U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE DIVISION

01129

94

TRIAL BURN PLAN

DEACTIVATION FURNACE

SENECA ARMY DEPOT
ROMULUS, NEW YORK

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PREPARED BY

MAIN
1893

TRIAL BURN PLAN
FOR THE
SENECA ARMY DEPOT

CONTENTS

CONTENTS
(Cont.)

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

acfm	Actual cubic feet per minute
APE	Ammunition Peculiar Equipment
ASTM	American Society of Testing Materials
AWFMS	Automatic Waste Feed Monitoring System
AWFSO	Automatic Waste Feed Shut-off
Btu	British thermal unit
cfm	Cubic Feet Minute
CO	Carbon Monoxide
DBP	D. Butylphthalate
DNT	Dinitrotoluene
DPA	Diphenylamine
DRE	Destruction and Removal Efficiency
dscf	dry standard cubic foot
DP	Differential Pressure
FM	Factory Mutual
FSG	Flame Safeguard Panel
HCB	Hexachlorobenezene
hp	horsepower
hr	hour
HT	High Temperature
ID	Induced Draft
i/o	Input/output
LT	Low Temperature
NG	Nitroglycerin
NDIR	Non Dispersive Infrared
pcos	Personal computer operatives station
PEP	Propellant/explosive/pyrotechnic
PIC	Product of Incomplete Combustion
PLC	Programmable Logic Controller
ppm	Parts per million
PV	Process Variable
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RPM	Revolutions Per Minute
scfm	Standard cubic feet per minute
SEAD	Seneca Army Depot

ACRONYMS AND ABBREVIATIONS
(Cont.)

SOP	Standard Operating Procedures
SP	Set Point
TBP	Trial Burn Plan
$TSLoO_2$	Thermal Stability Low Oxygen

SECTION 1

INTRODUCTION

A US Army Ammunition Peculiar Equipment (APE) 1236 incineration system, located at Seneca Army Depot (SEAD) serves the purpose of incinerating obsolete munitions and explosive waste from an Army wide inventory. The obsolete munitions are incinerated to burn the explosive/propellant contents from metal components which are then recovered and sold as scrap.

This trial burn plan describes the tests that will be conducted to demonstrate the performance of the APE 1236 incineration system, in accordance with the requirements of 40 CFR 270.62. It also will show that the operation of the APE 1236 systems conforms to RCRA regulations for the incineration of hazardous waste. The following performance requirements will be demonstrated during the trial burn:

- The incinerator will achieve a destruction and removal efficiency (DRE) of 99.99% for each principle organic hazardous constituent (POHC) selected for the demonstration.

- The incinerator will not emit particulate matter in excess of 0.08 grains per dry standard cubic foot (dscf), corrected to 7% oxygen in the stack gas.

- The incinerator will achieve a 99% removal of hydrochloric acid (HCl) or 4 lb/hr HCl emission rate, whichever is greater.

- The carbon monoxide concentration in the stack gas (corrected to 7% oxygen) will be less than 100 ppmv, based on a 1 hour rolling average.

- The incinerator operation will not result in excessive fugitive emissions.

- The incinerator's automatic waste feed shutoff (AWFSO) system will be fully functional.

To present the information in a logical manner, the trial burn plan (TBP) is organized by sections. These sections are briefly described below.

Section 2, Engineering Description: Provides a detailed description of the major components and instrumentation used in the incineration system. Operating procedures for waste destruction are also included.

Section 3, Waste Characterization: Gives the composition of the waste (munitions) to be destroyed in the incineration system. Chemical and physical data for the different waste components are provided. The waste specific operating parameters are listed for each waste where available.

Section 4, Trial Burn Waste Selection: Provides rationale for the POHCs selected for the DRE demonstration tests and the waste items selected for the particulate, metals and other demonstration tests.

Section 5, Trial Burn Protocol: Gives operating parameters for the different demonstration tests. Heat and mass balance information are included.

Section 6, Sampling and Analytical Plan: Details the sampling and analytical procedures used for the different demonstration tests. The QA/QC procedures for sampling and analysis are covered. This section also lists the process conditions that will be monitored during the demonstration tests and outlines the trial burn report to be submitted to the regulatory agencies.

Section 7, AWFSO Test Procedures: Provides procedures that test and demonstrate the operation of the system which automatically shuts off waste to the incineration system when certain process conditions are not met.

Section 8, Trial Burn Schedule: Gives a day-by-day schedule of events during the trial burn.

SECTION 2

ENGINEERING DESCRIPTION

This section provides a detailed engineering description of the APE 1236 incineration system, as required by CFR 270.62. The APE 1236 is a rotary kiln incinerator which has been recently upgraded to include an afterburner and additional instrumentation. The US Army employs the APE 1236 at SEAD to deactivate munitions.

