidence that suggested the tested items were specially selected. Because of the limited number of data points, a C rating was deemed appropriate for this set of circumstances.
- D: Accepted for some ordnance. The emission factors were developed using C-rated test data, there is little variability among items, and there was no evidence that suggested the tested items were specially selected. Because of the limited number of data points, a D rating was deemed appropriate for this set of circumstances.
- E: Rejected. The ordnance described in this report were developed primarily using A- and B-rated test data rather than C- or D-rated data, there is little variability among items, and there was no evidence that suggested the tested items were specially selected. Therefore, an E emission factor rating was deemed inappropriate.

### **5.2 Emission Factor Ratings Assigned – Based on All Available Test Data**

The proceeding sections of this Background Document concern the emission measurement methods, data analysis, and calculations used to develop emission factors for specific ordnance.

However, USAEC's ordnance emission factor development program includes more than 200 ordnance that have been tested under more than 25 separate test series. Because many of these ordnance are similar in size and/or chemical composition, a statistical analysis was conducted to assess the similarity of the emission factors developed for similar ordnance. The results of this analysis were used to reevaluate the emission factor ratings assigned on an ordnance-specific basis.

USAEC characterized individual ordnance as falling into one of 17 separate categories, depending upon the size and/or chemical composition of the ordnance. The ordnance and their respective categories are identified in Table 9 along with a comment field describing the number of data points.

Within each of the 17 ordnance categories identified by USAEC, emission factors for each compound were compared. To allow the comparison of emission factors for ordnance with similar constituents but significant differences in net explosive weight, the comparison was made using the normalized emission factor units of mass of compound released per pound NEW. Based upon information provided by EPA,<sup>11</sup> the following procedures were used to assess the data correlation:

1. The relative standard deviation, defined as the standard deviation divided by the mean, was calculated for each compound within each ordnance category.
2. If the relative standard deviation was less than 1.0, the evaluated emission factors were considered to demonstrate good correlation. As such, the rating for these emission factors could be elevated to a maximum of an A, depending on the number of data points within the evaluated ordnance category.
3. If the relative standard deviation was between 1.0 and 2.0, the evaluated emission factors were considered to demonstrate fair correlation. As such, the rating for these emission factors could be elevated to a maximum of a B, depending on the number of data points within the evaluated ordnance category.
4. If the relative standard deviation was greater than 2.0, the evaluated emission factors were considered to demonstrate poor correlation. As such, the emission factor rating could not be elevated, regardless of the amount of data available.

A poor correlation between emission factors was not necessarily construed as being indicative of poor test data. Rather, a poor correlation was more likely to indicate that the ordnance included in the category were not as similar in nature as anticipated by USAEC when the ordnance categories were defined.

In addition to assessing the data correlation, an assessment was made of the number of test data points available within each of the 17 ordnance categories. Because each ordnance test consisted of two test data points (i.e., two test runs per ordnance or two independent sampling trains were used during an ordnance test), the number of test data points available in each of the ordnance categories varied from 2 to 68. Based upon information provided by EPA,<sup>11</sup> the following assumptions were used to assess whether sufficient category-specific test data points were available to justify elevating the emission factor ratings based on ordnance-specific data only:

1. If 20 or more data points were available, the emission factor rating could be elevated to a maximum of an A, provided that the data also demonstrated a good correlation.
2. If at least 10 but less than 20 data points were available, the emission factor rating could be elevated to a maximum of a B, provided that the data also demonstrated a good correlation.
3. If less than 10 data points were available, the emission factor rating could not be elevated, regardless of the data correlation.

TABLE 9 ORDNANCE CATEGORIZATION FOR EMISSION FACTOR CORRELATION ASSESSMENT

Category	DODIC	Ordnance Description	Test Series	Comment
CS	G963	M7A3 CS Riot Control Agent Hand Grenade	DPG VI	<10 data points
	K765	CS Riot Control Agent Capsule	DPG VI	
Demolition	G900	TH3 AN-M14 Incendiary Hand Grenade	EO 5	20+ data points
	G911	MK3A2 Offensive Hand Grenade	EO 2	
	G911	MK3A2 Offensive Hand Grenade	EO 6	
	K010	M4 Field Incendiary Burster	EO 5	
	K145	M18A1 Antipersonnel Mine	EO 2	
	M023	M112 Demolition Block Charge	EO 1	
	M030	1/4-Pound Demolition Block Charge	EO 1	
	M030	1/4-Pound Demolition Block Charge	EO 3	
	M031	1/2-Pound Demolition Block Charge	DPG IV-A	
	M032	1-Pound Demolition Block Charge	EO 2	
	M032	1-Pound Demolition Block Charge	EO 3	
	M130	M6 Electric Blasting Cap	EO 7	
	M131	M7 Non-Electric Blasting Cap	EO 7	
	M241	M10 High Explosive Universal Destructor	DPG IV-B	
	M456	PETN Type 1 Detonating Cord	DPG IV-A	
	M500	M21 Cartridge Actuated Cutter	EO 10	
	M591	M1 Military Dynamite Demolition Block Charge	EO 1	
	M913	M58A3 Linear Demolition Charge	EO 3	
	ML05	MK24 Powder Actuated Cutter	EO 11	
	ML09	Linear Shaped Demolition Charge, 20 gr/ft	DPG IV-A	
	ML15	Linear Shaped Demolition Charge, 225 gr/ft	DPG IV-A	
	ML47	M11 Non-Electric Blasting Cap with 30-foot Shock Tube	EO 7	
	MM50	M221 Clipped Shaped Demolition Charge	EO 11	
MN02	M12 Non-Electric Blasting Cap with 500-foot Shock Tube	EO 7		
MN03	M13 Non-Electric Blasting Cap with 1,000-foot Shock Tube	EO 7		
MN06	M14 Non-Electric Time Delay Blasting Cap	EO 7		

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Demolition, continued	MN06	M14 Non-Electric Time Delay Blasting Cap	EO 7	20+ data points
	MN07	M15 Non-Electric Time Delay Blasting Cap	EO 11	
	MN08	M81 Time Blasting Fuse Igniter	EO 9	
	MN68	M151 Booster Demolition Charge	DPG VIII	
	None	PAX-11, Granular Powder Burn	EO 4	
	None	PAX-11, Molded Pellet Detonation	EO 4	
Fuse	G878	M228 Practice Hand Grenade Fuse	DPG VI	10+ data points
	K051	M604 Anti-Tank Practice Mine Fuse	EO 6	
	N278	M564 Mechanical Time and Super Quick (MTSQ) Fuse	EO 11	
	N285	M577A1 Mechanical Time and Super Quick (MTSQ) Fuse	EO 9	
	N286	M582 Mechanical Time and Super Quick (MTSQ) Fuse	EO 7	
	N335	M557 Point Detonating Fuse	EO 5	
	N340	M739A1 Point Detonating Fuse	EO 5	
	N464	M732 Proximity Fuse	EO 9	
Grenade	G881	M67 Fragmentation Hand Grenade	EO 1	<10 data points
	G978	M82 Simulant Screening Smoke Launcher Grenade	DPG V-B	
	G982	M83 Terephthalic Acid (TA) Smoke Practice Hand Grenade	DPG V-A	
	GG09 <sup>a</sup>	M84 Non-Lethal Stun Hand Grenade	EO 12	
Illumination	B535	M583A1 40-mm White Star Parachute Cartridge	DPG IV-B	20+ data points
	B536	M585 40-mm White Star Cluster Cartridge	DPG IV-B	
	B627	M83A3 60-mm Illuminating Cartridge (projectile only)	DPG V-B	
	D505	M485A2 155-mm Illumination Projectile (projectile only)	DPG I	
	L305	M195 Green Star Parachute Signal Flare	DPG I	
	L306	M158 Red Star Cluster Signal Flare	DPG II	
	L307	M159 White Star Cluster Signal Flare	DPG II	

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Illumination, continued	L311	M126A1 Red Star Parachute Signal Flare	DPG II	20+ data points
	L312	M127A1 White Star Parachute Signal Flare	DPG I	
	L314	M125A1 Green Star Cluster Signal Flare	DPG I	
	L367	M22 Anti-Tank Guided Missile and Rocket Launching Simulator	DPG VI	
	L410	M206 Aircraft Countermeasure Flare	DPG VI	
Inert	HA11 <sup>a</sup>	2.75-inch Rocket, MK40 Mod 3 Motor with M255A1 Flechette Warhead	Unclear	<10 data points
Large	C511	M490 105-mm Target Practice Tracer Cartridge (M13 tracer only)	EO 6	<10 data points
	C784 <sup>a</sup>	M831 120-mm Target Practice Tracer Cartridge	EO 12	
	C785 <sup>a</sup>	M865 120-mm Target Practice Discarding Sabot Tracer Cartridge	EO 12	
Medium	BA11 <sup>a</sup>	M1001 40-mm Canister Cartridge	EO 12	<10 data points
	BA15 <sup>a</sup>	M769 60-mm Full Range Practice Cartridge	EO 12	
Medium-FP	A652	M220 20-mm Target Practice Tracer Cartridge	FP 9	10+ data points
	A940	M910 25-mm Target Practice Discarding Sabot Tracer Cartridge	FP 8	
	A976	M793 25-mm Target Practice Tracer Cartridge	FP 8	
	B505	M662 40-mm Red Star Parachute Cartridge	DPG VIII	
	B519	M781 40-mm Practice Cartridge	FP 2	
	B584	M918 40-mm Practice Cartridge	FP 2	
Mine	K042	M88 Practice Canister Mine (Volcano)	DPG VIII	<10 data points
Mortar	CA03	XM929 120-mm White Phosphorus Smoke Cartridge (projectile only)	DPG V-B	<10 data points
Projectile	B129	M789 30-mm High Explosive Dual Purpose Cartridge (projectile only)	EO 9	20+ data points
	B542	M430 40-mm High Explosive Dual Purpose Cartridge (projectile only)	EO 3	
	B571	M383 40-mm High Explosive Cartridge (projectile only)	EO 3	

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Projectile, continued	B632	M49A4 60-mm High Explosive Cartridge (projectile only)	EO 3	20+ data points
	B642	M720 60-mm High Explosive Cartridge (projectile only)	EO 6	
	B643	M888 60-mm High Explosive Cartridge (projectile only)	EO 11	
	C995	M136 AT4 Recoilless Rifle, 84-mm Cartridge (projectile only)	EO 3	
	H557	M72A3 66-mm High Explosive Antitank Rocket (projectile only)	EO 1	
	H708	M73 35-mm Subcaliber Practice Rocket	DPG VIII	
	None	M720 60-mm Mortar HE Cartridge with PAX-21 Charge (projectile only)	EO 8	
	PJ02	FIM-92A Stinger-Basic Guided Missile (projectile only)	EO 6	
Propellant	B627	M83A3 60-mm Illuminating Cartridge (propelling charge only)	FP 10	20+ data points
	B642	M720 60-mm High Explosive Cartridge (propelling charge only)	FP 4	
	B645	M766 60-mm Short Range Practice Mortar Cartridge (propelling charge only)	FP 10	
	C226	M301A3 81-mm Illuminating Cartridge (propelling charge only)	FP 4	
	C379	M934 120-mm High Explosive Cartridge (Zone 1 - propelling charge only)	FP 8	
	C511	M490 105-mm Target Practice Tracer Cartridge (propelling charge only)	FP 5	
	C784	M831 120-mm Target Practice Tracer Cartridge (propelling charge only)	FP 5	
	C785	M865 120-mm Target Practice Discarding Sabot Tracer Cartridge (propelling charge only)	FP 5	
	C868	M821 81-mm High Explosive Cartridge (propelling charge only)	FP 4	
	C876	M880 81-mm Target Practice Short Range Cartridge (propelling charge only)	FP 4	
	CA09	M931 120-mm Full Range Practice Cartridge (Zone 1 - propelling charge only)	FP 8	

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Propellant, continued	CA09	M931 120-mm Full Range Practice Cartridge (Zone 4 - propelling charge)	FP 8	20+ data points
	D533	M119A2 155-mm Propelling Charge (Zone 7)	FP 5	
	D540	M3 155-mm Propelling Charge (Zone 3, M199 Cannon)	FP 1	
	D540	M3 155-mm Propelling Charge (Zone 3, M199 Cannon)	FP 5	
	D540	M3 155-mm Propelling Charge (Zone 3, M284 Cannon)	FP 1	
	D540	M3 155-mm Propelling Charge (Zone 5, M199 Cannon)	FP 1	
	D540	M3A1 155-mm Propelling Charge (Zone 3, M199 Cannon)	FP 1	
	D540	M3A1 155-mm Propelling Charge (Zone 3, M284 Cannon)	FP 1	
	D541	M4A2 155-mm Propelling Charge (Zone 7)	FP 5	
	M174	.50 Caliber Blank Cartridge (Electrically Initiated)	EO 10	
	M842 <sup>a</sup>	M1 Electric Flash Squib	Unclear	
	MD73	M796 Impulse Cartridge	EO 11	
	MN60	M79 Electric Match Igniter	EO 9	
	PJ02	FIM-92A Stinger-Basic Guided Missile (launch motor)	EO 5	
PJ02	FIM-92A Stinger-Basic Guided Missile (flight motor)	FP 7		
Pyrotechnic	H975 <sup>a</sup>	2.75-inch Rocket, MK66 Mod 3 Motor with M274 Smoke Signature Practice Warhead	Unclear	20+ data points
	L366	M74A1 Projectile Air Burst Simulator	DPG IV-B	
	L495	M49A1 Surface Trip Flare	DPG II	
	L508	M72 Red Railroad Warning Fusee	DPG VI	
	L592	TOW Blast Simulator	DPG V-A	
	L594	M115A2 Ground Burst Simulator	DPG I	
	L595 <sup>a</sup>	M9 Liquid Projectile Air Burst Simulator	EO 12	
	L596	M110 Flash Artillery Simulator	DPG I	
L598	M117 Flash Booby Trap Simulator	DPG I		

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Pyrotechnic, continued	L599	M118 Illuminating Booby Trap Simulator	DPG II	20+ data points
	L600	M119 Whistling Booby Trap Simulator	DPG II	
	L601	M116A1 Hand Grenade Simulator	DPG I	
	L602	M21 Artillery Flash Simulator	DPG IV-B	
	L709	M25 Target Hit Simulator	EO 2	
	L709	XM25 Target Hit Simulator	DPG V-B	
	L720	M26 Target Kill Simulator	EO 6	
	M327	Firing Device Coupling Base	EO 11	
	M448	M2A1 8-second Delay Percussion Detonator	EO 10	
	M626	M1 Pressure Type Demolition Firing Device	EO 9	
	M627 <sup>a</sup>	M5 Pressure Release Igniter	Unclear	
	M630	M1 Pull Type Demolition Firing Device	DPG V-A	
	M630	M1 Pull Type Demolition Firing Device	EO 9	
	M670	M700 Time Blasting Fuse	EO 11	
M766	M60 Time Blasting Fuse Igniter	EO 9		
ML03	M142 Multipurpose Demolition Firing Device	EO 10		
Rocket/Missile	H459	2.75-inch Rocket, MK40 Mod 3 Motor with Flechette Warhead (propelling rocket only)	FP 7	10+ data points
	H557	M72A3 66-mm High Explosive Antitank Rocket (propelling rocket only)	FP 4	
	H557	M72A3 66-mm High Explosive Antitank Rocket (propelling rocket only)	FP 7	
	H708	M73 35-mm Subcaliber Practice Rocket (motor only)	FP 9	
	H974	2.75-inch Rocket, MK66 Mod 3 Motor with M267 Practice Warhead (propelling rocket only)	FP 7	
Small Arm-FP	A010	M220 10 Gage Blank/Subcaliber Salute Cartridge	FP 9	20+ data points
	A011	12 Gage #00 Shot Cartridge	FP 9	
	A017	12 Gage #9 Shot Cartridge	FP 10	
	A059	M855 5.56-mm Ball Cartridge (fired from the M16A1 Rifle)	FP 3	



TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Small Arm-FP, continued	A059	M855 5.56-mm Ball Cartridge (fired from the M16A2 Rifle)	FP 3	20+ data points
	A059	M855 5.56-mm Ball Cartridge (No-Lead)	FP 4	
	A063	M856 5.56-mm Tracer Cartridge	FP 3	
	A065	M862 5.56-mm Practice Ball Cartridge	FP 3	
	A066	M193 5.56-mm Ball Cartridge	FP 6	
	A068	M196 5.56-mm Tracer Cartridge	FP 6	
	A080	M200 5.56-mm Blank Cartridge	FP 3	
	A086	.22 Caliber Long Rifle Ball Cartridge	FP 4	
	A106	.22 Caliber Standard Velocity Long Rifle Ball Cartridge	FP 4	
	A111	M82 7.62-mm Blank Cartridge	FP 3	
	A131	M62 7.62-mm Tracer Cartridge	FP 6	
	A136	M118 7.62-mm Ball Match Cartridge	FP 6	
	A143	M80 7.62-mm Ball Cartridge	FP 3	
	A171	M852 7.62-mm Ball Match Cartridge	FP 6	
	A182	M1 .30 Caliber Ball Cartridge	FP 6	
	A212	M2 .30 Caliber Ball Cartridge	FP 6	
	A218	M25 .30 Caliber Tracer Cartridge	FP 9	
	A247	M72 .30 Caliber Ball Match Cartridge	FP 6	
	A363	M882 9-mm Ball Cartridge	FP 3	
	A365	M181A1 14.5-mm Artillery Training Cartridge	DPG V-A	
	A366 <sup>a</sup>	M182 14.5-mm Artillery Training Cartridge	Unclear	
	A400	M41 .38 Caliber Special Ball Cartridge	FP 9	
	A403	.38 Caliber Special Blank Cartridge	FP 9	
	A475	M1911 .45 Caliber Ball Cartridge	FP 3	
	A518	M903 .50 Caliber SLAP Cartridge	FP 9	
	A518	M962 .50 Caliber SLAP-T Cartridge	FP 10	
	A525	M2 .50 Caliber Armor Piercing Cartridge	FP 8	
	A557	M17 .50 Caliber Tracer Cartridge	FP 3	
	A557	M33 .50 Caliber Ball Cartridge	FP 3	
	A598	M1A1 .50 Caliber Blank Cartridge	FP 3	

TABLE 9 (cont.)