The engineering description section is divided into the following subsections:

- Description of major components
- Description of instrumentation
- Operating procedures

Equipment layout, elevation drawings and a functional control process diagram (SK 88-07) for the incineration system are located in map pockets in Volume 3 of the RCRA Part B Permit Submittal. A list of drawing, which can be found in the RCRA Part B Submittal, is included as Appendix A to this TBP. (Note that many of the drawings refer to the Tooele Army Depot. The APE 1236 incinerator system at Tooele is identical to the one located at SEAD.) An isometric of the incinerator system is shown in Figure 2-1.

2.1 Description of Major Components

2.1.1 Fuel and Waste Feed Systems

No. 2 fuel oil is used to fire the burners in both the kiln and afterburner, and propane is used as pilot fuel for the afterburner burner. The propane storage, fuel oil storage and pumping areas are shown on drawing AC SK-88-55-02 sheet 1 of 3. The propane and fuel oil piping from the storage and pumping area to the incinerator area is installed in a concrete ditch for leak containment.

The propane storage tank is a 1000 gallon horizontal drum mounted on a concrete pad. The appropriate valves, fittings, regulators, and piping are installed for propane pressure reduction and transportation to the afterburner burner pilot train.

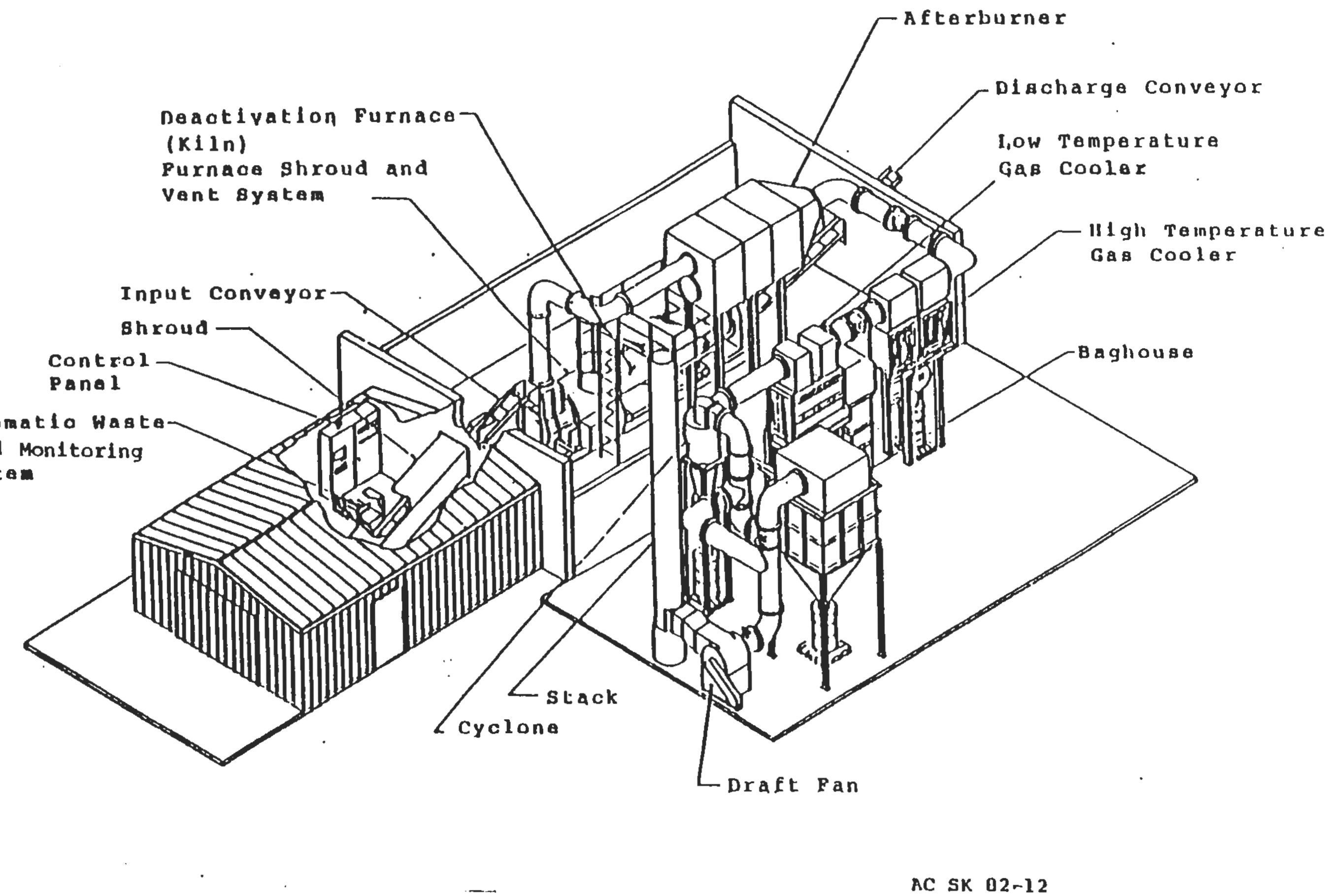


FIGURE 2-1 APE 1236 - Isometric View

2-2

The fuel oil storage tank is a 4000 gallon drum mounted on a 24'-4" by 14'-4" concrete pad. The fuel oil storage tank pad has a 30"- high wall on all sides for secondary containment. A pump, with the required valves and piping, is used to transport the fuel oil to the incinerator area.

The waste feed system consists of the waste loading conveyor kiln feed conveyor, and automatic waste feed monitoring system (AWFMS). Munitions are loaded onto the waste loading conveyor in the feed room by the automatic waste feed monitoring system, and then the waste loading conveyor transports the munitions through the kiln barrier wall to the kiln feed conveyor located inside the kiln area. The conveyor arrangement is shown in Figure 2-2.