Category	DODIC	Ordnance Description	Test Series	Comment
Smoke	C870	M819 81-mm Red Phosphorus Smoke Cartridge	DPG VII	20+ data points
	G815	L8A3 Red Phosphorus Screening Smoke Launcher Grenade (UK)	DPG VII	
	G930	AN-M8 Hexachloroethane (HC) Smoke Hand Grenade	DPG V-A	
	G940	M18 Green Smoke Hand Grenade	DPG III	
	G945	M18 Yellow Smoke Hand Grenade	DPG III	
	G950	M18 Red Smoke Hand Grenade	DPG III	
	G950	M18 Red Smoke Hand Grenade (new formulation)	DPG V-A	
	G955	M18 Violet Smoke Hand Grenade	DPG III	
	G955	M18 Violet Smoke Hand Grenade (new formulation)	DPG V-A	
	K866	ABC-M5 30-pound HC Smoke Pot	DPG VII	
K867	M4A2 Floating Type HC Smoke Pot	DPG VII		

<sup>a</sup> Although testing may have been completed, emission factors for this ordnance have not yet been analyzed for inclusion in AP-42; therefore, these data were not included in the data correlation.

4. If the data demonstrated a fair correlation and 20 or more data points were available, the emission factor rating could be elevated to a maximum of a B.
5. If the data demonstrated a fair correlation and at least 10 but less than 20 data points were available, the emission factor rating could be elevated to a maximum of a C.

Using the criteria specified above, the emission factor ratings assigned to ordnance in each of the 17 ordnance categories were reevaluated. This evaluation indicated that some of the emission factor ratings associated with ordnance included in ten categories could be elevated from a C or D rating to an A or B rating. These ten categories are:

1. Demolition
2. Fuse
3. Illumination
4. Medium – Firing Point
5. Projectile
6. Propellant
7. Pyrotechnic
8. Rocket/Missile
9. Small Arm – Firing Point
10. Smoke

A final assessment was made as to the emission factor rating assigned based on ordnance-specific test data only. If the original emission factor data rating assigned was a C, then the emission factor rating was elevated to an A or B, as appropriate, based upon the data for the whole ordnance category. If the

original emission factor data rating assigned was a D, then the emission factor rating was elevated to a B or C, as appropriate, based upon the data for the whole ordnance category. The analysis is documented in an Excel spreadsheet that is located on the EPA website at: <http://www.epa.gov/ttn/chief/ap42/index.html>.

Within the current test series:

- DODIC B505 was included in the Medium FP category, which includes more than 10 data points
- DODIC H708 was included in the Projectile category, which includes more than 20 data points
- DODIC K042 was included in the Mine category, which includes less than 10 test data points
- DODIC MN68 was included in the Demolition category, which includes more than 20 test data points

As a result, some emission factor ratings associated with DODICs B505, H708, and MN68 were elevated, while none of the emission factor ratings associated with DODIC K042 were elevated. The emission factor ratings assigned are presented in Appendix A.

## 6.0 REFERENCES

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8. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, U.S. Environmental Protection Agency, <http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm>.
9. *Report No. 9 for the Firing Point Emission Study, Phase II*, Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, May 2005.

10. *Background Document, Report on Revisions to 5<sup>th</sup> Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Firing Point Emission Study Phase II Series 9 Testing Conducted at Aberdeen Proving Ground, Maryland, MACTEC Federal Programs, Inc., Research Triangle Park, NC, November 2007.*
11. Information regarding the relationship between emission factor data correlation, the number of data points available, and the resulting emission factor rating assigned supplied upon request by Mr. Ron Myers, Measurement Policy Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 2006.

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**APPENDIX A**

**COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR ORDNANCE  
INCLUDED IN PHASE VIII TESTING AT DUGWAY PROVING GROUND, UTAH**

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TABLE A1 COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR  
DODIC B505, M662 40-MM RED STAR PARACHUTE CARTRIDGE

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
Carbon Dioxide, Criteria Pollutants, Total Nonmethane Hydrocarbons, and Total Suspended Particulates				
124-38-9	Carbon dioxide <sup>f</sup>	4.7 E-02	2.5 E-01	--
630-08-0	Carbon monoxide <sup>f</sup>	2.2 E-03	1.2 E-02	--
7439-92-1	Lead	1.6 E-05	8.7 E-05	--
--	Oxides of nitrogen	3.1 E-04	1.6 E-03	--
--	PM-2.5 <sup>f</sup>	8.2 E-03	4.3 E-02	--
--	PM-10 <sup>f</sup>	9.9 E-03	5.2 E-02	--
7446-09-5	Sulfur dioxide <sup>g</sup>	1.5 E-04	7.8 E-04	--
--	Total nonmethane hydrocarbons <sup>g</sup>	1.5 E-05	7.9 E-05	--
12789-66-1	Total suspended particulate <sup>f</sup>	1.2 E-02	6.6 E-02	--
Hazardous Air Pollutants and Toxic Chemicals				
83-32-9	Acenaphthene	ND	ND	1.6 E-03
208-96-8	Acenaphthylene	9.4 E-08	5.0 E-07	--
75-07-0	Acetaldehyde <sup>f</sup>	3.3 E-06	1.7 E-05	--
75-05-8	Acetonitrile <sup>f</sup>	ND	ND	1.3 E-02
98-86-2	Acetophenone	ND	ND	7.7 E-03
53-96-3	2-Acetylaminofluorene	ND	ND	1.6 E-03
107-02-8	Acrolein	2.0 E-07	1.0 E-06	--
107-13-1	Acrylonitrile	ND	ND	6.6 E-03
107-05-1	Allyl chloride	ND	ND	9.6 E-03
92-67-1	4-Aminobiphenyl	ND	ND	3.2 E-02
7664-41-7	Ammonia	1.3 E-06	6.7 E-06	--
62-53-3	Aniline	ND	ND	2.4 E-02
120-12-7	Anthracene <sup>f</sup>	ND	ND	1.6 E-03
71-43-2	Benzene <sup>g</sup>	0	0	--
92-87-5	Benzidine	ND	ND	1.6 E-01
56-55-3	Benzo[a]anthracene	ND	ND	1.9 E-03
205-99-2	Benzo[b]fluoranthene	ND	ND	3.5 E-03
207-08-9	Benzo[k]fluoranthene	ND	ND	2.0 E-03
191-24-2	Benzo[g,h,i]perylene	ND	ND	5.2 E-03
50-32-8	Benzo[a]pyrene	ND	ND	1.6 E-03
100-44-7	Benzyl chloride	ND	ND	3.9 E-03
75-25-2	Bromoform	ND	ND	7.8 E-03

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
74-83-9	Bromomethane	ND	ND	2.9 E-03
101-55-3	4-Bromophenylphenylether	ND	ND	1.6 E-03
106-99-0	1,3-Butadiene	ND	ND	1.7 E-03
71-36-3	n-Butanol	ND	ND	9.2 E-03
85-68-7	Butylbenzylphthalate	ND	ND	2.0 E-03
123-72-8	Butyraldehyde	ND	ND	2.2 E-02
7440-43-9	Cadmium	9.9 E-07	5.3 E-06	--
86-74-8	Carbazole	ND	ND	2.1 E-03
75-15-0	Carbon disulfide	ND	ND	2.3 E-03
56-23-5	Carbon tetrachloride	ND	ND	4.7 E-03
106-47-8	4-Chloroaniline	ND	ND	1.9 E-02
108-90-7	Chlorobenzene	ND	ND	3.5 E-03
75-00-3	Chloroethane	ND	ND	2.0 E-03
111-91-1	bis(2-Chloroethoxy)methane	ND	ND	1.6 E-03
111-44-4	bis(2-Chloroethyl)ether	ND	ND	1.8 E-03
67-66-3	Chloroform	ND	ND	3.7 E-03
108-60-1	bis(2-Chloroisopropyl)ether	ND	ND	2.5 E-03
74-87-3	Chloromethane	ND	ND	6.3 E-03
91-58-7	2-Chloronaphthalene	ND	ND	1.6 E-03
7005-72-3	4-Chlorophenylphenyl ether	ND	ND	1.6 E-03
108-39-4 / 106-44-5	m-Cresol/p-Cresol	ND	ND	6.5 E-03
7440-47-3	Chromium	5.4 E-07	2.9 E-06	--
218-01-9	Chrysene	ND	ND	2.1 E-03
7440-48-4	Cobalt	ND	ND	1.8 E-03
7440-50-8	Copper	7.2 E-06	3.8 E-05	--
4170-30-3	Crotonaldehyde	ND	ND	6.3 E-02
98-82-8	Cumene	ND	ND	3.7 E-03
110-82-7	Cyclohexane	0	0	--
53-70-3	Dibenz[a,h]anthracene	ND	ND	1.9 E-03
132-64-9	Dibenzofuran	ND	ND	1.6 E-03
106-93-4	1,2-Dibromoethane	ND	ND	5.8 E-03
84-74-2	Dibutylphthalate	ND	ND	3.2 E-02
95-50-1	1,2-Dichlorobenzene	ND	ND	4.5 E-03
541-73-1	1,3-Dichlorobenzene	ND	ND	4.5 E-03



TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
106-46-7	1,4-Dichlorobenzene	ND	ND	4.5 E-03
91-94-1	3,3'-Dichlorobenzidine	ND	ND	2.4 E-02
75-27-4	Dichlororobromomethane	ND	ND	5.0 E-03
75-71-8	Dichlorodifluoromethane	ND	ND	3.7 E-03
75-34-3	1,1-Dichloroethane	ND	ND	3.0 E-03
107-06-2	1,2-Dichloroethane	ND	ND	3.0 E-03
120-83-2	2,4-Dichlorophenol	ND	ND	1.6 E-03
78-87-5	1,2-Dichloropropane	ND	ND	3.5 E-03
10061-02-6	trans-1,3-Dichloro-1-propene	ND	ND	3.4 E-03
76-14-2	Dichlorotetrafluoroethane	ND	ND	5.3 E-03
60-11-7	p-Dimethylaminoazobenzene	ND	ND	1.6 E-03
57-97-6	7,12-Dimethylbenz[a]anthracene	ND	ND	1.6 E-03
119-93-7	3,3'-Dimethylbenzidine	ND	ND	1.6 E-01
105-67-9	2,4-Dimethylphenol	ND	ND	2.0 E-02
131-11-3	Dimethyl phthalate	ND	ND	1.6 E-03
99-65-0	1,3-Dinitrobenzene	ND	ND	7.8 E-03
534-52-1	4,6-Dinitro-o-cresol	ND	ND	2.8 E-02
51-28-5	2,4-Dinitrophenol	ND	ND	7.1 E-02
121-14-2	2,4-Dinitrotoluene	ND	ND	7.7 E-03
606-20-2	2,6-Dinitrotoluene	ND	ND	1.4 E-03
88-85-7	Dinoseb	ND	ND	3.2 E-03
123-91-1	1,4-Dioxane	ND	ND	1.1 E-02
--	Total dioxin/furan compounds	1.1 E-10	6.0 E-10	--
122-39-4	Diphenylamine	ND	ND	1.6 E-03
122-66-7	1,2-Diphenylhydrazine	ND	ND	1.6 E-03
100-41-4	Ethylbenzene	0	0	--
74-85-1	Ethylene	ND	ND	8.6 E-03
117-81-7	bis(2-Ethylhexyl)phthalate	ND	ND	3.2 E-02
206-44-0	Fluoranthene	ND	ND	1.7 E-03
86-73-7	Fluorene <sup>f</sup>	ND	ND	1.6 E-03
50-00-0	Formaldehyde	1.1 E-06	6.0 E-06	--
76-13-1	Freon 113	ND	ND	5.8 E-03
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin <sup>g</sup>	1.2 E-11	6.3 E-11	--

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	6.6 E-12	3.5 E-11	--
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ND	ND	9.7 E-09
118-74-1	Hexachlorobenzene	ND	ND	1.6 E-03
87-68-3	Hexachlorobutadiene	ND	ND	3.3 E-02
77-47-4	Hexachlorocyclopentadiene	ND	ND	3.2 E-02
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ND	ND	6.5 E-09
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin <sup>g</sup>	7.3 E-12	3.9 E-11	--
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	2.5 E-13	1.3 E-12	--
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	8.4 E-13	4.5 E-12	--
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran <sup>g</sup>	6.7 E-12	3.5 E-11	--
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	ND	ND	6.5 E-09
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran <sup>g</sup>	4.8 E-13	2.6 E-12	--
67-72-1	Hexachloroethane	ND	ND	1.7 E-03
110-54-3	Hexane <sup>g</sup>	0	0	--
7647-01-0	Hydrochloric acid	ND	ND	5.8 E-02
74-90-8	Hydrogen cyanide <sup>f</sup>	0	0	--
193-39-5	Indeno[1,2,3-cd]pyrene	ND	ND	1.7 E-03
78-59-1	Isophorone	ND	ND	1.6 E-03
67-63-0	Isopropyl alcohol	ND	ND	7.5 E-03
120-58-1	Isosafrole	ND	ND	1.6 E-03
7439-92-1	Lead	1.6 E-05	8.7 E-05	6.5 E-03
7439-97-6	Mercury	6.3 E-08	3.4 E-07	--
126-98-7	Methacrylonitrile	ND	ND	8.4 E-03
96-33-3	Methyl acrylate	ND	ND	1.1 E-02
56-49-5	3-Methylcholanthrene	ND	ND	1.6 E-03
75-09-2	Methylene chloride <sup>g</sup>	1.4 E-06	7.5 E-06	--
108-10-1	Methyl isobutyl ketone	ND	ND	3.1 E-03
80-62-6	Methyl methacrylate	ND	ND	1.2 E-02
91-57-6	2-Methylnaphthalene	ND	ND	1.6 E-03
95-48-7	2-Methylphenol	ND	ND	9.7 E-03
1634-04-4	Methyl tert-butyl ether	ND	ND	2.7 E-03

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
91-20-3	Naphthalene	6.3 E-07	3.3 E-06	--
134-32-7	1-Naphthylamine	ND	ND	3.2 E-02
91-59-8	2-Naphthylamine	ND	ND	3.2 E-02
100-01-6	4-Nitroaniline	ND	ND	6.5 E-03
98-95-3	Nitrobenzene	ND	ND	8.7 E-03
55-63-0	Nitroglycerin	ND	ND	1.4 E-02
88-75-5	2-Nitrophenol	ND	ND	1.6 E-03
100-02-7	4-Nitrophenol	ND	ND	1.1 E-02
79-46-9	2-Nitropropane	ND	ND	1.1 E-02
924-16-3	N-Nitroso-di-n-butylamine	ND	ND	1.6 E-03
55-18-5	N-Nitrosodiethylamine	ND	ND	1.6 E-03
62-75-9	N-Nitrosodimethylamine	ND	ND	1.6 E-03
86-30-6	N-Nitrosodiphenylamine	ND	ND	2.8 E-03
621-64-7	N-Nitroso-di-n-propylamine	ND	ND	1.6 E-03
59-89-2	N-Nitrosomorpholine	ND	ND	1.6 E-03
100-75-4	N-Nitrosopiperidine	ND	ND	1.6 E-03
99-55-8	5-Nitro-o-toluidine	ND	ND	2.6 E-02
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	3.5 E-11	1.9 E-10	--
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran <sup>g</sup>	2.2 E-11	1.2 E-10	--
608-93-5	Pentachlorobenzene	ND	ND	1.6 E-03
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin <sup>g</sup>	9.3 E-12	5.0 E-11	--
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran <sup>g</sup>	8.2 E-12	4.4 E-11	--
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	ND	ND	6.1 E-09
76-01-7	Pentachloroethane	ND	ND	1.6 E-03
82-68-8	Pentachloronitrobenzene	ND	ND	1.6 E-03
87-86-5	Pentachlorophenol	ND	ND	8.1 E-02
85-01-8	Phenanthrene	ND	ND	1.6 E-03
108-95-2	Phenol	4.8 E-07	2.6 E-06	--
123-38-6	Propionaldehyde	ND	ND	6.3 E-02
115-07-1	Propylene	ND	ND	1.3 E-02
129-00-0	Pyrene <sup>f</sup>	ND	ND	1.7 E-03
110-86-1	Pyridine <sup>g</sup>	7.7 E-08	4.1 E-07	--
94-59-7	Safrole	ND	ND	1.6 E-03

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
7440-22-4	Silver	ND	ND	3.5 E-03
100-42-5	Styrene	ND	ND	3.2 E-03
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin <sup>g</sup>	4.0 E-12	2.1 E-11	--
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran <sup>g</sup>	1.5 E-12	7.8 E-12	--
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	5.2 E-03
127-18-4	Tetrachloroethylene	ND	ND	5.1 E-03
7440-28-0	Thallium	ND	ND	1.3 E-02
108-88-3	Toluene <sup>g</sup>	2.9 E-06	1.5 E-05	--
95-53-4	o-Toluidine	ND	ND	2.1 E-02
120-82-1	1,2,4-Trichlorobenzene	ND	ND	2.3 E-02
71-55-6	1,1,1-Trichloroethane	ND	ND	4.1 E-03
79-00-5	1,1,2-Trichloroethane	ND	ND	4.1 E-03
79-01-6	Trichloroethylene	ND	ND	4.0 E-03
75-69-4	Trichlorofluoromethane <sup>f</sup>	ND	ND	4.2 E-03
95-95-4	2,4,5-Trichlorophenol	ND	ND	4.2 E-03
88-06-2	2,4,6-Trichlorophenol	ND	ND	2.4 E-03
96-18-4	1,2,3-Trichloropropane	ND	ND	1.8 E-02
95-63-6	1,2,4-Trimethylbenzene <sup>g</sup>	0	0	--
540-84-1	2,2,4-Trimethylpentane	ND	ND	1.4 E-02
108-05-4	Vinyl acetate	ND	ND	1.1 E-02
75-01-4	Vinyl chloride	ND	ND	1.1 E-02
75-35-4	Vinylidene chloride	ND	ND	3.0 E-03
106-42-3, 108-38-3	m-Xylene, p-Xylene <sup>g</sup>	0	0	--
95-47-6	o-Xylene <sup>g</sup>	0	0	--
7440-66-6	Zinc <sup>g</sup>	8.9 E-06	4.7 E-05	--
Other Pollutants				
67-64-1	Acetone	6.3 E-06	3.4 E-05	--
74-86-2	Acetylene	ND	ND	8.0 E-03
35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	9.3 E-04
19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	9.0 E-04
100-52-7	Benzaldehyde	ND	ND	6.3 E-02
65-85-0	Benzoic acid	ND	ND	1.5 E-01
100-51-6	Benzyl alcohol	ND	ND	1.1 E-01

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
106-97-8	n-Butane	ND	ND	1.8 E-02
106-98-9	1-Butene	ND	ND	7.0 E-03
590-18-1	cis-2-Butene	ND	ND	7.0 E-03
624-64-6	trans-2-Butene	ND	ND	7.0 E-03
107-14-2	Chloroacetonitrile	ND	ND	2.3 E-02
2698-41-1	o-chlorobenzalmalononitrile	ND	ND	3.2 E-03
109-69-3	1-Chlorobutane	ND	ND	2.8 E-02
59-50-7	4-Chloro-3-methylphenol	ND	ND	2.0 E-03
90-13-1	1-Chloronaphthalene	ND	ND	1.6 E-03
95-57-8	2-Chlorophenol	ND	ND	1.6 E-03
287-92-3	Cyclopentane	ND	ND	8.7 E-03
120-92-3	Cyclopentanone <sup>h</sup>	5.8 E-07	3.1 E-06	--
124-18-5	n-Decane	ND	ND	1.8 E-02
124-48-1	Dibromochloromethane	ND	ND	6.4 E-03
156-59-2	cis-1,2-Dichloroethene	ND	ND	3.0 E-03
156-60-5	trans-1,2-Dichloroethene	ND	ND	3.4 E-03
87-65-0	2,6-Dichlorophenol	ND	ND	1.6 E-03
10061-01-5	cis-1,3-Dichloropropene	ND	ND	3.4 E-03
141-93-5	1,3-Diethylbenzene	ND	ND	1.7 E-02
105-05-5	1,4-Diethylbenzene	ND	ND	1.7 E-02
84-66-2	Diethylphthalate	ND	ND	2.4 E-03
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	1.3 E-01
75-83-2	2,2-Dimethylbutane	ND	ND	1.1 E-02
79-29-8	2,3-Dimethylbutane	ND	ND	1.1 E-02
565-59-3	2,3-Dimethylpentane	ND	ND	1.2 E-02
108-08-7	2,4-Dimethylpentane	ND	ND	1.2 E-02
117-84-0	Di-n-octylphthalate	ND	ND	1.8 E-03
624-92-0	Disulfide, dimethyl <sup>h</sup>	3.3 E-06	1.8 E-05	--
74-84-0	Ethane	ND	ND	9.2 E-03
64-17-5	Ethanol <sup>g</sup>	0	0	--
60-29-7	Ethyl ether	ND	ND	9.3 E-03
97-63-2	Ethyl methacrylate	ND	ND	3.5 E-02
62-50-0	Ethyl methanesulfonate	ND	ND	1.6 E-03
620-14-4	m-Ethyltoluene	ND	ND	1.5 E-02
611-14-3	o-Ethyltoluene	ND	ND	1.5 E-02

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
622-96-8	p-Ethyltoluene	ND	ND	1.5 E-02
142-82-5	n-Heptane <sup>g</sup>	0	0	--
1888-71-7	Hexachloropropene	ND	ND	2.3 E-03
66-25-1	Hexaldehyde	ND	ND	6.3 E-02
591-78-6	2-Hexanone	ND	ND	1.2 E-02
592-41-6	1-Hexene	ND	ND	1.0 E-02
2691-41-0	HMX	ND	ND	3.8 E-02
75-28-5	Isobutane <sup>g</sup>	7.5 E-08	4.0 E-07	--
78-79-5	Isoprene	ND	ND	8.5 E-03
590-86-3	Isovaleraldehyde	ND	ND	6.3 E-02
5989-27-5	d-Limonene	ND	ND	1.7 E-02
7439-95-4	Magnesium	4.3 E-03	2.3 E-02	--
108-87-2	Methylcyclohexane	ND	ND	1.2 E-02
96-37-7	Methylcyclopentane	0	0	--
78-93-3	Methyl ethyl ketone <sup>g</sup>	0	0	--
592-27-8	2-Methylheptane	ND	ND	1.4 E-02
589-81-1	3-Methylheptane	ND	ND	1.4 E-02
591-76-4	2-Methylhexane	ND	ND	1.2 E-02
589-34-4	3-Methylhexane	0	0	--
66-27-3	Methyl methanesulfonate	ND	ND	1.8 E-03
107-83-5	2-Methylpentane <sup>g</sup>	0	0	--
96-14-0	3-Methylpentane	ND	ND	1.1 E-02
88-74-4	2-Nitroaniline	ND	ND	1.6 E-03
99-09-2	3-Nitroaniline	ND	ND	6.5 E-03
10595-95-6	N-Nitrosomethylethylamine	ND	ND	2.7 E-03
930-55-2	N-Nitrosopyrrolidine	ND	ND	1.6 E-03
88-72-2	2-Nitrotoluene	ND	ND	5.1 E-02
99-99-0	4-Nitrotoluene	ND	ND	1.5 E-02
111-84-2	n-Nonane	ND	ND	1.6 E-02
111-65-9	n-Octane	ND	ND	1.4 E-02
78-78-4	i-Pentane	0	0	--
109-66-0	n-Pentane <sup>g</sup>	0	0	--
109-67-1	1-Pentene	ND	ND	8.7 E-03
627-20-3	cis-2-Pentene	ND	ND	8.7 E-03
646-04-8	trans-2-Pentene	ND	ND	8.7 E-03

TABLE A1 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
14797-73-0	Perchlorate	1.2 E-07	6.6 E-07	--
78-11-5	PETN	ND	ND	1.0 E-02
62-44-2	Phenacetin	ND	ND	1.6 E-03
2769-94-0	Phenol, 2,4-bis(1-phenylethyl)- <sup>h</sup>	7.3 E-07	3.9 E-06	--
80-56-8	alpha-Pinene	ND	ND	1.7 E-02
127-91-3	beta-Pinene	ND	ND	1.7 E-02
74-98-6	Propane	ND	ND	1.4 E-02
103-65-1	n-Propylbenzene	ND	ND	3.7 E-03
121-82-4	RDX	ND	ND	8.3 E-04
95-94-3	1,2,4,5-Tetrachlorobenzene	ND	ND	1.6 E-03
58-90-2	2,3,4,6-Tetrachlorophenol	ND	ND	2.1 E-03
109-99-9	Tetrahydrofuran <sup>g</sup>	0	0	--
479-45-8	Tetryl	ND	ND	2.8 E-03
620-23-5 / 104-87-0	m,p-Tolualdehyde	ND	ND	6.3 E-02
529-20-4	o-Tolualdehyde	ND	ND	6.3 E-02
526-73-8	1,2,3-Trimethylbenzene	ND	ND	1.5 E-02
108-67-8	1,3,5-Trimethylbenzene	0	0	--
565-75-3	2,3,4-Trimethylpentane	ND	ND	1.4 E-02
99-35-4	1,3,5-Trinitrobenzene	ND	ND	1.5 E-03
118-96-7	2,4,6-Trinitrotoluene	ND	ND	1.2 E-03
1120-21-4	Undecane	ND	ND	2.0 E-02
110-62-3	Valeraldehyde	ND	ND	6.3 E-02

<sup>a</sup> CASRN = Chemical Abstracts Service Registry Number.

<sup>b</sup> ND = nondetected.

<sup>c</sup> Emission factors rated C unless otherwise noted.

<sup>d</sup> NEW = Net explosive weight. The NEW for this compound is 1.88 E-01 pounds per item.

<sup>e</sup> Data provided for compounds that were not detected.

<sup>f</sup> Emission factor rated B because of correlation with emission factors for similar ordnance and number of test data points.

<sup>g</sup> Emission factor rated D because the factor is based upon C-rated test data.

<sup>h</sup> Emission factor rated D because the factor is for a tentatively identified compound.

TABLE A2 COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR DODIC H708, M73 35-MM SUBCALIBER PRACTICE ROCKET (WARHEAD ONLY)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
Carbon Dioxide, Criteria Pollutants, Total Nonmethane Hydrocarbons, and Total Suspended Particulates				
124-38-9	Carbon dioxide <sup>f</sup>	7.3 E-06	2.3 E-03	--
630-08-0	Carbon monoxide <sup>f</sup>	0	0	--
7439-92-1	Lead <sup>f</sup>	0	0	--
--	Oxides of nitrogen <sup>f</sup>	4.0 E-06	1.3 E-03	--
--	PM-2.5 <sup>f</sup>	5.3 E-04	1.7 E-01	--
--	PM-10 <sup>f</sup>	5.5 E-04	1.7 E-01	--
7446-09-5	Sulfur dioxide	2.5 E-04	7.8 E-02	--
--	Total nonmethane hydrocarbons	2.1 E-06	6.6 E-04	--
12789-66-1	Total suspended particulate <sup>f</sup>	5.5 E-04	1.7 E-01	--
Hazardous Air Pollutants and Toxic Chemicals				
83-32-9	Acenaphthene <sup>g</sup>	ND	ND	8.6 E-04
208-96-8	Acenaphthylene <sup>f</sup>	ND	ND	8.6 E-04
75-07-0	Acetaldehyde <sup>g</sup>	ND	ND	2.0 E-02
75-05-8	Acetonitrile <sup>g</sup>	ND	ND	1.4 E-02
98-86-2	Acetophenone	ND	ND	4.1 E-03
53-96-3	2-Acetylaminofluorene	ND	ND	8.6 E-04
107-02-8	Acrolein	ND	ND	7.5 E-03
107-13-1	Acrylonitrile <sup>g</sup>	ND	ND	7.1 E-03
107-05-1	Allyl chloride	ND	ND	1.0 E-02
92-67-1	4-Aminobiphenyl	ND	ND	1.7 E-02
7664-41-7	Ammonia <sup>h</sup>	0	0	--
62-53-3	Aniline	ND	ND	1.3 E-02
120-12-7	Anthracene	ND	ND	8.6 E-04
7440-36-0	Antimony	2.7 E-05	8.6 E-03	--
71-43-2	Benzene <sup>g</sup>	4.5 E-08	1.4 E-05	--
92-87-5	Benzidine	ND	ND	8.8 E-02
56-55-3	Benzo[a]anthracene <sup>g</sup>	ND	ND	1.0 E-03
205-99-2	Benzo[b]fluoranthene <sup>g</sup>	ND	ND	1.9 E-03
207-08-9	Benzo[k]fluoranthene <sup>g</sup>	ND	ND	1.1 E-03
191-24-2	Benzo[g,h,i]perylene <sup>g</sup>	ND	ND	2.8 E-03
50-32-8	Benzo[a]pyrene <sup>g</sup>	ND	ND	8.6 E-04
100-44-7	Benzyl chloride	ND	ND	4.2 E-03



TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
75-25-2	Bromoform	ND	ND	8.4 E-03
74-83-9	Bromomethane	ND	ND	3.2 E-03
101-55-3	4-Bromophenylphenylether	ND	ND	8.6 E-04
106-99-0	1,3-Butadiene	ND	ND	1.8 E-03
71-36-3	n-Butanol	ND	ND	9.9 E-03
85-68-7	Butylbenzylphthalate	ND	ND	1.1 E-03
123-72-8	Butyraldehyde	ND	ND	2.4 E-02
7440-43-9	Cadmium <sup>i</sup>	8.4 E-09	2.6 E-06	--
86-74-8	Carbazole	ND	ND	1.1 E-03
75-15-0	Carbon disulfide	ND	ND	2.5 E-03
56-23-5	Carbon tetrachloride	ND	ND	5.1 E-03
106-47-8	4-Chloroaniline	ND	ND	1.0 E-02
108-90-7	Chlorobenzene	ND	ND	3.8 E-03
75-00-3	Chloroethane	ND	ND	2.1 E-03
111-91-1	bis(2-Chloroethoxy)methane	ND	ND	8.6 E-04
111-44-4	bis(2-Chloroethyl)ether	ND	ND	9.7 E-04
67-66-3	Chloroform	ND	ND	4.0 E-03
108-60-1	bis(2-Chloroisopropyl)ether	ND	ND	1.3 E-03
74-87-3	Chloromethane	ND	ND	6.7 E-03
91-58-7	2-Chloronaphthalene	ND	ND	8.6 E-04
7005-72-3	4-Chlorophenylphenyl ether	ND	ND	8.6 E-04
108-39-4 / 106-44-5	m-Cresol/p-Cresol	ND	ND	3.4 E-03
218-01-9	Chrysene <sup>g</sup>	ND	ND	1.1 E-03
7440-48-4	Cobalt	ND	ND	8.9 E-04
4170-30-3	Crotonaldehyde	ND	ND	5.0 E-02
98-82-8	Cumene	ND	ND	4.0 E-03
110-82-7	Cyclohexane	ND	ND	2.8 E-03
53-70-3	Dibenz[a,h]anthracene	ND	ND	1.0 E-03
132-64-9	Dibenzofuran	ND	ND	8.6 E-04
106-93-4	1,2-Dibromoethane	ND	ND	6.3 E-03
84-74-2	Dibutylphthalate <sup>g</sup>	ND	ND	1.7 E-02
95-50-1	1,2-Dichlorobenzene	ND	ND	4.9 E-03
541-73-1	1,3-Dichlorobenzene	ND	ND	4.9 E-03
106-46-7	1,4-Dichlorobenzene	ND	ND	4.9 E-03

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
91-94-1	3,3'-Dichlorobenzidine	ND	ND	1.3 E-02
75-27-4	Dichlororobromomethane	ND	ND	5.5 E-03
75-71-8	Dichlorodifluoromethane	ND	ND	4.0 E-03
75-34-3	1,1-Dichloroethane	ND	ND	3.3 E-03
107-06-2	1,2-Dichloroethane	ND	ND	3.3 E-03
120-83-2	2,4-Dichlorophenol	ND	ND	8.6 E-04
78-87-5	1,2-Dichloropropane	ND	ND	3.8 E-03
10061-02-6	trans-1,3-Dichloro-1-propene	ND	ND	3.7 E-03
76-14-2	Dichlorotetrafluoroethane	ND	ND	5.7 E-03
60-11-7	p-Dimethylaminoazobenzene	ND	ND	8.6 E-04
57-97-6	7,12-Dimethylbenz[a]anthracene	ND	ND	8.8 E-04
119-93-7	3,3'-Dimethylbenzidine	ND	ND	8.6 E-02
105-67-9	2,4-Dimethylphenol	ND	ND	1.1 E-02
131-11-3	Dimethyl phthalate	ND	ND	8.6 E-04
99-65-0	1,3-Dinitrobenzene	ND	ND	4.5 E-03
534-52-1	4,6-Dinitro-o-cresol	ND	ND	1.5 E-02
51-28-5	2,4-Dinitrophenol	ND	ND	3.8 E-02
121-14-2	2,4-Dinitrotoluene	2.2 E-08	7.0 E-06	--
606-20-2	2,6-Dinitrotoluene	ND	ND	8.6 E-04
88-85-7	Dinoseb	ND	ND	1.7 E-03
123-91-1	1,4-Dioxane	ND	ND	1.2 E-02
--	Total dioxin/furan compounds	3.8 E-11	1.2 E-08	--
122-39-4	Diphenylamine	ND	ND	8.6 E-04
122-66-7	1,2-Diphenylhydrazine	ND	ND	8.6 E-04
100-41-4	Ethylbenzene <sup>i</sup>	3.7 E-08	1.2 E-05	--
74-85-1	Ethylene <sup>f</sup>	ND	ND	9.3 E-03
117-81-7	bis(2-Ethylhexyl)phthalate	ND	ND	1.7 E-02
206-44-0	Fluoranthene <sup>f</sup>	ND	ND	9.3 E-04
86-73-7	Fluorene <sup>g</sup>	ND	ND	8.6 E-04
50-00-0	Formaldehyde	9.2 E-08	2.9 E-05	--
76-13-1	Freon 113	ND	ND	6.2 E-03
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin <sup>i</sup>	1.9 E-12	5.8 E-10	--
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran <sup>i</sup>	3.9 E-13	1.2 E-10	--