The waste loading conveyor is 18'-6" long and 8 inches wide with flights spaced 18 inches apart. The conveyor is covered by a shroud. To prevent loading of munitions other than through the weighing system, the conveyor has a positive gear drive which is driven by an electric motor. The automatic waste feed shut off (AWFSO) system (described in Section 2.3.3) can disable the waste loading conveyor by terminating power to the drive motor.

The kiln feed conveyor is located within the kiln barrier walls. This conveyor transports munitions from the waste loading conveyor to the kiln feed chute. If the AWFSO system is activated, the waste loading conveyor stops but the kiln feed conveyor continues to run. This safety feature ensures that munitions will be loaded into the kiln once they reach the proximity of the kiln feed chute. Otherwise, the munitions could overheat and explode at the entrance to the kiln feed chute.

The kiln feed conveyor is 6 feet long and 8 inches wide with flights spaced 18 inches apart. The conveyor has a positive gear drive which is driven by an electric motor.

The AWFMS consists of a frame, weigh scale, electrical enclosures, push-off system and connection cables to the control system. The frame is made of carbon steel and is designed to fit over the waste loading conveyor and house the scale, push-off system and one electrical enclosure. The frame protects the electrical components and is part of the system which prevents exceeding the feed rate for a munition. The weigh scale is an explosion proof scale which can weigh accurately to 1/1000 of 1 pound. It weighs the munitions each time before they are loaded on the conveyor and prevents loading excess feed onto the conveyor.

The push-off system is a box mounted over the scale which is powered by an air cylinder. It pushed the munitions off the scale onto the conveyor. It is triggered automatically when the door is shut. It will not move if the munitions on the scale exceed the allowable weight limit for that item. The first electric enclosure houses the sensors transmitters and power supply for the scale. It provides signals to the control systems which are used by the PLC to make decisions and activate operations. The second electric enclosure houses the air valves which operate the air cylinders that move the push off box and lock the