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ND	ND	8.9 E-09
118-74-1	Hexachlorobenzene	ND	ND	8.6 E-04
87-68-3	Hexachlorobutadiene	ND	ND	3.5 E-02
77-47-4	Hexachlorocyclopentadiene	ND	ND	1.7 E-02
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ND	ND	6.7 E-09
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin <sup>i</sup>	1.4 E-13	4.5 E-11	--
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ND	ND	6.7 E-09
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	ND	ND	4.4 E-09
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	2.4 E-14	7.5 E-12	--
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	ND	ND	6.7 E-09
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	ND	ND	4.4 E-09
67-72-1	Hexachloroethane	ND	ND	9.3 E-04
110-54-3	Hexane <sup>i</sup>	5.6 E-08	1.7 E-05	--
7647-01-0	Hydrochloric acid	ND	ND	4.2 E-02
74-90-8	Hydrogen cyanide <sup>g</sup>	ND	ND	1.6 E-01
193-39-5	Indeno[1,2,3-cd]pyrene	ND	ND	9.3 E-04
78-59-1	Isophorone	ND	ND	8.6 E-04
67-63-0	Isopropyl alcohol	ND	ND	8.0 E-03
120-58-1	Isosafrole	ND	ND	8.6 E-04
7439-92-1	Lead <sup>f</sup>	0	0	3.4 E-03
7439-97-6	Mercury	ND	ND	1.1 E-04
126-98-7	Methacrylonitrile	ND	ND	8.9 E-03
96-33-3	Methyl acrylate	ND	ND	1.1 E-02
56-49-5	3-Methylcholanthrene	ND	ND	8.6 E-04
108-10-1	Methyl isobutyl ketone	ND	ND	3.3 E-03
80-62-6	Methyl methacrylate	ND	ND	1.3 E-02
91-57-6	2-Methylnaphthalene	ND	ND	8.6 E-04
95-48-7	2-Methylphenol	ND	ND	5.2 E-03
1634-04-4	Methyl tert-butyl ether	ND	ND	2.9 E-03
91-20-3	Naphthalene <sup>f</sup>	ND	ND	1.0 E-03
134-32-7	1-Naphthylamine	ND	ND	1.7 E-02
91-59-8	2-Naphthylamine	ND	ND	1.7 E-02

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
100-01-6	4-Nitroaniline	ND	ND	3.4 E-03
98-95-3	Nitrobenzene	ND	ND	5.0 E-03
55-63-0	Nitroglycerin	ND	ND	8.3 E-03
88-75-5	2-Nitrophenol	ND	ND	8.6 E-04
100-02-7	4-Nitrophenol	ND	ND	5.7 E-03
79-46-9	2-Nitropropane	ND	ND	1.2 E-02
924-16-3	N-Nitroso-di-n-butylamine	ND	ND	8.6 E-04
55-18-5	N-Nitrosodiethylamine	ND	ND	8.6 E-04
62-75-9	N-Nitrosodimethylamine	ND	ND	8.6 E-04
86-30-6	N-Nitrosodiphenylamine	ND	ND	1.5 E-03
621-64-7	N-Nitroso-di-n-propylamine	ND	ND	8.6 E-04
59-89-2	N-Nitrosomorpholine	ND	ND	8.6 E-04
100-75-4	N-Nitrosopiperidine	ND	ND	8.6 E-04
99-55-8	5-Nitro-o-toluidine	ND	ND	1.4 E-02
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin <sup>i</sup>	3.4 E-11	1.1 E-08	--
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran <sup>i</sup>	1.7 E-12	5.5 E-10	--
608-93-5	Pentachlorobenzene	ND	ND	8.6 E-04
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ND	ND	8.9 E-09
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	ND	ND	4.4 E-09
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	ND	ND	4.4 E-09
76-01-7	Pentachloroethane	ND	ND	8.6 E-04
82-68-8	Pentachloronitrobenzene	ND	ND	8.6 E-04
87-86-5	Pentachlorophenol	ND	ND	4.3 E-02
85-01-8	Phenanthrene <sup>f</sup>	ND	ND	8.6 E-04
108-95-2	Phenol	ND	ND	1.6 E-03
123-38-6	Propionaldehyde	ND	ND	5.0 E-02
115-07-1	Propylene <sup>g</sup>	ND	ND	1.4 E-02
129-00-0	Pyrene <sup>f</sup>	ND	ND	9.1 E-04
110-86-1	Pyridine	ND	ND	1.3 E-03
94-59-7	Safrole	ND	ND	8.6 E-04
7440-22-4	Silver	ND	ND	1.7 E-03
100-42-5	Styrene <sup>g</sup>	ND	ND	3.5 E-03
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	6.7 E-09

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran <sup>g</sup>	ND	ND	4.4 E-09
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	5.6 E-03
127-18-4	Tetrachloroethylene	ND	ND	5.5 E-03
7440-28-0	Thallium	ND	ND	6.3 E-03
108-88-3	Toluene <sup>h</sup>	3.0 E-07	9.4 E-05	--
95-53-4	o-Toluidine	ND	ND	1.1 E-02
120-82-1	1,2,4-Trichlorobenzene	ND	ND	2.4 E-02
71-55-6	1,1,1-Trichloroethane	ND	ND	4.4 E-03
79-00-5	1,1,2-Trichloroethane	ND	ND	4.4 E-03
79-01-6	Trichloroethylene	ND	ND	4.4 E-03
75-69-4	Trichlorofluoromethane	ND	ND	4.6 E-03
95-95-4	2,4,5-Trichlorophenol	ND	ND	2.2 E-03
88-06-2	2,4,6-Trichlorophenol	ND	ND	1.3 E-03
96-18-4	1,2,3-Trichloropropane	ND	ND	2.0 E-02
95-63-6	1,2,4-Trimethylbenzene	ND	ND	4.0 E-03
540-84-1	2,2,4-Trimethylpentane	ND	ND	1.5 E-02
108-05-4	Vinyl acetate	ND	ND	1.1 E-02
75-01-4	Vinyl chloride	ND	ND	1.1 E-02
75-35-4	Vinylidene chloride	ND	ND	3.2 E-03
106-42-3, 108-38-3	m-Xylene, p-Xylene <sup>i</sup>	2.1 E-07	6.5 E-05	--
95-47-6	o-Xylene <sup>i</sup>	5.7 E-08	1.8 E-05	--
Other Pollutants				
67-64-1	Acetone <sup>g</sup>	2.1 E-07	6.4 E-05	--
74-86-2	Acetylene <sup>g</sup>	ND	ND	8.7 E-03
35572-78-2	2-Amino-4,6-dinitrotoluene	1.8 E-08	5.7 E-06	--
19406-51-0	4-Amino-2,6-dinitrotoluene <sup>i</sup>	1.6 E-08	4.9 E-06	--
100-52-7	Benzaldehyde	ND	ND	5.0 E-02
65-85-0	Benzoic acid	ND	ND	7.9 E-02
100-51-6	Benzyl alcohol	ND	ND	6.0 E-02
106-97-8	n-Butane	ND	ND	1.9 E-02
123-92-2	1-Butanol, 3-methyl-, acetate <sup>j</sup>	3.4 E-06	1.1 E-03	--
106-98-9	1-Butene	ND	ND	7.5 E-03
590-18-1	cis-2-Butene	ND	ND	7.5 E-03
624-64-6	trans-2-Butene	ND	ND	7.5 E-03

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
107-14-2	Chloroacetonitrile	ND	ND	2.5 E-02
2698-41-1	o-chlorobenzalmalononitrile	2.7 E-08	8.3 E-06	--
109-69-3	1-Chlorobutane	ND	ND	3.1 E-02
59-50-7	4-Chloro-3-methylphenol	ND	ND	1.1 E-03
90-13-1	1-Chloronaphthalene	ND	ND	8.6 E-04
95-57-8	2-Chlorophenol	ND	ND	8.6 E-04
287-92-3	Cyclopentane	ND	ND	9.3 E-03
124-18-5	n-Decane	ND	ND	1.9 E-02
124-48-1	Dibromochloromethane	ND	ND	6.9 E-03
156-59-2	cis-1,2-Dichloroethene	ND	ND	3.2 E-03
156-60-5	trans-1,2-Dichloroethene	ND	ND	3.7 E-03
87-65-0	2,6-Dichlorophenol	ND	ND	8.6 E-04
10061-01-5	cis-1,3-Dichloropropene	ND	ND	3.7 E-03
141-93-5	1,3-Diethylbenzene	ND	ND	1.8 E-02
105-05-5	1,4-Diethylbenzene	ND	ND	1.8 E-02
84-66-2	Diethylphthalate	ND	ND	1.3 E-03
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	1.0 E-01
75-83-2	2,2-Dimethylbutane	ND	ND	1.1 E-02
79-29-8	2,3-Dimethylbutane	ND	ND	1.1 E-02
565-59-3	2,3-Dimethylpentane	ND	ND	1.3 E-02
108-08-7	2,4-Dimethylpentane	ND	ND	1.3 E-02
117-84-0	Di-n-octylphthalate	ND	ND	9.7 E-04
74-84-0	Ethane <sup>s</sup>	ND	ND	1.0 E-02
64-17-5	Ethanol	3.9 E-08	1.2 E-05	--
60-29-7	Ethyl ether	ND	ND	9.9 E-03
97-63-2	Ethyl methacrylate	ND	ND	3.8 E-02
62-50-0	Ethyl methanesulfonate	ND	ND	8.6 E-04
620-14-4	m-Ethyltoluene	ND	ND	1.6 E-02
611-14-3	o-Ethyltoluene	ND	ND	1.6 E-02
622-96-8	p-Ethyltoluene	ND	ND	1.6 E-02
142-82-5	n-Heptane	ND	ND	3.3 E-03
1888-71-7	Hexachloropropene	ND	ND	1.2 E-03
66-25-1	Hexaldehyde	ND	ND	5.0 E-02
591-78-6	2-Hexanone	ND	ND	1.3 E-02
592-41-6	1-Hexene	ND	ND	1.1 E-02

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
2691-41-0	HMX	ND	ND	2.2 E-02
75-28-5	Isobutane	ND	ND	7.7 E-03
78-79-5	Isoprene	ND	ND	9.1 E-03
590-86-3	Isovaleraldehyde	ND	ND	5.0 E-02
5989-27-5	d-Limonene	ND	ND	1.8 E-02
108-87-2	Methylcyclohexane	ND	ND	1.3 E-02
96-37-7	Methylcyclopentane	ND	ND	1.1 E-02
78-93-3	Methyl ethyl ketone	1.6 E-07	5.1 E-05	--
592-27-8	2-Methylheptane	ND	ND	1.5 E-02
589-81-1	3-Methylheptane	ND	ND	1.5 E-02
591-76-4	2-Methylhexane	ND	ND	1.3 E-02
589-34-4	3-Methylhexane	ND	ND	1.3 E-02
66-27-3	Methyl methanesulfonate	ND	ND	9.5 E-04
107-83-5	2-Methylpentane	5.9 E-08	1.9 E-05	--
96-14-0	3-Methylpentane	ND	ND	1.1 E-02
88-74-4	2-Nitroaniline	ND	ND	8.6 E-04
99-09-2	3-Nitroaniline	ND	ND	3.4 E-03
10595-95-6	N-Nitrosomethylethylamine	ND	ND	1.4 E-03
930-55-2	N-Nitrosopyrrolidine	ND	ND	8.6 E-04
88-72-2	2-Nitrotoluene	ND	ND	3.0 E-02
99-99-0	4-Nitrotoluene	ND	ND	8.4 E-03
111-84-2	n-Nonane	ND	ND	1.7 E-02
111-65-9	n-Octane	ND	ND	1.5 E-02
78-78-4	i-Pentane <sup>i</sup>	9.6 E-08	3.0 E-05	--
109-66-0	n-Pentane	6.0 E-08	1.9 E-05	--
109-67-1	1-Pentene	ND	ND	9.3 E-03
627-20-3	cis-2-Pentene	ND	ND	9.3 E-03
646-04-8	trans-2-Pentene	ND	ND	9.3 E-03
14797-73-0	Perchlorate	4.3 E-08	1.3 E-05	--
78-11-5	PETN	ND	ND	5.9 E-03
62-44-2	Phenacetin	ND	ND	8.6 E-04
80-56-8	alpha-Pinene	ND	ND	1.8 E-02
127-91-3	beta-Pinene	ND	ND	1.8 E-02
74-98-6	Propane <sup>i</sup>	1.3 E-07	4.0 E-05	--
103-65-1	n-Propylbenzene	ND	ND	4.0 E-03

TABLE A2 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
121-82-4	RDX	1.5 E-08	4.7 E-06	--
95-94-3	1,2,4,5-Tetrachlorobenzene	ND	ND	8.6 E-04
58-90-2	2,3,4,6-Tetrachlorophenol	ND	ND	1.1 E-03
109-99-9	Tetrahydrofuran	9.8 E-08	3.1 E-05	--
479-45-8	Tetryl	ND	ND	1.6 E-03
620-23-5 / 104-87-0	m,p-Tolualdehyde	ND	ND	5.0 E-02
529-20-4	o-Tolualdehyde	ND	ND	5.0 E-02
526-73-8	1,2,3-Trimethylbenzene	ND	ND	1.6 E-02
108-67-8	1,3,5-Trimethylbenzene	ND	ND	4.0 E-03
565-75-3	2,3,4-Trimethylpentane	ND	ND	1.5 E-02
99-35-4	1,3,5-Trinitrobenzene	5.1 E-09	1.6 E-06	--
118-96-7	2,4,6-Trinitrotoluene	4.8 E-09	1.5 E-06	--
1120-21-4	Undecane	ND	ND	2.1 E-02
110-62-3	Valeraldehyde	ND	ND	5.0 E-02

<sup>a</sup> CASRN = Chemical Abstracts Service Registry Number.

<sup>b</sup> ND = nondetected.

<sup>c</sup> Emission factors rated C unless otherwise noted.

<sup>d</sup> NEW = Net explosive weight. The NEW for this compound is 3.20 E-03 pounds per item.

<sup>e</sup> Data provided for compounds that were not detected.

<sup>f</sup> Emission factor rated A because of correlation with emission factors for similar ordnance and number of test data points.

<sup>g</sup> Emission factor rated B because of correlation with emission factors for similar ordnance and number of test data points.

<sup>h</sup> Emission factor based upon C-rated test data, but because of correlation with emission factors for similar ordnance and number of data points the factor was upgraded from a D rating to a C rating.

<sup>i</sup> Emission factor rated D because the factor is based upon C-rated test data.

<sup>j</sup> Emission factor rated D because the factor is for a tentatively identified compound.



TABLE A3 COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR DODIC H708, M73 35-MM SUBCALIBER PRACTICE ROCKET (TOTAL)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
Carbon Dioxide, Criteria Pollutants, Methane, Total Nonmethane Hydrocarbons, and Total Suspended Particulate				
124-38-9	Carbon dioxide <sup>g</sup>	1.4 E-02	4.6 E-01	--
630-08-0	Carbon monoxide <sup>g</sup>	2.5 E-03	8.4 E-02	--
7439-92-1	Lead	6.2 E-06	2.1 E-04	--
74-82-8	Methane	7.1 E-06	2.4 E-04	--
--	Oxides of nitrogen <sup>f</sup>	4.0 E-06	1.4 E-04	--
--	PM-2.5 <sup>g</sup>	1.7 E-03	5.7 E-02	--
--	PM-10 <sup>g</sup>	1.8 E-03	5.9 E-02	--
7446-09-5	Sulfur dioxide	2.5 E-04	8.5 E-03	--
--	Total nonmethane hydrocarbons	2.1 E-06	7.1 E-05	--
12789-66-1	Total suspended particulate <sup>g</sup>	1.8 E-03	6.2 E-02	--
Hazardous Air Pollutants and Toxic Chemicals				
83-32-9	Acenaphthene	ND	ND	8.6 E-04
208-96-8	Acenaphthylene	0	0	--
75-07-0	Acetaldehyde	6.0 E-07	2.0 E-05	--
75-05-8	Acetonitrile <sup>g</sup>	0	0	--
98-86-2	Acetophenone	ND	ND	4.1 E-03
53-96-3	2-Acetylaminofluorene	ND	ND	8.6 E-04
107-02-8	Acrolein	ND	ND	7.5 E-03
107-13-1	Acrylonitrile	1.6 E-06	5.3 E-05	--
107-05-1	Allyl chloride	ND	ND	8.9 E-04
7429-90-5	Aluminum	1.3 E-05	4.3 E-04	--
92-67-1	4-Aminobiphenyl	ND	ND	1.7 E-02
7664-41-7	Ammonia <sup>h</sup>	0	0	--
62-53-3	Aniline	ND	ND	1.3 E-02
120-12-7	Anthracene	ND	ND	8.6 E-04
7440-36-0	Antimony	3.0 E-05	1.0 E-03	--
7440-38-2	Arsenic	ND	ND	2.5 E-02
7440-39-3	Barium	1.1 E-06	3.8 E-05	--
71-43-2	Benzene	7.2 E-07	2.4 E-05	--
92-87-5	Benzidine	ND	ND	8.8 E-02
56-55-3	Benzo[a]anthracene	6.0 E-10	2.0 E-08	--
205-99-2	Benzo[b]fluoranthene	ND	ND	1.7 E-05

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
207-08-9	Benzo[k]fluoranthene	ND	ND	1.7 E-05
191-24-2	Benzo[g,h,i]perylene	ND	ND	1.7 E-05
50-32-8	Benzo[a]pyrene	ND	ND	1.7 E-05
192-97-2	Benzo[e]pyrene	ND	ND	1.7 E-05
100-44-7	Benzyl chloride	ND	ND	2.6 E-04
7440-41-7	Beryllium	ND	ND	1.2 E-02
75-25-2	Bromoform	ND	ND	5.3 E-04
74-83-9	Bromomethane	ND	ND	3.6 E-04
101-55-3	4-Bromophenylphenylether	ND	ND	8.6 E-04
106-99-0	1,3-Butadiene	ND	ND	1.8 E-03
75-65-0	t-Butyl alcohol <sup>i</sup>	8.5 E-07	2.9 E-05	--
71-36-3	n-Butanol	ND	ND	9.9 E-03
85-68-7	Butylbenzylphthalate	ND	ND	1.1 E-03
123-72-8	Butyraldehyde	ND	ND	7.6 E-03
7440-43-9	Cadmium	7.4 E-05	2.5 E-03	--
86-74-8	Carbazole	ND	ND	1.1 E-03
75-15-0	Carbon disulfide <sup>i</sup>	4.3 E-08	1.5 E-06	--
56-23-5	Carbon tetrachloride	ND	ND	3.2 E-04
106-47-8	4-Chloroaniline	ND	ND	1.0 E-02
108-90-7	Chlorobenzene	ND	ND	2.4 E-04
75-45-6	Chlorodifluoromethane	ND	ND	2.5 E-04
75-00-3	Chloroethane	ND	ND	6.2 E-04
111-91-1	bis(2-Chloroethoxy)methane	ND	ND	8.6 E-04
111-44-4	bis(2-Chloroethyl)ether	ND	ND	9.7 E-04
67-66-3	Chloroform	ND	ND	4.0 E-04
108-60-1	bis(2-Chloroisopropyl)ether	ND	ND	1.3 E-03
74-87-3	Chloromethane	0	0	--
91-58-7	2-Chloronaphthalene	ND	ND	8.6 E-04
95-57-8	2-Chlorophenol	ND	ND	1.7 E-02
7005-72-3	4-Chlorophenylphenyl ether	ND	ND	8.6 E-04
7440-47-3	Chromium <sup>i</sup>	4.0 E-06	1.3 E-04	--
18540-29-9	Hexavalent chromium	1.1 E-07	3.5 E-06	--
108-39-4 / 106-44-5	m-Cresol/p-Cresol	ND	ND	3.4 E-03
218-01-9	Chrysene	ND	ND	1.1 E-03