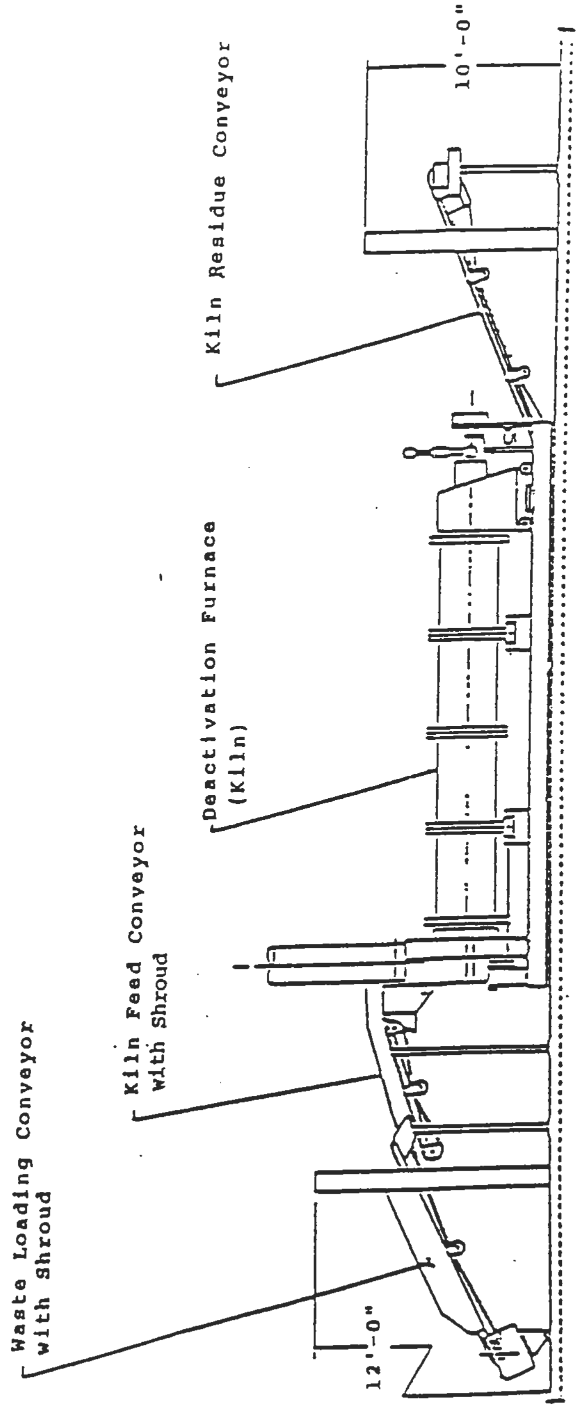


FIGURE 2-2 Input Conveyor Concept

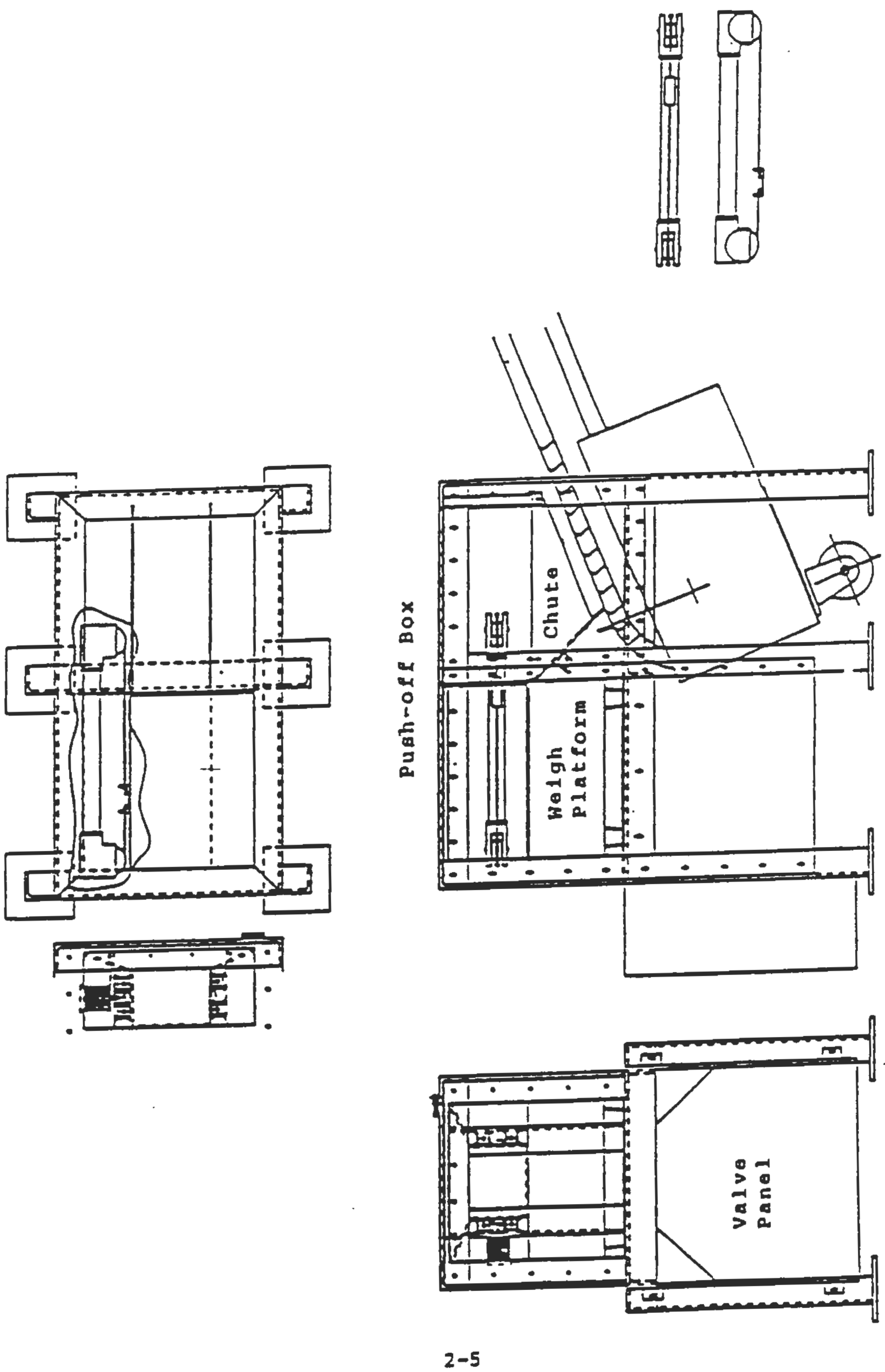


FIGURE 2-3 Automatic Waste Feed Monitoring System

door during each cycle. The cables transmit data to the computer which compares the weight on the scale with the weight which is stored in the memory of the computer. If the weight on the scale is less than the limit allowed, the computer signals the PLC to load to the conveyor. The AWFMS is shown in Figure 2-3 and on SK 89-09-01. (Drawing SK 89-02-2 through SK 89-09-20 are also provided.)

2.1.2 Rotary Kiln (Deactivation Furnace)

The rotary kiln is designed to ignite the munitions and effectively burn out reactive components from the metal shells. The heat to ignite the munitions is initially provided by fuel oil firing countercurrent to the movement of munitions. Combustion gases and entrained ash exit the kiln adjacent to the munitions feed chute. Non-entrained ash and the metal components of the munitions are discharged at the burner end of the kiln. The kiln is shown on Figure 2-4.

The munitions are propelled through the kiln toward the flame at the burner end by means of spiral flights which are an integral part of the kiln casting. As the munitions approach the flame and become heated, they either detonate or burn freely, depending upon the munition configuration and characteristics. High order detonations are contained by the thick cast steel kiln walls. The spiral flights provide physical separation of munitions or groups of munitions, discouraging sympathetic propagation of detonations and defeating fragments generated by detonations. Munitions feed rates, residence time within the furnace (determined by speed of revolution of the kiln) and operating temperatures have been established for each munition by controlled testing prior to the production operation. Munitions-specific operating conditions are discussed in Section 3.0.

The kiln is 20 feet long with an average internal diameter of 30.5 inches. It is made of four 5 foot long sections that are bolted together. The two center sections have a wall thickness of 3.25 inches and the two end sections have a wall thickness of 2.25 inches. The kiln is constructed of ASTM A217 chromium molybdenum steel for high strength and ductility at elevated temperatures. For additional personnel safety, the kiln is surrounded by barricade walls.

The kiln is equipped with a Hauck 783 proportioning burner installed in the breaching at the residue discharge end of the kiln. This is a distillate oil fired burner with a capacity of 3 million BTU/hr and a nominal turndown ratio of 4:1. Appendix B contains information on the Hauck 783 burner. Both atomizing air and combustion air are provided by a Hauck 5 hp centrifugal blower, the burner and blower assembly is shown on drawing ACT-377-200-12.

Fuel oil and combustion air are ratioed by links and levers connecting the fuel and air control valves. The control valves are operated by an actuator which receives a signal from the kiln exit temperature controller. The controller set point is determined by the munitions being burned and may range from 300°F to 900°F. The input to the controller is provided by a thermocouple located in the kiln exit duct.