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
7440-48-4	Cobalt	ND	ND	8.9 E-04
7440-50-8	Copper	5.8 E-06	2.0 E-04	--
106-44-5	p-Cresol	ND	ND	1.7 E-02
4170-30-3	Crotonaldehyde	ND	ND	7.6 E-03
98-82-8	Cumene <sup>i</sup>	6.6 E-08	2.2 E-06	--
57-12-5	Particulate cyanide	ND	ND	1.2 E-02
110-82-7	Cyclohexane	ND	ND	2.8 E-03
53-70-3	Dibenz[a,h]anthracene	ND	ND	1.7 E-05
132-64-9	Dibenzofuran	ND	ND	8.6 E-04
106-93-4	1,2-Dibromoethane	ND	ND	3.9 E-04
84-74-2	Dibutylphthalate	ND	ND	2.2 E-03
95-50-1	1,2-Dichlorobenzene	ND	ND	4.9 E-04
541-73-1	1,3-Dichlorobenzene	ND	ND	4.3 E-04
106-46-7	1,4-Dichlorobenzene	ND	ND	4.3 E-04
91-94-1	3,3'-Dichlorobenzidine	ND	ND	1.3 E-02
75-27-4	Dichlororobromomethane	ND	ND	4.1 E-04
75-71-8	Dichlorodifluoromethane	9.1 E-09	3.1 E-07	--
75-34-3	1,1-Dichloroethane	ND	ND	3.7 E-04
107-06-2	1,2-Dichloroethane	ND	ND	2.1 E-04
75-43-4	Dichlorofluoromethane	ND	ND	2.1 E-04
120-83-2	2,4-Dichlorophenol	ND	ND	8.6 E-04
78-87-5	1,2-Dichloropropane	ND	ND	3.3 E-04
10061-02-6	trans-1,3-Dichloro-1-propene	ND	ND	2.3 E-04
76-14-2	Dichlorotetrafluoroethane	ND	ND	5.0 E-04
60-11-7	p-Dimethylaminoazobenzene	ND	ND	8.6 E-04
57-97-6	7,12-Dimethylbenz[a]anthracene	ND	ND	8.8 E-04
119-93-7	3,3'-Dimethylbenzidine	ND	ND	8.6 E-02
105-67-9	2,4-Dimethylphenol	ND	ND	1.1 E-02
131-11-3	Dimethyl phthalate	ND	ND	8.6 E-04
99-65-0	1,3-Dinitrobenzene	ND	ND	1.1 E-03
534-52-1	4,6-Dinitro-o-cresol	ND	ND	1.5 E-02
51-28-5	2,4-Dinitrophenol	ND	ND	1.7 E-02
121-14-2	2,4-Dinitrotoluene	2.2 E-08	7.6 E-07	--
606-20-2	2,6-Dinitrotoluene	ND	ND	8.6 E-04
88-85-7	Dinoseb	ND	ND	1.7 E-03

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
123-91-1	1,4-Dioxane	ND	ND	3.3 E-04
--	Total dioxin/furan compounds	3.8 E-11	1.3 E-09	--
122-39-4	Diphenylamine	ND	ND	8.6 E-04
122-66-7	1,2-Diphenylhydrazine	ND	ND	8.6 E-04
140-88-5	Ethyl acrylate	ND	ND	1.7 E-04
100-41-4	Ethylbenzene <sup>i</sup>	3.7 E-08	1.3 E-06	--
74-85-1	Ethylene <sup>g</sup>	4.7 E-06	1.6 E-04	--
117-81-7	bis(2-Ethylhexyl)phthalate	ND	ND	2.2 E-03
206-44-0	Fluoranthene	2.5 E-09	8.3 E-08	--
86-73-7	Fluorene	9.5 E-10	3.2 E-08	--
50-00-0	Formaldehyde <sup>g</sup>	1.4 E-06	4.8 E-05	--
76-13-1	Freon 113	ND	ND	5.5 E-04
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin <sup>i</sup>	1.9 E-12	6.4 E-11	--
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran <sup>i</sup>	3.9 E-13	1.3 E-11	--
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ND	ND	9.8 E-10
118-74-1	Hexachlorobenzene	ND	ND	8.6 E-04
87-68-3	Hexachlorobutadiene	ND	ND	7.6 E-04
77-47-4	Hexachlorocyclopentadiene	ND	ND	1.7 E-02
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0	0	--
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin <sup>i</sup>	1.4 E-13	4.9 E-12	--
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ND	ND	6.7 E-09
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	ND	ND	4.4 E-09
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	2.4 E-14	8.1 E-13	--
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	ND	ND	9.6 E-10
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	ND	ND	8.8 E-10
67-72-1	Hexachloroethane	ND	ND	5.9 E-04
110-54-3	Hexane <sup>i</sup>	5.6 E-08	1.9 E-06	--
7647-01-0	Hydrochloric acid	1.4 E-04	4.7 E-03	--
74-90-8	Hydrogen cyanide	1.2 E-07	4.0 E-06	--
7664-39-3	Hydrogen fluoride	1.4 E-06	4.6 E-05	--

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
193-39-5	Indeno[1,2,3-cd]pyrene	ND	ND	1.7 E-05
78-59-1	Isophorone	ND	ND	8.6 E-04
67-63-0	Isopropyl alcohol	ND	ND	8.0 E-03
120-58-1	Isosafrole	ND	ND	8.6 E-04
7439-92-1	Lead	6.2 E-06	2.1 E-04	--
7439-96-5	Manganese	ND	ND	1.2 E-02
7439-97-6	Mercury	ND	ND	1.1 E-04
126-98-7	Methacrylonitrile	ND	ND	8.9 E-03
96-33-3	Methyl acrylate	ND	ND	2.5 E-04
74-95-3	Methylene bromide	ND	ND	5.1 E-04
56-49-5	3-Methylcholanthrene	ND	ND	8.6 E-04
75-09-2	Methylene chloride	0	0	--
74-88-4	Methyl iodide	ND	ND	3.5 E-04
108-10-1	Methyl isobutyl ketone <sup>i</sup>	6.2 E-06	2.1 E-04	--
80-62-6	Methyl methacrylate <sup>i</sup>	4.0 E-06	1.4 E-04	--
91-57-6	2-Methylnaphthalene	ND	ND	8.6 E-04
95-48-7	2-Methylphenol	ND	ND	5.2 E-03
1634-04-4	Methyl tert-butyl ether <sup>i</sup>	0	0	--
91-20-3	Naphthalene	3.2 E-08	1.1 E-06	--
134-32-7	1-Naphthylamine	ND	ND	1.7 E-02
91-59-8	2-Naphthylamine	ND	ND	1.7 E-02
7440-02-0	Nickel	ND	ND	2.5 E-02
7697-37-2	Nitric acid	ND	ND	9.3 E-02
100-01-6	4-Nitroaniline	ND	ND	3.4 E-03
98-95-3	Nitrobenzene	ND	ND	1.1 E-03
55-63-0	Nitroglycerin <sup>i</sup>	1.9 E-07	6.3 E-06	--
88-75-5	2-Nitrophenol	ND	ND	8.6 E-04
100-02-7	4-Nitrophenol	ND	ND	5.7 E-03
79-46-9	2-Nitropropane	ND	ND	1.2 E-02
924-16-3	N-Nitroso-di-n-butylamine	ND	ND	8.6 E-04
55-18-5	N-Nitrosodiethylamine	ND	ND	8.6 E-04
62-75-9	N-Nitrosodimethylamine	ND	ND	8.6 E-04
86-30-6	N-Nitrosodiphenylamine	ND	ND	1.5 E-03
621-64-7	N-Nitroso-di-n-propylamine	ND	ND	8.6 E-04
59-89-2	N-Nitrosomorpholine	ND	ND	8.6 E-04

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
100-75-4	N-Nitrosopiperidine	ND	ND	8.6 E-04
99-55-8	5-Nitro-o-toluidine	ND	ND	1.4 E-02
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin <sup>i</sup>	3.4 E-11	1.1 E-09	--
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran <sup>i</sup>	1.7 E-12	5.9 E-11	--
608-93-5	Pentachlorobenzene	ND	ND	8.6 E-04
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ND	ND	9.8 E-10
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	ND	ND	1.3 E-09
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	ND	ND	1.3 E-09
76-01-7	Pentachloroethane	ND	ND	8.6 E-04
82-68-8	Pentachloronitrobenzene	ND	ND	8.6 E-04
87-86-5	Pentachlorophenol	ND	ND	1.7 E-02
85-01-8	Phenanthrene	2.4 E-09	8.1 E-08	--
108-95-2	Phenol	ND	ND	1.6 E-03
123-38-6	Propionaldehyde <sup>i</sup>	3.9 E-07	1.3 E-05	--
115-07-1	Propylene	ND	ND	1.4 E-02
129-00-0	Pyrene	2.9 E-09	9.8 E-08	--
110-86-1	Pyridine	ND	ND	1.3 E-03
94-59-7	Safrole	ND	ND	8.6 E-04
7782-49-2	Selenium	ND	ND	4.9 E-02
7440-22-4	Silver	ND	ND	1.7 E-03
100-42-5	Styrene <sup>g</sup>	8.7 E-08	2.9 E-06	--
7664-93-9	Sulfuric acid	5.3 E-05	1.8 E-03	--
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	1.2 E-09
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	ND	ND	8.5 E-10
630-20-6	1,1,1,2-Tetrachloroethane	ND	ND	3.5 E-04
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	3.5 E-04
127-18-4	Tetrachloroethylene <sup>i</sup>	1.3 E-08	4.3 E-07	--
7440-28-0	Thallium	ND	ND	6.3 E-03
108-88-3	Toluene <sup>h</sup>	4.6 E-07	1.5 E-05	--
95-53-4	o-Toluidine	ND	ND	1.1 E-02
120-82-1	1,2,4-Trichlorobenzene	ND	ND	1.3 E-03
71-55-6	1,1,1-Trichloroethane	ND	ND	4.4 E-04
79-00-5	1,1,2-Trichloroethane	ND	ND	2.8 E-04

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
79-01-6	Trichloroethylene	ND	ND	4.4 E-03
75-69-4	Trichlorofluoromethane	0	0	--
95-95-4	2,4,5-Trichlorophenol	ND	ND	2.2 E-03
88-06-2	2,4,6-Trichlorophenol	ND	ND	1.3 E-03
96-18-4	1,2,3-Trichloropropane	ND	ND	4.9 E-04
95-63-6	1,2,4-Trimethylbenzene <sup>i</sup>	1.6 E-05	5.3 E-04	--
540-84-1	2,2,4-Trimethylpentane	ND	ND	1.9 E-04
7440-62-2	Vanadium <sup>i</sup>	4.2 E-09	1.4 E-07	--
108-05-4	Vinyl acetate	ND	ND	3.9 E-04
75-01-4	Vinyl chloride	ND	ND	2.6 E-04
75-35-4	Vinylidene chloride	ND	ND	2.0 E-04
106-42-3, 108-38-3	m-Xylene, p-Xylene <sup>i</sup>	8.2 E-07	2.8 E-05	--
95-47-6	o-Xylene <sup>i</sup>	6.1 E-07	2.0 E-05	--
7440-66-6	Zinc <sup>g</sup>	9.4 E-06	3.2 E-04	--
Other Pollutants				
67-64-1	Acetone <sup>g</sup>	4.1 E-07	1.4 E-05	--
74-86-2	Acetylene	1.8 E-06	6.1 E-05	--
35572-78-2	2-Amino-4,6-dinitrotoluene	1.8 E-08	6.1 E-07	--
19406-51-0	4-Amino-2,6-dinitrotoluene <sup>i</sup>	1.6 E-08	5.3 E-07	--
100-52-7	Benzaldehyde	ND	ND	7.6 E-03
611-14-3	Benzene, 1-ethyl-2-methyl <sup>j</sup>	9.1 E-07	3.1 E-05	--
768-49-0	Benzene, (2-methyl-1-propenyl) <sup>j</sup>	2.0 E-07	6.8 E-06	--
103-65-1	Benzene, propyl <sup>j</sup>	3.7 E-07	1.2 E-05	--
488-23-3	Benzene, 1,2,3,4-tetramethyl <sup>j</sup>	8.2 E-07	2.8 E-05	--
526-73-8	Benzene, 1,2,3-trimethyl <sup>j</sup>	1.8 E-06	6.2 E-05	--
65-85-0	Benzoic acid	ND	ND	7.9 E-02
100-51-6	Benzyl alcohol	ND	ND	1.7 E-02
108-86-1	Bromobenzene	ND	ND	3.9 E-04
78-79-5	1,3-Butadiene, 2-methyl <sup>j</sup>	3.1 E-07	1.0 E-05	--
106-97-8	n-Butane	ND	ND	1.9 E-02
123-92-2	1-Butanol, 3-methyl-, acetate <sup>j</sup>	3.4 E-06	1.2 E-04	--
106-98-9	1-Butene	ND	ND	7.5 E-03
590-18-1	cis-2-Butene	ND	ND	7.5 E-03
624-64-6	trans-2-Butene	ND	ND	7.5 E-03

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
107-00-6	1-Butyne	ND	ND	4.5 E-02
503-17-3	2-Butyne	ND	ND	4.5 E-02
7440-70-2	Calcium	1.7 E-05	5.7 E-04	--
7440-44-0	Elemental carbon	0	0	--
7440-44-0	Organic carbon	1.5 E-05	5.1 E-04	--
7440-44-0	Total carbon	1.5 E-05	5.1 E-04	--
107-14-2	Chloroacetonitrile	ND	ND	2.5 E-02
2698-41-1	o-chlorobenzalmalononitrile	2.7 E-08	9.0 E-07	--
39638-32-9	bis(2-Chloroisopropyl)ether	ND	ND	1.7 E-02
109-69-3	1-Chlorobutane	ND	ND	3.1 E-02
59-50-7	4-Chloro-3-methylphenol	ND	ND	1.1 E-03
90-13-1	1-Chloronaphthalene	ND	ND	8.6 E-04
95-57-8	2-Chlorophenol	ND	ND	8.6 E-04
287-92-3	Cyclopentane	ND	ND	9.3 E-03
541-05-9	Cyclotrisiloxane, hexamethyl <sup>j</sup>	8.5 E-07	2.9 E-05	--
112-31-2	Decanal <sup>i</sup>	4.7 E-07	1.6 E-05	--
124-18-5	n-Decane	ND	ND	1.9 E-02
124-48-1	Dibromochloromethane	ND	ND	5.2 E-04
156-59-2	cis-1,2-Dichloroethene	ND	ND	2.0 E-04
156-60-5	trans-1,2-Dichloroethene	ND	ND	4.8 E-04
87-65-0	2,6-Dichlorophenol	ND	ND	8.6 E-04
10061-01-5	cis-1,3-Dichloropropene	ND	ND	2.8 E-04
141-93-5	1,3-Diethylbenzene	ND	ND	1.8 E-02
105-05-5	1,4-Diethylbenzene	ND	ND	1.8 E-02
84-66-2	Diethylphthalate	ND	ND	1.3 E-03
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	7.6 E-03
75-83-2	2,2-Dimethylbutane	ND	ND	1.1 E-02
79-29-8	2,3-Dimethylbutane	ND	ND	1.1 E-02
565-59-3	2,3-Dimethylpentane	ND	ND	1.3 E-02
108-08-7	2,4-Dimethylpentane	ND	ND	1.3 E-02
117-84-0	Di-n-octylphthalate	ND	ND	9.7 E-04
74-84-0	Ethane	ND	ND	1.0 E-02
141-78-6	Ethyl acetate	ND	ND	1.4 E-03
64-17-5	Ethanol	3.9 E-08	1.3 E-06	--
122-62-3	bis(2-Ethylhexyl) sebacate <sup>j</sup>	2.7 E-07	9.0 E-06	--



TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
60-29-7	Ethyl ether	ND	ND	9.9 E-03
97-63-2	Ethyl methacrylate	ND	ND	3.3 E-04
62-50-0	Ethyl methanesulfonate	ND	ND	8.6 E-04
620-14-4	m-Ethyltoluene	ND	ND	1.6 E-02
611-14-3	o-Ethyltoluene	ND	ND	1.6 E-02
622-96-8	p-Ethyltoluene <sup>i</sup>	2.4 E-06	8.3 E-05	--
142-82-5	n-Heptane <sup>i</sup>	2.5 E-08	8.4 E-07	--
1888-71-7	Hexachloropropene	ND	ND	1.2 E-03
66-25-1	Hexaldehyde	ND	ND	7.6 E-03
591-78-6	2-Hexanone	ND	ND	2.9 E-04
592-41-6	1-Hexene	ND	ND	1.1 E-02
2691-41-0	HMX	ND	ND	2.2 E-03
10035-10-6	Hydrogen bromide	ND	ND	9.3 E-02
75-28-5	Isobutane	ND	ND	7.7 E-03
78-79-5	Isoprene	ND	ND	9.1 E-03
590-86-3	Isovaleraldehyde	ND	ND	7.6 E-03
5989-27-5	d-Limonene	ND	ND	1.8 E-02
7439-95-4	Magnesium	4.5 E-06	1.5 E-04	--
108-87-2	Methylcyclohexane	ND	ND	1.3 E-02
96-37-7	Methylcyclopentane	ND	ND	1.1 E-02
78-93-3	Methyl ethyl ketone <sup>i</sup>	1.6 E-06	5.4 E-05	--
592-27-8	2-Methylheptane	ND	ND	1.5 E-02
589-81-1	3-Methylheptane	ND	ND	1.5 E-02
591-76-4	2-Methylhexane	ND	ND	1.3 E-02
589-34-4	3-Methylhexane	ND	ND	1.3 E-02
66-27-3	Methyl methanesulfonate	ND	ND	9.5 E-04
107-83-5	2-Methylpentane	5.9 E-08	2.0 E-06	--
96-14-0	3-Methylpentane	ND	ND	1.1 E-02
98-83-9	alpha-Methylstyrene <sup>i</sup>	5.4 E-08	1.8 E-06	--
479-45-8	Methyl-2,4,6-trinitrophenylnitramine	ND	ND	1.1 E-03
88-74-4	2-Nitroaniline	ND	ND	8.6 E-04
99-09-2	3-Nitroaniline	ND	ND	3.4 E-03
10595-95-6	N-Nitrosomethylethylamine	ND	ND	1.4 E-03
930-55-2	N-Nitrosopyrrolidine	ND	ND	8.6 E-04
88-72-2	2-Nitrotoluene	ND	ND	1.1 E-03

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
99-08-1	3-Nitrotoluene	ND	ND	1.1 E-03
99-99-0	4-Nitrotoluene	ND	ND	1.1 E-03
124-19-6	Nonanal <sup>i</sup>	4.3 E-07	1.5 E-05	--
111-84-2	n-Nonane	ND	ND	1.7 E-02
111-65-9	n-Octane	ND	ND	1.9 E-04
591-95-7	1,2-Pentadiene <sup>i</sup>	4.1 E-07	1.4 E-05	--
78-11-5	Pentaerythritol tetranitrate	ND	ND	2.2 E-03
78-78-4	i-Pentane <sup>i</sup>	9.6 E-08	3.2 E-06	--
109-66-0	n-Pentane	6.0 E-08	2.0 E-06	--
109-67-1	1-Pentene	ND	ND	9.3 E-03
627-20-3	cis-2-Pentene	ND	ND	9.3 E-03
646-04-8	trans-2-Pentene	ND	ND	9.3 E-03
14797-73-0	Perchlorate	4.3 E-08	1.4 E-06	--
78-11-5	PETN	ND	ND	5.9 E-03
62-44-2	Phenacetin	ND	ND	8.6 E-04
7664-38-2	Phosphoric acid	ND	ND	9.3 E-02
80-56-8	alpha-Pinene	ND	ND	1.8 E-02
127-91-3	beta-Pinene	ND	ND	1.8 E-02
74-98-6	Propane <sup>i</sup>	1.3 E-07	4.4 E-06	--
115-11-7	1-Propene, 2-methyl	0	0	--
103-65-1	n-Propylbenzene	ND	ND	4.0 E-03
74-99-7	Propyne	ND	ND	3.3 E-02
121-82-4	RDX	1.5 E-08	5.1 E-07	--
95-94-3	1,2,4,5-Tetrachlorobenzene	ND	ND	8.6 E-04
58-90-2	2,3,4,6-Tetrachlorophenol	ND	ND	1.1 E-03
109-99-9	Tetrahydrofuran	9.8 E-08	3.3 E-06	--
479-45-8	Tetryl	ND	ND	1.6 E-03
620-23-5, 104-87-0	m,p-Tolualdehyde	ND	ND	5.0 E-02
529-20-4	o-Tolualdehyde	ND	ND	5.0 E-02
1334-78-7	o,m,p-Tolualdehyde	ND	ND	2.3 E-02
25323-89-1	Trichloroethane	ND	ND	3.0 E-04
526-73-8	1,2,3-Trimethylbenzene	ND	ND	1.6 E-02
108-67-8	1,3,5-Trimethylbenzene	4.5 E-06	1.5 E-04	--
565-75-3	2,3,4-Trimethylpentane	ND	ND	1.5 E-02

TABLE A3 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
99-35-4	1,3,5-Trinitrobenzene	5.1 E-09	1.7 E-07	--
118-96-7	2,4,6-Trinitrotoluene	4.8 E-09	1.6 E-07	--
1120-21-4	Undecane	ND	ND	2.1 E-02
110-62-3	Valeraldehyde	ND	ND	7.6 E-03

<sup>a</sup> CASRN = Chemical Abstracts Service Registry Number.

<sup>b</sup> ND = nondetected.

<sup>c</sup> Emission factors rated C unless otherwise noted.

<sup>d</sup> NEW = Net explosive weight. The NEW for this compound is 2.96 E-02 pounds per item.

<sup>e</sup> Data provided for compounds that were not detected.

<sup>f</sup> Emission factor rated A because of correlation with emission factors for similar ordnance and number of test data points.

<sup>g</sup> Emission factor rated B because of correlation with emission factors for similar ordnance and number of test data points.

<sup>h</sup> Emission factor based upon C-rated test data, but because of correlation with emission factors for similar ordnance and number of data points the factor was upgraded from a D rating to a C rating.

<sup>i</sup> Emission factor rated D because the factor is based upon C-rated test data.

<sup>j</sup> Emission factor rated D because the factor is for a tentatively identified compound.

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TABLE A4 COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR  
DODIC K042, M88 PRACTICE CANISTER MINE (VOLCANO)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
Carbon Dioxide, Criteria Pollutants, Total Nonmethane Hydrocarbons, and Total Suspended Particulates				
124-38-9	Carbon dioxide	1.5 E-04	1.1 E-02	--
630-08-0	Carbon monoxide	6.8 E-05	4.9 E-03	--
7439-92-1	Lead	7.6 E-06	5.5 E-04	--
--	Oxides of nitrogen	9.4 E-05	6.8 E-03	--
--	PM-2.5	2.2 E-04	1.6 E-02	--
--	PM-10	2.5 E-04	1.8 E-02	--
7446-09-5	Sulfur dioxide	1.6 E-05	1.2 E-03	--
--	Total nonmethane hydrocarbons	4.9 E-06	3.5 E-04	--
12789-66-1	Total suspended particulate	2.4 E-04	1.7 E-02	--
Hazardous Air Pollutants and Toxic Chemicals				
83-32-9	Acenaphthene	ND	ND	8.8 E-04
208-96-8	Acenaphthylene	ND	ND	8.8 E-04
75-07-0	Acetaldehyde	1.4 E-06	1.0 E-04	--
75-05-8	Acetonitrile	ND	ND	1.9 E-02
98-86-2	Acetophenone	ND	ND	4.2 E-03
53-96-3	2-Acetylaminofluorene	ND	ND	8.8 E-04
107-02-8	Acrolein	ND	ND	9.8 E-03
107-13-1	Acrylonitrile	ND	ND	9.3 E-03
107-05-1	Allyl chloride	ND	ND	1.3 E-02
92-67-1	4-Aminobiphenyl	ND	ND	1.8 E-02
7664-41-7	Ammonia <sup>f</sup>	4.7 E-07	3.4 E-05	--
62-53-3	Aniline	ND	ND	1.3 E-02
120-12-7	Anthracene	ND	ND	8.8 E-04
7440-36-0	Antimony	3.7 E-06	2.6 E-04	--
71-43-2	Benzene	2.1 E-07	1.5 E-05	--
92-87-5	Benzidine	ND	ND	8.9 E-02
56-55-3	Benzo[a]anthracene	ND	ND	1.0 E-03
205-99-2	Benzo[b]fluoranthene	ND	ND	1.9 E-03
207-08-9	Benzo[k]fluoranthene	ND	ND	1.1 E-03
191-24-2	Benzo[g,h,i]perylene	ND	ND	2.8 E-03
50-32-8	Benzo[a]pyrene	ND	ND	8.8 E-04
100-44-7	Benzyl chloride	ND	ND	5.8 E-03

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
75-25-2	Bromoform	ND	ND	1.2 E-02
74-83-9	Bromomethane	ND	ND	4.3 E-03
101-55-3	4-Bromophenylphenylether	ND	ND	8.8 E-04
106-99-0	1,3-Butadiene	1.4 E-07	1.0 E-05	--
71-36-3	n-Butanol	ND	ND	1.3 E-02
85-68-7	Butylbenzylphthalate	1.4 E-08	1.0 E-06	--
123-72-8	Butyraldehyde	ND	ND	3.3 E-02
7440-43-9	Cadmium	1.4 E-08	9.8 E-07	--
86-74-8	Carbazole	ND	ND	1.1 E-03
75-15-0	Carbon disulfide	1.5 E-07	1.1 E-05	--
56-23-5	Carbon tetrachloride	ND	ND	7.0 E-03
106-47-8	4-Chloroaniline	ND	ND	1.1 E-02
108-90-7	Chlorobenzene	ND	ND	5.2 E-03
75-00-3	Chloroethane	ND	ND	3.0 E-03
111-91-1	bis(2-Chloroethoxy)methane	ND	ND	8.8 E-04
111-44-4	bis(2-Chloroethyl)ether	ND	ND	9.8 E-04
67-66-3	Chloroform	ND	ND	5.4 E-03
108-60-1	bis(2-Chloroisopropyl)ether	ND	ND	1.3 E-03
74-87-3	Chloromethane	ND	ND	8.8 E-03
91-58-7	2-Chloronaphthalene	ND	ND	8.8 E-04
7005-72-3	4-Chlorophenylphenyl ether	ND	ND	8.8 E-04
108-39-4 / 106-44-5	m-Cresol/p-Cresol	ND	ND	3.5 E-03
7440-47-3	Chromium	8.1 E-07	5.8 E-05	--
218-01-9	Chrysene	ND	ND	1.1 E-03
7440-48-4	Cobalt	ND	ND	8.8 E-04
7440-50-8	Copper	3.8 E-06	2.7 E-04	--
4170-30-3	Crotonaldehyde	ND	ND	3.6 E-02
98-82-8	Cumene	ND	ND	5.5 E-03
110-82-7	Cyclohexane	ND	ND	3.8 E-03
53-70-3	Dibenz[a,h]anthracene	ND	ND	1.1 E-03
132-64-9	Dibenzofuran	ND	ND	8.8 E-04
106-93-4	1,2-Dibromoethane	ND	ND	8.6 E-03
84-74-2	Dibutylphthalate	ND	ND	1.8 E-02
95-50-1	1,2-Dichlorobenzene	ND	ND	6.7 E-03

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
541-73-1	1,3-Dichlorobenzene	ND	ND	6.7 E-03
106-46-7	1,4-Dichlorobenzene	ND	ND	6.7 E-03
91-94-1	3,3'-Dichlorobenzidine	ND	ND	1.3 E-02
75-27-4	Dichlororobromomethane	ND	ND	7.5 E-03
75-71-8	Dichlorodifluoromethane	ND	ND	5.5 E-03
75-34-3	1,1-Dichloroethane	ND	ND	4.5 E-03
107-06-2	1,2-Dichloroethane	ND	ND	4.5 E-03
120-83-2	2,4-Dichlorophenol	ND	ND	8.8 E-04
78-87-5	1,2-Dichloropropane	ND	ND	5.2 E-03
10061-02-6	trans-1,3-Dichloro-1-propene	ND	ND	5.1 E-03
76-14-2	Dichlorotetrafluoroethane	ND	ND	7.8 E-03
60-11-7	p-Dimethylaminoazobenzene	ND	ND	8.8 E-04
57-97-6	7,12-Dimethylbenz[a]anthracene	ND	ND	8.9 E-04
119-93-7	3,3'-Dimethylbenzidine	ND	ND	8.8 E-02
105-67-9	2,4-Dimethylphenol	ND	ND	1.1 E-02
131-11-3	Dimethyl phthalate	ND	ND	8.8 E-04
99-65-0	1,3-Dinitrobenzene	ND	ND	4.5 E-03
534-52-1	4,6-Dinitro-o-cresol	ND	ND	1.5 E-02
51-28-5	2,4-Dinitrophenol	ND	ND	3.9 E-02
121-14-2	2,4-Dinitrotoluene	ND	ND	4.4 E-03
606-20-2	2,6-Dinitrotoluene	ND	ND	8.3 E-04
88-85-7	Dinoseb	ND	ND	1.7 E-03
123-91-1	1,4-Dioxane	ND	ND	1.5 E-02
--	Total dioxin/furan compounds	5.8 E-12	4.2 E-10	--
122-39-4	Diphenylamine	ND	ND	8.8 E-04
122-66-7	1,2-Diphenylhydrazine	ND	ND	8.8 E-04
100-41-4	Ethylbenzene	ND	ND	4.9 E-03
74-85-1	Ethylene	9.5 E-07	6.8 E-05	--
117-81-7	bis(2-Ethylhexyl)phthalate	ND	ND	1.8 E-02
206-44-0	Fluoranthene	ND	ND	9.5 E-04
86-73-7	Fluorene	ND	ND	8.8 E-04
50-00-0	Formaldehyde	1.6 E-06	1.1 E-04	--
76-13-1	Freon 113	ND	ND	8.6 E-03
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	8.2 E-13	5.9 E-11	--

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	ND	ND	7.3 E-09
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	ND	ND	7.3 E-09
118-74-1	Hexachlorobenzene	ND	ND	8.8 E-04
87-68-3	Hexachlorobutadiene	ND	ND	4.6 E-02
77-47-4	Hexachlorocyclopentadiene	ND	ND	1.8 E-02
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	ND	ND	7.3 E-09
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	ND	ND	7.3 E-09
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	ND	ND	7.3 E-09
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	ND	ND	4.9 E-09
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	ND	ND	4.9 E-09
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	ND	ND	7.3 E-09
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	ND	ND	4.9 E-09
67-72-1	Hexachloroethane	ND	ND	9.5 E-04
110-54-3	Hexane	ND	ND	3.9 E-03
7647-01-0	Hydrochloric acid	ND	ND	4.4 E-02
74-90-8	Hydrogen cyanide	ND	ND	1.7 E-02
193-39-5	Indeno[1,2,3-cd]pyrene	ND	ND	9.5 E-04
78-59-1	Isophorone	ND	ND	8.8 E-04
67-63-0	Isopropyl alcohol	ND	ND	1.0 E-02
120-58-1	Isosafrole	ND	ND	8.8 E-04
7439-92-1	Lead	7.6 E-06	5.5 E-04	3.5 E-03
7439-97-6	Mercury	ND	ND	1.1 E-04
126-98-7	Methacrylonitrile	ND	ND	1.2 E-02
96-33-3	Methyl acrylate	ND	ND	1.5 E-02
56-49-5	3-Methylcholanthrene	ND	ND	8.8 E-04
75-09-2	Methylene chloride	ND	ND	3.9 E-03
108-10-1	Methyl isobutyl ketone	ND	ND	4.6 E-03
80-62-6	Methyl methacrylate	ND	ND	1.7 E-02
91-57-6	2-Methylnaphthalene	ND	ND	8.8 E-04
95-48-7	2-Methylphenol	ND	ND	5.3 E-03
1634-04-4	Methyl tert-butyl ether	ND	ND	4.0 E-03

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
91-20-3	Naphthalene	1.5 E-08	1.1 E-06	--
134-32-7	1-Naphthylamine	ND	ND	1.8 E-02
91-59-8	2-Naphthylamine	ND	ND	1.8 E-02
7440-02-0	Nickel	1.7 E-07	1.3 E-05	--
100-01-6	4-Nitroaniline	ND	ND	3.5 E-03
98-95-3	Nitrobenzene	ND	ND	5.0 E-03
55-63-0	Nitroglycerin	ND	ND	8.3 E-03
88-75-5	2-Nitrophenol	ND	ND	8.8 E-04
100-02-7	4-Nitrophenol	ND	ND	5.8 E-03
79-46-9	2-Nitropropane	ND	ND	1.6 E-02
924-16-3	N-Nitroso-di-n-butylamine	ND	ND	8.8 E-04
55-18-5	N-Nitrosodiethylamine	ND	ND	8.8 E-04
62-75-9	N-Nitrosodimethylamine	ND	ND	8.8 E-04
86-30-6	N-Nitrosodiphenylamine	ND	ND	1.5 E-03
621-64-7	N-Nitroso-di-n-propylamine	ND	ND	8.8 E-04
59-89-2	N-Nitrosomorpholine	ND	ND	8.8 E-04
100-75-4	N-Nitrosopiperidine	ND	ND	8.8 E-04
99-55-8	5-Nitro-o-toluidine	ND	ND	1.4 E-02
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	4.8 E-12	3.4 E-10	--
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	1.9 E-13	1.4 E-11	--
608-93-5	Pentachlorobenzene	ND	ND	8.8 E-04
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	ND	ND	7.3 E-09
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	ND	ND	7.3 E-09
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	ND	ND	4.9 E-09
76-01-7	Pentachloroethane	ND	ND	8.8 E-04
82-68-8	Pentachloronitrobenzene	ND	ND	8.8 E-04
87-86-5	Pentachlorophenol	ND	ND	4.4 E-02
85-01-8	Phenanthrene	ND	ND	8.8 E-04
108-95-2	Phenol	3.1 E-08	2.2 E-06	--
123-38-6	Propionaldehyde	8.5 E-07	6.1 E-05	--
115-07-1	Propylene	2.9 E-07	2.1 E-05	--
129-00-0	Pyrene	ND	ND	9.3 E-04
110-86-1	Pyridine	ND	ND	1.3 E-03



TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
94-59-7	Safrole	ND	ND	8.8 E-04
7440-22-4	Silver	ND	ND	1.7 E-03
100-42-5	Styrene	ND	ND	4.8 E-03
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	ND	ND	7.3 E-09
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	ND	ND	7.3 E-09
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	7.7 E-03
127-18-4	Tetrachloroethylene	ND	ND	7.6 E-03
7440-28-0	Thallium	ND	ND	6.1 E-03
108-88-3	Toluene	3.7 E-07	2.7 E-05	--
95-53-4	o-Toluidine	ND	ND	1.1 E-02
120-82-1	1,2,4-Trichlorobenzene	ND	ND	3.2 E-02
71-55-6	1,1,1-Trichloroethane	ND	ND	6.1 E-03
79-00-5	1,1,2-Trichloroethane	ND	ND	6.1 E-03
79-01-6	Trichloroethylene	ND	ND	6.0 E-03
75-69-4	Trichlorofluoromethane	ND	ND	6.3 E-03
95-95-4	2,4,5-Trichlorophenol	ND	ND	2.3 E-03
88-06-2	2,4,6-Trichlorophenol	ND	ND	1.3 E-03
96-18-4	1,2,3-Trichloropropane	ND	ND	2.6 E-02
95-63-6	1,2,4-Trimethylbenzene	ND	ND	5.5 E-03
540-84-1	2,2,4-Trimethylpentane	ND	ND	2.0 E-02
108-05-4	Vinyl acetate	ND	ND	1.5 E-02
75-01-4	Vinyl chloride	ND	ND	1.5 E-02
75-35-4	Vinylidene chloride	ND	ND	4.4 E-03
106-42-3, 108-38-3	m-Xylene, p-Xylene	0	0	--
95-47-6	o-Xylene	ND	ND	4.9 E-03
7440-66-6	Zinc	3.7 E-06	2.7 E-04	--
<b>Other Pollutants</b>				
67-64-1	Acetone	1.8 E-06	1.3 E-04	--
74-86-2	Acetylene	3.5 E-07	2.5 E-05	--
35572-78-2	2-Amino-4,6-dinitrotoluene	ND	ND	5.4 E-04
19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	5.2 E-04
100-52-7	Benzaldehyde	ND	ND	3.6 E-02
65-85-0	Benzoic acid	ND	ND	8.1 E-02
100-51-6	Benzyl alcohol	ND	ND	6.1 E-02

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
106-97-8	n-Butane	ND	ND	2.7 E-02
123-92-2	1-Butanol, 3-methyl-, acetate <sup>g</sup>	5.5 E-06	3.9 E-04	--
106-98-9	1-Butene	ND	ND	9.8 E-03
590-18-1	cis-2-Butene	ND	ND	9.8 E-03
624-64-6	trans-2-Butene	ND	ND	9.8 E-03
689-97-4	1-Buten-3-yne <sup>g</sup>	2.0 E-07	1.5 E-05	--
107-14-2	Chloroacetonitrile	ND	ND	3.5 E-02
2698-41-1	o-chlorobenzalmalononitrile	ND	ND	1.8 E-03
109-69-3	1-Chlorobutane	ND	ND	4.2 E-02
59-50-7	4-Chloro-3-methylphenol	ND	ND	1.1 E-03
90-13-1	1-Chloronaphthalene	ND	ND	8.8 E-04
95-57-8	2-Chlorophenol	ND	ND	8.8 E-04
287-92-3	Cyclopentane	ND	ND	1.2 E-02
124-18-5	n-Decane	ND	ND	2.5 E-02
124-48-1	Dibromochloromethane	ND	ND	9.5 E-03
156-59-2	cis-1,2-Dichloroethene	ND	ND	4.4 E-03
156-60-5	trans-1,2-Dichloroethene	ND	ND	5.1 E-03
87-65-0	2,6-Dichlorophenol	ND	ND	8.8 E-04
10061-01-5	cis-1,3-Dichloropropene	ND	ND	5.1 E-03
141-93-5	1,3-Diethylbenzene	ND	ND	2.3 E-02
105-05-5	1,4-Diethylbenzene	ND	ND	2.3 E-02
84-66-2	Diethylphthalate	0	0	--
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	7.1 E-02
75-83-2	2,2-Dimethylbutane	ND	ND	1.5 E-02
79-29-8	2,3-Dimethylbutane	ND	ND	1.5 E-02
565-59-3	2,3-Dimethylpentane	ND	ND	1.7 E-02
108-08-7	2,4-Dimethylpentane	ND	ND	1.7 E-02
117-84-0	Di-n-octylphthalate	ND	ND	9.8 E-04
74-84-0	Ethane	2.4 E-07	1.7 E-05	--
64-17-5	Ethanol	ND	ND	8.0 E-03
60-29-7	Ethyl ether	ND	ND	1.3 E-02
97-63-2	Ethyl methacrylate	ND	ND	5.2 E-02
62-50-0	Ethyl methanesulfonate	ND	ND	8.8 E-04
620-14-4	m-Ethyltoluene	ND	ND	2.1 E-02
611-14-3	o-Ethyltoluene	ND	ND	2.1 E-02

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
622-96-8	p-Ethyltoluene	ND	ND	2.1 E-02
4100-80-5	2,5-Furandione, dihydro-3-methyl- <sup>g</sup>	3.6 E-07	2.6 E-05	--
98-01-1	Furfural <sup>g</sup>	1.2 E-07	8.4 E-06	--
142-82-5	n-Heptane	ND	ND	4.6 E-03
1888-71-7	Hexachloropropene	ND	ND	1.3 E-03
66-25-1	Hexaldehyde	ND	ND	3.6 E-02
591-78-6	2-Hexanone	ND	ND	1.7 E-02
592-41-6	1-Hexene	ND	ND	1.5 E-02
2691-41-0	HMX	ND	ND	2.2 E-02
75-28-5	Isobutane	ND	ND	1.0 E-02
78-79-5	Isoprene	ND	ND	1.2 E-02
590-86-3	Isovaleraldehyde	ND	ND	3.6 E-02
5989-27-5	d-Limonene	ND	ND	2.4 E-02
108-87-2	Methylcyclohexane	ND	ND	1.7 E-02
96-37-7	Methylcyclopentane	ND	ND	1.5 E-02
78-93-3	Methyl ethyl ketone	2.5 E-08	1.8 E-06	--
592-27-8	2-Methylheptane	ND	ND	1.9 E-02
589-81-1	3-Methylheptane	ND	ND	2.0 E-02
591-76-4	2-Methylhexane	ND	ND	1.7 E-02
589-34-4	3-Methylhexane	ND	ND	1.7 E-02
66-27-3	Methyl methanesulfonate	ND	ND	9.6 E-04
107-83-5	2-Methylpentane	ND	ND	1.5 E-02
96-14-0	3-Methylpentane	ND	ND	1.5 E-02
88-74-4	2-Nitroaniline	ND	ND	8.8 E-04
99-09-2	3-Nitroaniline	ND	ND	3.5 E-03
10595-95-6	N-Nitrosomethylethylamine	ND	ND	1.5 E-03
930-55-2	N-Nitrosopyrrolidine	ND	ND	8.8 E-04
88-72-2	2-Nitrotoluene	ND	ND	3.0 E-02
99-99-0	4-Nitrotoluene	ND	ND	8.4 E-03
111-84-2	n-Nonane	ND	ND	2.2 E-02
111-65-9	n-Octane	ND	ND	2.0 E-02
78-78-4	i-Pentane	ND	ND	1.3 E-02
109-66-0	n-Pentane	ND	ND	1.3 E-02
109-67-1	1-Pentene	ND	ND	1.2 E-02
627-20-3	cis-2-Pentene	ND	ND	1.2 E-02

TABLE A4 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
646-04-8	trans-2-Pentene	ND	ND	1.2 E-02
14797-73-0	Perchlorate	2.5 E-08	1.8 E-06	--
78-11-5	PETN	ND	ND	5.9 E-03
62-44-2	Phenacetin	ND	ND	8.8 E-04
80-56-8	alpha-Pinene	ND	ND	2.4 E-02
127-91-3	beta-Pinene	ND	ND	2.4 E-02
74-98-6	Propane	ND	ND	2.0 E-02
115-11-7	1-Propene, 2-methyl- <sup>g</sup>	3.4 E-07	2.4 E-05	--
103-65-1	n-Propylbenzene	ND	ND	5.5 E-03
74-99-7	1-Propyne <sup>g</sup>	2.4 E-07	1.7 E-05	--
121-82-4	RDX	ND	ND	4.8 E-04
95-94-3	1,2,4,5-Tetrachlorobenzene	ND	ND	8.8 E-04
58-90-2	2,3,4,6-Tetrachlorophenol	ND	ND	1.1 E-03
109-99-9	Tetrahydrofuran	5.2 E-08	3.7 E-06	--
479-45-8	Tetryl	ND	ND	1.6 E-03
620-23-5 / 104-87-0	m,p-Tolualdehyde	ND	ND	3.6 E-02
529-20-4	o-Tolualdehyde	ND	ND	3.6 E-02
526-73-8	1,2,3-Trimethylbenzene	ND	ND	2.1 E-02
108-67-8	1,3,5-Trimethylbenzene	ND	ND	5.5 E-03
565-75-3	2,3,4-Trimethylpentane	ND	ND	2.0 E-02
99-35-4	1,3,5-Trinitrobenzene	ND	ND	8.5 E-04
118-96-7	2,4,6-Trinitrotoluene	ND	ND	7.1 E-04
1120-21-4	Undecane	ND	ND	2.7 E-02
110-62-3	Valeraldehyde	ND	ND	3.6 E-02

<sup>a</sup> CASRN = Chemical Abstracts Service Registry Number.

<sup>b</sup> ND = nondetected.

<sup>c</sup> Emission factors rated C unless otherwise noted.

<sup>d</sup> NEW = Net explosive weight. The NEW for this compound is 1.39 E-02 pounds per item.

<sup>e</sup> Data provided for compounds that were not detected.

<sup>f</sup> Emission factor rated D because the factor is based upon C-rated test data.

<sup>g</sup> Emission factor rated D because the factor is for a tentatively identified compound.

TABLE A5 COMPOUNDS ANALYZED AND EMISSION FACTORS DEVELOPED FOR  
DODIC MN68, M151 BOOSTER DEMOLITION CHARGE

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
Carbon Dioxide, Criteria Pollutants, Total Nonmethane Hydrocarbons, and Total Suspended Particulates				
124-38-9	Carbon dioxide <sup>f</sup>	4.5 E-03	4.6 E-01	--
630-08-0	Carbon monoxide <sup>g</sup>	1.2 E-03	1.2 E-01	--
7439-92-1	Lead	1.1 E-04	1.2 E-02	--
--	Oxides of nitrogen <sup>f</sup>	9.2 E-05	9.5 E-03	--
--	PM-2.5 <sup>f</sup>	6.1 E-04	6.3 E-02	--
--	PM-10	7.3 E-04	7.5 E-02	--
7446-09-5	Sulfur dioxide	3.6 E-05	3.8 E-03	--
--	Total nonmethane hydrocarbons <sup>g</sup>	3.6 E-05	3.7 E-03	--
12789-66-1	Total suspended particulate	7.2 E-04	7.5 E-02	--
Hazardous Air Pollutants and Toxic Chemicals				
83-32-9	Acenaphthene <sup>g</sup>	ND	ND	9.1 E-04
208-96-8	Acenaphthylene <sup>g</sup>	ND	ND	9.1 E-04
75-07-0	Acetaldehyde	1.9 E-06	2.0 E-04	--
75-05-8	Acetonitrile <sup>g</sup>	3.1 E-06	3.2 E-04	--
98-86-2	Acetophenone <sup>g</sup>	1.8 E-07	1.9 E-05	--
53-96-3	2-Acetylaminofluorene	ND	ND	9.1 E-04
107-02-8	Acrolein	2.3 E-07	2.4 E-05	--
107-13-1	Acrylonitrile <sup>g</sup>	8.4 E-07	8.7 E-05	--
107-05-1	Allyl chloride	ND	ND	1.2 E-02
92-67-1	4-Aminobiphenyl	ND	ND	1.8 E-02
7664-41-7	Ammonia <sup>g</sup>	2.8 E-06	2.9 E-04	--
62-53-3	Aniline	ND	ND	1.3 E-02
120-12-7	Anthracene <sup>g</sup>	ND	ND	9.1 E-04
71-43-2	Benzene <sup>g</sup>	5.9 E-06	6.1 E-04	--
92-87-5	Benzidine	ND	ND	9.3 E-02
56-55-3	Benzo[a]anthracene <sup>g</sup>	ND	ND	1.1 E-03
205-99-2	Benzo[b]fluoranthene <sup>g</sup>	ND	ND	2.0 E-03
207-08-9	Benzo[k]fluoranthene <sup>g</sup>	ND	ND	1.1 E-03
191-24-2	Benzo[g,h,i]perylene <sup>g</sup>	ND	ND	2.9 E-03
50-32-8	Benzo[a]pyrene <sup>g</sup>	ND	ND	9.1 E-04
100-44-7	Benzyl chloride	ND	ND	5.2 E-03
92-52-4	Biphenyl <sup>h</sup>	1.1 E-07	1.1 E-05	--

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
75-25-2	Bromoform	ND	ND	1.0 E-02
74-83-9	Bromomethane	ND	ND	3.9 E-03
101-55-3	4-Bromophenylphenylether	ND	ND	9.1 E-04
106-99-0	1,3-Butadiene <sup>f</sup>	1.1 E-06	1.2 E-04	--
71-36-3	n-Butanol	ND	ND	1.2 E-02
85-68-7	Butylbenzylphthalate <sup>g</sup>	1.3 E-08	1.3 E-06	--
123-72-8	Butyraldehyde	ND	ND	2.9 E-02
7440-43-9	Cadmium	1.4 E-07	1.4 E-05	--
86-74-8	Carbazole	ND	ND	1.2 E-03
75-15-0	Carbon disulfide	1.0 E-07	1.0 E-05	--
56-23-5	Carbon tetrachloride	ND	ND	6.3 E-03
106-47-8	4-Chloroaniline	ND	ND	1.1 E-02
108-90-7	Chlorobenzene	ND	ND	4.6 E-03
75-00-3	Chloroethane	ND	ND	2.6 E-03
111-91-1	bis(2-Chloroethoxy)methane	ND	ND	9.1 E-04
111-44-4	bis(2-Chloroethyl)ether	ND	ND	1.0 E-03
67-66-3	Chloroform	ND	ND	4.9 E-03
108-60-1	bis(2-Chloroisopropyl)ether	ND	ND	1.4 E-03
74-87-3	Chloromethane	ND	ND	8.2 E-03
91-58-7	2-Chloronaphthalene	ND	ND	9.1 E-04
7005-72-3	4-Chlorophenylphenyl ether	ND	ND	9.1 E-04
108-39-4 / 106-44-5	m-Cresol/p-Cresol	ND	ND	3.6 E-03
7440-47-3	Chromium	1.6 E-06	1.6 E-04	--
218-01-9	Chrysene	ND	ND	1.2 E-03
7440-48-4	Cobalt <sup>g</sup>	1.2 E-08	1.2 E-06	--
7440-50-8	Copper <sup>g</sup>	7.4 E-07	7.6 E-05	--
4170-30-3	Crotonaldehyde	ND	ND	4.2 E-02
98-82-8	Cumene <sup>g</sup>	ND	ND	4.9 E-03
110-82-7	Cyclohexane <sup>g</sup>	ND	ND	3.4 E-03
53-70-3	Dibenz[a,h]anthracene	ND	ND	1.1 E-03
132-64-9	Dibenzofuran	ND	ND	9.1 E-04
106-93-4	1,2-Dibromoethane	ND	ND	7.7 E-03
84-74-2	Dibutylphthalate <sup>g</sup>	ND	ND	1.8 E-02
95-50-1	1,2-Dichlorobenzene	ND	ND	6.0 E-03

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
541-73-1	1,3-Dichlorobenzene	ND	ND	6.0 E-03
106-46-7	1,4-Dichlorobenzene	ND	ND	6.0 E-03
91-94-1	3,3'-Dichlorobenzidine	ND	ND	1.3 E-02
75-27-4	Dichlororobromomethane	ND	ND	6.7 E-03
75-71-8	Dichlorodifluoromethane	ND	ND	4.9 E-03
75-34-3	1,1-Dichloroethane	ND	ND	4.0 E-03
107-06-2	1,2-Dichloroethane	ND	ND	4.0 E-03
120-83-2	2,4-Dichlorophenol	ND	ND	9.1 E-04
78-87-5	1,2-Dichloropropane	ND	ND	4.6 E-03
10061-02-6	trans-1,3-Dichloro-1-propene	ND	ND	4.5 E-03
76-14-2	Dichlorotetrafluoroethane	ND	ND	7.0 E-03
60-11-7	p-Dimethylaminoazobenzene	ND	ND	9.1 E-04
57-97-6	7,12-Dimethylbenz[a]anthracene	ND	ND	9.3 E-04
119-93-7	3,3'-Dimethylbenzidine	ND	ND	9.1 E-02
105-67-9	2,4-Dimethylphenol	ND	ND	1.1 E-02
131-11-3	Dimethyl phthalate	ND	ND	9.1 E-04
99-65-0	1,3-Dinitrobenzene	ND	ND	4.6 E-03
534-52-1	4,6-Dinitro-o-cresol	ND	ND	1.6 E-02
51-28-5	2,4-Dinitrophenol	ND	ND	4.0 E-02
121-14-2	2,4-Dinitrotoluene	ND	ND	4.5 E-03
606-20-2	2,6-Dinitrotoluene <sup>g</sup>	ND	ND	8.4 E-04
88-85-7	Dinoseb	ND	ND	1.8 E-03
123-91-1	1,4-Dioxane	ND	ND	1.4 E-02
--	Total dioxin/furan compounds	2.1 E-09	2.2 E-07	--
122-39-4	Diphenylamine	ND	ND	9.1 E-04
122-66-7	1,2-Diphenylhydrazine	ND	ND	9.1 E-04
100-41-4	Ethylbenzene <sup>g</sup>	3.3 E-09	3.4 E-07	--
74-85-1	Ethylene	1.6 E-05	1.7 E-03	--
117-81-7	bis(2-Ethylhexyl)phthalate <sup>f</sup>	ND	ND	1.8 E-02
206-44-0	Fluoranthene <sup>g</sup>	ND	ND	9.8 E-04
86-73-7	Fluorene	ND	ND	9.1 E-04
50-00-0	Formaldehyde	4.2 E-07	4.4 E-05	--
76-13-1	Freon 113	ND	ND	7.6 E-03
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin <sup>i</sup>	1.0 E-10	1.0 E-08	--