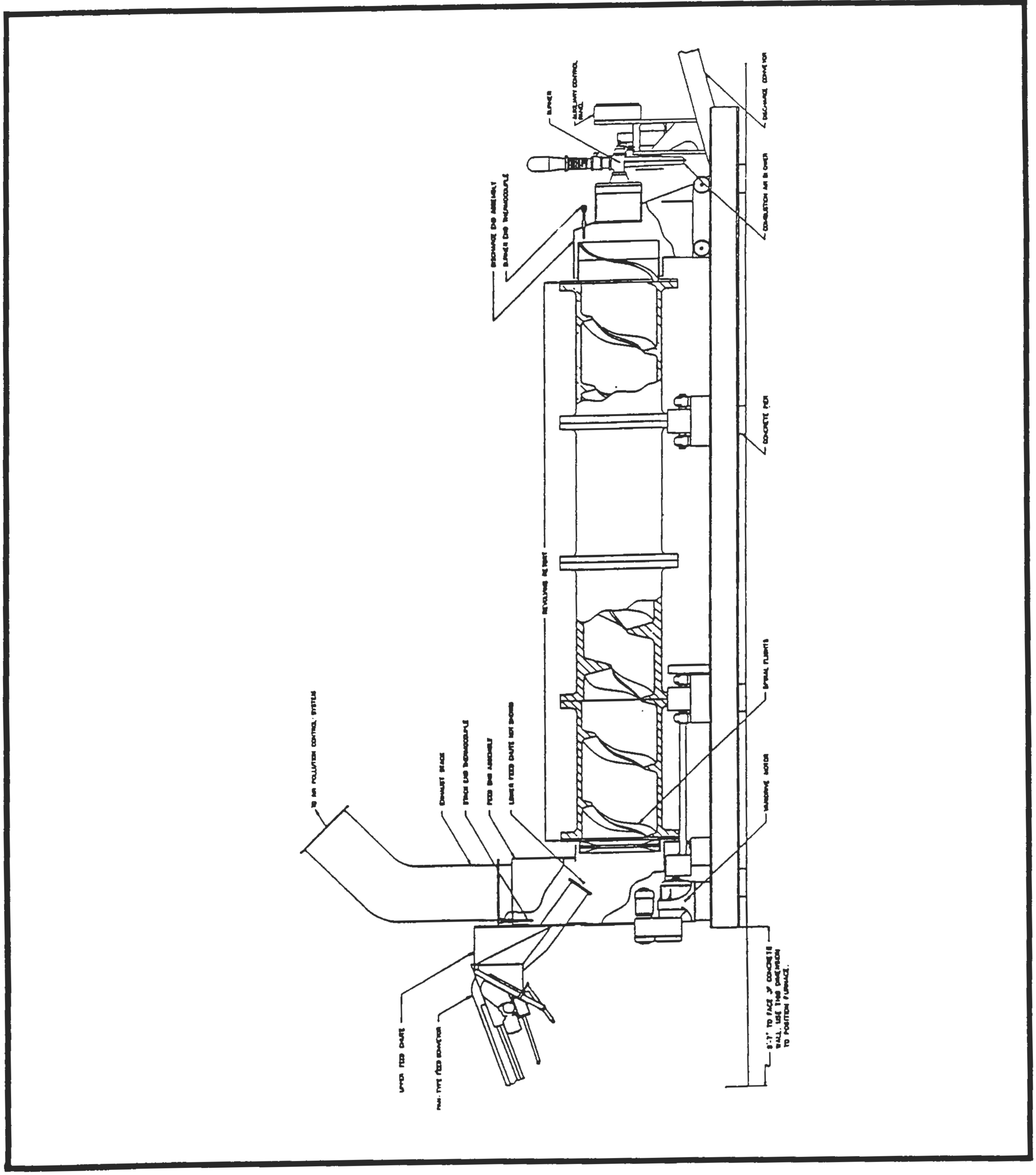


FIGURE 2-4 Deactivation Furnace

The combustion control supervisory system is a Factory Mutual (FM) approved flame safety system which includes the proper safety shut-off valves, pressure switches, pressure regulators, flame detector, and burner controller. (This is shown as the Flame Safeguard Panel, FSG on the drawing.) The burner must be ignited for waste to be fed to the incinerator.

The kiln is operated under a slight negative pressure (vacuum) to control fugitive emissions. Typically, this pressure is -0.15 to -0.25 in. water column. The vacuum is produced by an induced draft (ID) fan located between the baghouse and the exhaust stack. The negative pressure in the kiln is determined by the gas flowrate and pressure drop through the air pollution control system and ID fan. A damper installed in the duct upstream of the ID fan is opened and closed by an electric actuator to control the gas flow rate and maintain the appropriate negative pressure. The kiln vacuum is an input to the AWFSO system. The input to the damper actuator is provided by the kiln pressure controller. The input to the pressure controller is a pressure (draft) transmitter measuring the kiln discharge pressure. This control loop is P-1201 on the Functional Process Control Diagram (SK 88-07).

Fugitive emissions from the kiln are controlled by a metal shroud which covers the entire kiln assembly including the feed chute and end plates. Ducts connect the shroud to the inlet of the combustion air blower for the kiln burner. The combustion air blower creates a negative pressure inside the shroud which pulls any fugitive emissions through the blower and discharges them into the kiln via the kiln burner. The shroud is fabricated from 11 gauge, A36 carbon steel. Figure 2-5 on the following page is a concept of the fugitive emissions control system. This shroud does not extend over the discharge end of the kiln and is not required to do so. (Operating experience has shown that fugitive emissions are not a problem for the discharge end.)

The kiln is trunnion driven by an electric motor. The kiln must be turning for the AWFSO interlocks to clear, allowing waste to be fed into the incinerator. The drive system can vary the kiln rotation from 0.5 to 4.5 revolutions per minute (rpm). Varying the kiln's rotational speed changes the amount of time required for material to travel through the kiln (kiln residence time). The required kiln residence time is waste specific. The following table shows kiln speed versus kiln residence time. (This table is based on actual testing conducted at Tooele Army Depot. SEAD's deactivation furnace is identical in every respect to Tooele's.)