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran <sup>i</sup>	2.2 E-11	2.2 E-09	--
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran <sup>i</sup>	2.6 E-12	2.7 E-10	--
118-74-1	Hexachlorobenzene	ND	ND	9.1 E-04
87-68-3	Hexachlorobutadiene	ND	ND	4.2 E-02
77-47-4	Hexachlorocyclopentadiene	ND	ND	1.8 E-02
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin <sup>i</sup>	1.2 E-12	1.2 E-10	--
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin <sup>i</sup>	2.6 E-12	2.7 E-10	--
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin <sup>i</sup>	1.8 E-12	1.8 E-10	--
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran <sup>i</sup>	1.2 E-12	1.2 E-10	--
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran <sup>i</sup>	9.3 E-13	9.6 E-11	--
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran <sup>i</sup>	1.3 E-12	1.4 E-10	--
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran <sup>i</sup>	1.6 E-12	1.6 E-10	--
67-72-1	Hexachloroethane	ND	ND	9.8 E-04
110-54-3	Hexane	ND	ND	3.5 E-03
7647-01-0	Hydrochloric acid	ND	ND	2.3 E-02
74-90-8	Hydrogen cyanide <sup>g</sup>	1.5 E-05	1.5 E-03	--
193-39-5	Indeno[1,2,3-cd]pyrene	ND	ND	9.8 E-04
78-59-1	Isophorone	ND	ND	9.1 E-04
67-63-0	Isopropyl alcohol	ND	ND	9.7 E-03
120-58-1	Isosafrole	ND	ND	9.1 E-04
7439-92-1	Lead	1.1 E-04	1.2 E-02	3.6 E-03
7439-97-6	Mercury	ND	ND	1.0 E-04
126-98-7	Methacrylonitrile	ND	ND	1.1 E-02
96-33-3	Methyl acrylate	ND	ND	1.4 E-02
56-49-5	3-Methylcholanthrene	ND	ND	9.1 E-04
75-09-2	Methylene chloride <sup>i</sup>	0	0	--
108-10-1	Methyl isobutyl ketone	ND	ND	4.1 E-03
80-62-6	Methyl methacrylate	ND	ND	1.6 E-02
91-57-6	2-Methylnaphthalene	1.6 E-08	1.6 E-06	--
95-48-7	2-Methylphenol	ND	ND	5.5 E-03
1634-04-4	Methyl tert-butyl ether	ND	ND	3.6 E-03



TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
91-20-3	Naphthalene <sup>g</sup>	1.1 E-07	1.2 E-05	--
134-32-7	1-Naphthylamine	ND	ND	1.8 E-02
91-59-8	2-Naphthylamine	ND	ND	1.8 E-02
7440-02-0	Nickel <sup>g</sup>	7.3 E-07	7.5 E-05	--
100-01-6	4-Nitroaniline	ND	ND	3.6 E-03
98-95-3	Nitrobenzene	ND	ND	5.1 E-03
55-63-0	Nitroglycerin	1.3 E-07	1.3 E-05	--
88-75-5	2-Nitrophenol	ND	ND	9.1 E-04
100-02-7	4-Nitrophenol	ND	ND	6.0 E-03
79-46-9	2-Nitropropane	ND	ND	1.4 E-02
924-16-3	N-Nitroso-di-n-butylamine	ND	ND	9.1 E-04
55-18-5	N-Nitrosodiethylamine	ND	ND	9.1 E-04
62-75-9	N-Nitrosodimethylamine	ND	ND	9.1 E-04
86-30-6	N-Nitrosodiphenylamine	ND	ND	1.6 E-03
621-64-7	N-Nitroso-di-n-propylamine	ND	ND	9.1 E-04
59-89-2	N-Nitrosomorpholine	ND	ND	9.1 E-04
100-75-4	N-Nitrosopiperidine	ND	ND	9.1 E-04
99-55-8	5-Nitro-o-toluidine	ND	ND	1.5 E-02
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	1.9 E-09	2.0 E-07	--
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran <sup>i</sup>	1.2 E-10	1.2 E-08	--
608-93-5	Pentachlorobenzene	ND	ND	9.1 E-04
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin <sup>i</sup>	1.9 E-12	2.0 E-10	--
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	ND	ND	4.3 E-09
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran <sup>i</sup>	9.0 E-13	9.3 E-11	--
76-01-7	Pentachloroethane	ND	ND	9.1 E-04
82-68-8	Pentachloronitrobenzene	ND	ND	9.1 E-04
87-86-5	Pentachlorophenol	ND	ND	4.5 E-02
85-01-8	Phenanthrene <sup>g</sup>	ND	ND	9.1 E-04
108-95-2	Phenol <sup>g</sup>	5.5 E-08	5.6 E-06	--
123-38-6	Propionaldehyde	5.9 E-07	6.1 E-05	--
115-07-1	Propylene <sup>g</sup>	3.5 E-06	3.6 E-04	--
129-00-0	Pyrene <sup>f</sup>	ND	ND	9.6 E-04
110-86-1	Pyridine	ND	ND	1.3 E-03

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
94-59-7	Safrole	ND	ND	9.1 E-04
7440-22-4	Silver	ND	ND	1.7 E-03
100-42-5	Styrene <sup>g</sup>	0	0	--
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	4.2 E-14	4.4 E-12	--
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	ND	ND	2.6 E-09
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	6.8 E-03
127-18-4	Tetrachloroethylene	ND	ND	6.8 E-03
7440-28-0	Thallium	ND	ND	6.0 E-03
108-88-3	Toluene <sup>g</sup>	0	0	--
95-53-4	o-Toluidine	ND	ND	1.2 E-02
120-82-1	1,2,4-Trichlorobenzene	ND	ND	2.9 E-02
71-55-6	1,1,1-Trichloroethane	ND	ND	5.4 E-03
79-00-5	1,1,2-Trichloroethane	ND	ND	5.4 E-03
79-01-6	Trichloroethylene	ND	ND	5.4 E-03
75-69-4	Trichlorofluoromethane	ND	ND	5.6 E-03
95-95-4	2,4,5-Trichlorophenol	ND	ND	2.4 E-03
88-06-2	2,4,6-Trichlorophenol	ND	ND	1.4 E-03
96-18-4	1,2,3-Trichloropropane	ND	ND	2.4 E-02
95-63-6	1,2,4-Trimethylbenzene <sup>g</sup>	ND	ND	4.9 E-03
540-84-1	2,2,4-Trimethylpentane <sup>g</sup>	ND	ND	1.8 E-02
108-05-4	Vinyl acetate	ND	ND	1.4 E-02
75-01-4	Vinyl chloride	ND	ND	1.4 E-02
75-35-4	Vinylidene chloride	ND	ND	4.0 E-03
106-42-3, 108-38-3	m-Xylene, p-Xylene	0	0	--
95-47-6	o-Xylene <sup>g</sup>	ND	ND	4.3 E-03
Other Pollutants				
67-64-1	Acetone <sup>i</sup>	1.8 E-06	1.8 E-04	--
74-86-2	Acetylene <sup>g</sup>	4.1 E-06	4.2 E-04	--
35572-78-2	2-Amino-4,6-dinitrotoluene <sup>g</sup>	ND	ND	5.5 E-04
19406-51-0	4-Amino-2,6-dinitrotoluene	ND	ND	5.3 E-04
100-52-7	Benzaldehyde	ND	ND	4.2 E-02
65-85-0	Benzoic acid	1.2 E-06	1.2 E-04	--
100-47-0	Benzonitrile <sup>h</sup>	2.1 E-07	2.2 E-05	--
100-51-6	Benzyl alcohol	ND	ND	6.4 E-02

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
694-87-1	Bicyclo[4.2.0]octa-1,3,5-triene <sup>h</sup>	3.2 E-07	3.3 E-05	--
106-97-8	n-Butane	ND	ND	2.4 E-02
106-98-9	1-Butene <sup>f</sup>	8.0 E-07	8.2 E-05	--
590-18-1	cis-2-Butene	1.1 E-07	1.2 E-05	--
624-64-6	trans-2-Butene	1.7 E-07	1.7 E-05	--
78-94-4	3-Buten-2-one <sup>h</sup>	3.7 E-07	3.8 E-05	--
107-14-2	Chloroacetonitrile	ND	ND	3.1 E-02
2698-41-1	o-chlorobenzalmalononitrile	ND	ND	1.8 E-03
109-69-3	1-Chlorobutane	ND	ND	3.8 E-02
59-50-7	4-Chloro-3-methylphenol	ND	ND	1.1 E-03
90-13-1	1-Chloronaphthalene	ND	ND	9.1 E-04
95-57-8	2-Chlorophenol	ND	ND	9.1 E-04
287-92-3	Cyclopentane	ND	ND	1.1 E-02
1191-96-4	Cyclopropane, ethyl- <sup>h</sup>	8.6 E-07	8.8 E-05	--
124-18-5	n-Decane	ND	ND	2.3 E-02
124-48-1	Dibromochloromethane	ND	ND	8.5 E-03
156-59-2	cis-1,2-Dichloroethene	ND	ND	4.0 E-03
156-60-5	trans-1,2-Dichloroethene	ND	ND	4.5 E-03
87-65-0	2,6-Dichlorophenol	ND	ND	9.1 E-04
10061-01-5	cis-1,3-Dichloropropene	ND	ND	4.5 E-03
141-93-5	1,3-Diethylbenzene	ND	ND	2.2 E-02
105-05-5	1,4-Diethylbenzene	ND	ND	2.2 E-02
84-66-2	Diethylphthalate	ND	ND	1.3 E-03
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	8.3 E-02
75-83-2	2,2-Dimethylbutane	ND	ND	1.4 E-02
79-29-8	2,3-Dimethylbutane <sup>g</sup>	ND	ND	1.4 E-02
565-59-3	2,3-Dimethylpentane <sup>g</sup>	ND	ND	1.6 E-02
108-08-7	2,4-Dimethylpentane <sup>g</sup>	ND	ND	1.6 E-02
117-84-0	Di-n-octylphthalate <sup>g</sup>	1.2 E-08	1.2 E-06	--
112-41-4	1-Dodecene <sup>h</sup>	1.3 E-07	1.4 E-05	--
74-84-0	Ethane <sup>g</sup>	3.8 E-06	3.9 E-04	--
64-17-5	Ethanol	ND	ND	7.5 E-03
60-29-7	Ethyl ether	ND	ND	1.2 E-02
97-63-2	Ethyl methacrylate	ND	ND	4.7 E-02
62-50-0	Ethyl methanesulfonate	ND	ND	9.1 E-04

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
620-14-4	m-Ethyltoluene <sup>g</sup>	ND	ND	2.0 E-02
611-14-3	o-Ethyltoluene <sup>g</sup>	ND	ND	2.0 E-02
622-96-8	p-Ethyltoluene <sup>g</sup>	ND	ND	4.9 E-03
142-82-5	n-Heptane <sup>g</sup>	ND	ND	4.1 E-03
1888-71-7	Hexachloropropene	ND	ND	1.3 E-03
66-25-1	Hexaldehyde	ND	ND	4.2 E-02
591-78-6	2-Hexanone	ND	ND	1.6 E-02
592-41-6	1-Hexene <sup>g</sup>	4.4 E-07	4.5 E-05	--
2691-41-0	HMX	ND	ND	2.2 E-02
75-28-5	Isobutane	1.2 E-07	1.2 E-05	--
78-79-5	Isoprene	ND	ND	1.1 E-02
590-86-3	Isovaleraldehyde	ND	ND	4.2 E-02
5989-27-5	d-Limonene	ND	ND	2.2 E-02
593-75-9	Methane, isocyano- <sup>h</sup>	2.1 E-06	2.1 E-04	--
108-87-2	Methylcyclohexane <sup>g</sup>	ND	ND	1.6 E-02
96-37-7	Methylcyclopentane <sup>g</sup>	ND	ND	1.4 E-02
78-93-3	Methyl ethyl ketone <sup>i</sup>	3.7 E-07	3.9 E-05	--
592-27-8	2-Methylheptane	ND	ND	1.8 E-02
589-81-1	3-Methylheptane	ND	ND	1.9 E-02
591-76-4	2-Methylhexane <sup>g</sup>	ND	ND	1.6 E-02
589-34-4	3-Methylhexane	ND	ND	1.6 E-02
66-27-3	Methyl methanesulfonate	ND	ND	1.0 E-03
107-83-5	2-Methylpentane <sup>g</sup>	ND	ND	1.4 E-02
96-14-0	3-Methylpentane <sup>g</sup>	ND	ND	1.4 E-02
88-74-4	2-Nitroaniline	ND	ND	9.1 E-04
99-09-2	3-Nitroaniline	ND	ND	3.6 E-03
10595-95-6	N-Nitrosomethylethylamine	ND	ND	1.5 E-03
930-55-2	N-Nitrosopyrrolidine	ND	ND	9.1 E-04
88-72-2	2-Nitrotoluene	ND	ND	3.0 E-02
99-99-0	4-Nitrotoluene	ND	ND	8.6 E-03
111-84-2	n-Nonane	ND	ND	2.1 E-02
111-65-9	n-Octane <sup>g</sup>	ND	ND	1.8 E-02
78-78-4	i-Pentane	ND	ND	1.2 E-02
109-66-0	n-Pentane	ND	ND	1.2 E-02
109-67-1	1-Pentene	3.9 E-07	4.1 E-05	--

TABLE A5 (cont.)

CASRN <sup>a</sup>	Compound	Emission Factor <sup>b,c</sup>		Minimum Detection Level mg/m <sup>3,e</sup>
		lb per item	lb per lb NEW <sup>d</sup>	
627-20-3	cis-2-Pentene	ND	ND	1.1 E-02
646-04-8	trans-2-Pentene	ND	ND	1.1 E-02
14797-73-0	Perchlorate	1.6 E-08	1.7 E-06	--
78-11-5	PETN	ND	ND	6.0 E-03
62-44-2	Phenacetin	ND	ND	9.1 E-04
80-56-8	alpha-Pinene	ND	ND	2.2 E-02
127-91-3	beta-Pinene	ND	ND	2.2 E-02
74-98-6	Propane <sup>g</sup>	7.0 E-07	7.2 E-05	--
107-12-0	Propanenitrile <sup>h</sup>	2.3 E-07	2.3 E-05	--
103-65-1	n-Propylbenzene	ND	ND	4.9 E-03
74-99-7	1-Propyne <sup>j</sup>	9.3 E-07	9.6 E-05	--
121-82-4	RDX	4.9 E-08	5.1 E-06	--
95-94-3	1,2,4,5-Tetrachlorobenzene	ND	ND	9.1 E-04
58-90-2	2,3,4,6-Tetrachlorophenol	ND	ND	1.2 E-03
109-99-9	Tetrahydrofuran	3.5 E-08	3.6 E-06	--
479-45-8	Tetryl	ND	ND	1.7 E-03
620-23-5 / 104-87-0	m,p-Tolualdehyde	ND	ND	4.2 E-02
529-20-4	o-Tolualdehyde	ND	ND	4.2 E-02
526-73-8	1,2,3-Trimethylbenzene	ND	ND	1.9 E-02
108-67-8	1,3,5-Trimethylbenzene <sup>g</sup>	ND	ND	4.9 E-03
565-75-3	2,3,4-Trimethylpentane <sup>g</sup>	ND	ND	1.8 E-02
99-35-4	1,3,5-Trinitrobenzene <sup>g</sup>	ND	ND	8.6 E-04
118-96-7	2,4,6-Trinitrotoluene <sup>g</sup>	ND	ND	7.3 E-04
1120-21-4	Undecane	ND	ND	2.5 E-02
110-62-3	Valeraldehyde	ND	ND	4.2 E-02
769-78-8	Vinyl benzoate <sup>h</sup>	4.3 E-07	4.5 E-05	--

TABLE A5 (cont.)

- <sup>a</sup> CASRN = Chemical Abstracts Service Registry Number.
- <sup>b</sup> ND = nondetected.
- <sup>c</sup> Emission factors rated C unless otherwise noted.
- <sup>d</sup> NEW = Net explosive weight. The NEW for this compound is 9.70 E-03 pounds per item.
- <sup>e</sup> Data provided for compounds that were not detected.
- <sup>f</sup> Emission factor rated A because of correlation with emission factors for similar ordnance and number of test data points.
- <sup>g</sup> Emission factor rated B because of correlation with emission factors for similar ordnance and number of test data points.
- <sup>h</sup> Emission factor rated D because the factor is for a tentatively identified compound.
- <sup>i</sup> Emission factor rated D because the factor is based upon C-rated test data.
- <sup>j</sup> Emission factor for a tentatively identified compound, but because of correlation with emission factors for similar ordnance and number of data points the factor was upgraded from a D rating to a C rating.

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## **APPENDIX B**

### **NEW AP-42 SECTIONS FOR ORDNANCE INCLUDED IN PHASE VIII TESTING AT DUGWAY PROVING GROUND, UTAH**

Electronic versions of the new AP-42 sections for ordnance included in Phase VIII testing at Dugway Proving Ground, Utah, are located on the EPA web site at:

<http://www.Epa.gov/ttn/chief/ap42/index.html>.

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