TABLE 2-1
KILN RESIDENCE TIME

Kiln Speed (rpm)	Inert Material Kiln Residence Time (minutes)
0.5	16.0
1.0	8.0
1.5	5.2
2.0	4.0

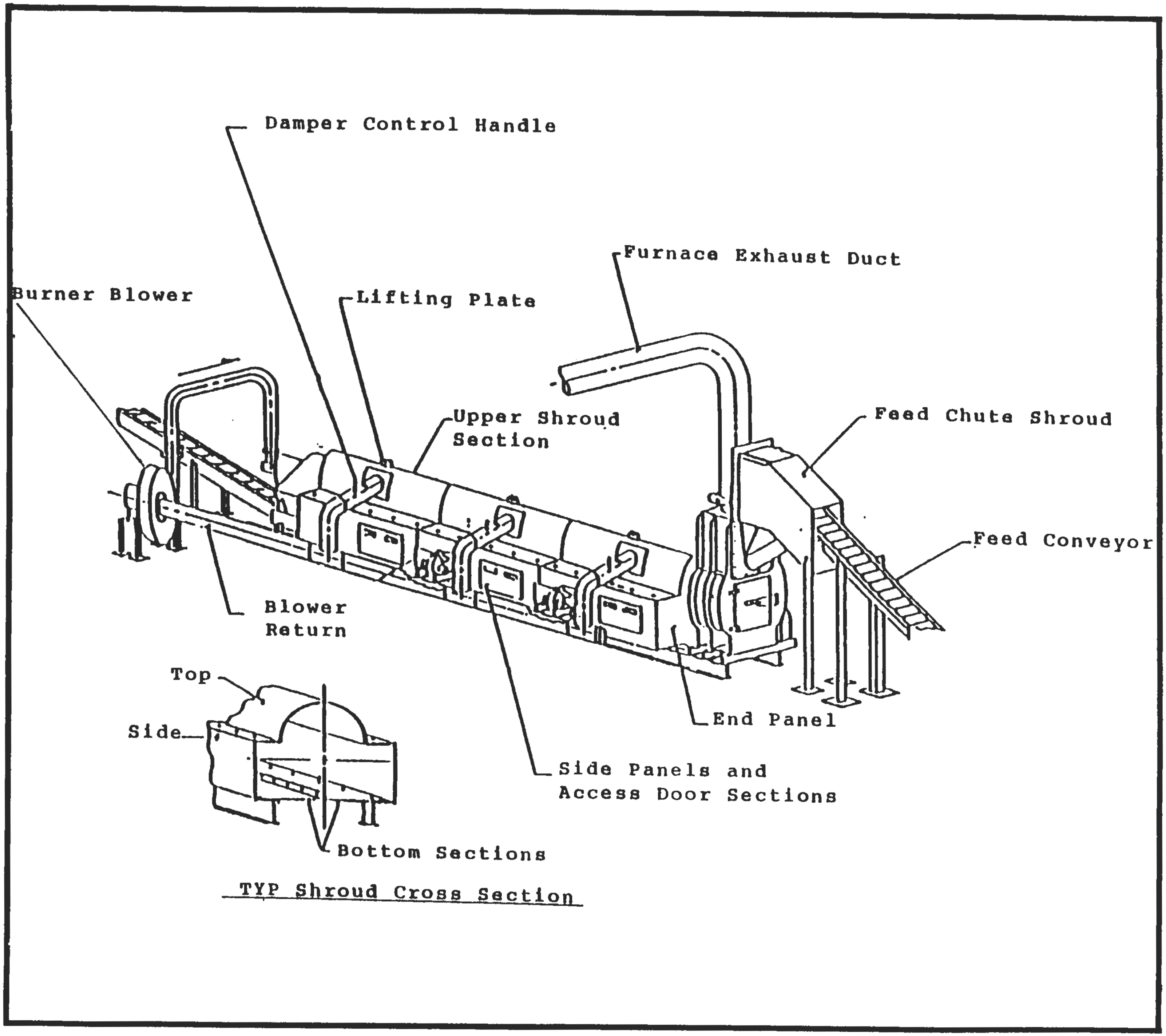


FIGURE 2-5 Fugitive Emission Control Concept

Kiln Speed (rpm)	Inert Material Kiln Residence Time (minutes)
2.5	3.2
3.0	2.6
3.5	2.3
4.0	2.0
4.5	1.8

Residue and scrap from the destroyed waste are removed from the kiln by the kiln residue conveyor. The kiln residue conveyor transports the waste from the kiln through the barrier wall to a collection point in another enclosed area. The kiln residue conveyor must be operational for the AWFSO interlocks to clear, allowing waste to be incinerated.

2.1.3 Afterburner

The kiln combustion gases are transported to the afterburner by a 24-inch-diameter steel duct. Combustion gases enter the afterburner directly above the burner at the upstream end where they are mixed with and heated by gases from fuel oil combustion. The afterburner is designed to heat up to 4,000 scfm of combustion gas from 400-900°F to 1200-1800°F, with a minimum gas residence time of one second.

The afterburner is rectangular with outer dimensions of 6 feet by 6 feet by 15 feet long with a transition cone at the discharge end. The afterburner is shown on the Southern Technologies drawing 11268-10-1 and 11263-10-3.

The afterburner is internally insulated with 8-inch-thick, 12-pound/cubic foot, ceramic fiber modules, individually anchored to the afterburner casing. The ceramic fiber surface is coated with a rigidizer/surface coating which provides surface hardness and erosion resistance. The skin temperature remains below 150°F during normal operation. The inside cross-section of the insulated afterburner is 4'8" X 4'8", with a total internal volume of 390 cubic feet.

The afterburner is equipped with a Hauck WRO-164 Wide Range burner. This burner is oil fired with a nominal capacity of 8 million Btu/hr and a 10:1 turndown ratio. Manufacturer's literature for the burner is provided in Appendix B.

Fuel oil and combustion air are ratioed by links and levers connecting the fuel and air control valves. The control valves are operated by an actuator which receives a signal from the afterburner temperature controller. The afterburner temperature controller setpoint ranges from 1200-1800°F. The input to the controller is provided by a thermocouple located in the afterburner exit duct.

The combustion supervisor system is an FM approved flame safety system which includes the proper safety shut-off valves, pressure switches, pressure regulator, flame detector and burner controller. (This is shown as the Flame Safeguard Panel, FSG on the drawing.) The burner must be ignited to enable waste incineration. The air blower is a Cincinnati Fan #HPF-7 capable of providing 1,600 scfm of air for both atomization and combustion.

2.1.4 High Temperature Gas Cooler

High temperature combustion gases exiting the afterburner flow through a 30 inch diameter stainless steel duct to the high temperature (HT) gas cooler. The HT gas cooler is a gas-to-air, cross-current, forced air heat exchanger that reduces the temperature of the combustion gases to less than 850°F. The HT gas cooler is capable of cooling 4000 scfm of combustion gas from 2200°F to 850°F. If the exit temperature exceeds 850°F, waste to the incinerator is automatically shut off. The HT gas cooler requires 25,400 cfm of 100°F ambient air to cool the combustion gases.

The gas cooler consists of two blocks containing 65 plates each. The plates have a height of 39 inches and a width of 20.5 inches. The HT gas cooler is constructed of 310 stainless steel. Combustion gases enter the inlet plenum of the cooler and pass alternately downward and upward through the first and second sections and then exit through the outlet plenum. The heat exchanger plates are spaced so that the combustion gases pass on one side and the ambient cooling air passes on the other. There are a series of plates, a series of exhaust chambers, and a series of cooling chambers. An operating data sheet is located in Appendix B and the mechanical design is shown on Drawing HTGC-1.

The blower that forces cooling air through the HT gas cooler is a 40 hp Fan Engineering #6 BCS. The blower is capable of providing 26,313 cfm at a static pressure of 5.2 inches water column. The amount of air delivered by the blower is determined by the HT gas cooler exit temperature. As the temperature changes, the output signal of the HT gas cooler temperature controller varies the damper on the blower inlet to control air flow. A thermocouple in the exit duct from the gas cooler provides the input to the HT gas cooler temperature controller.

The HT gas cooler is equipped with a sonic horn to remove particles from the exchanger plates. The horn emits sound pressure waves with sufficient vibrational energy to shear deposits from the surface of the plates, and it is operated by compressed air. The frequency of the sound waves and the duration of the cleaning cycle are adjustable from a local panel. Adjustments are made based on the temperature differential across the HT gas cooler. The sonic horn is an Envirocare #AH 30.

Particles and residue are removed from the HT gas cooler by a double chamber dumping valve. The valve has two gates that are electric motor driven. Only one gate is open at any time so the vacuum in the HT gas cooler is maintained.

2.1.5 Low Temperature Gas Cooler

Combustion gases exit the HT gas cooler through a 24-inch diameter steel duct and enter the low temperature (LT) gas cooler. The LT gas cooler is a gas-to-air, cross-current, forced air heat exchanger that reduces the combustion gas temperature to less than 350°F. The LT gas cooler is capable of cooling 4000 scfm of combustion gases from 900°F to 250°F. Waste to the incinerator is automatically shut off if the LT gas cooler exit temperature exceeds 350°F. The LT gas cooler requires 16,400 cfm of 100°F ambient air to cool the combustion gases.

The LT gas cooler consists of two blocks containing 75 plates each. The plates have a height of 50 inches and a width of 26 inches. The LT gas cooler is constructed of carbon steel. Combustion gases enter the inlet plenum of the cooler and pass alternately downward and upward through the first and second sections and then exit through the outlet plenum. Heat exchanger plates are spaced so that the combustion gases pass on one side and the ambient cooling air passes on the other. There are a series of plates, a series of exhaust chambers, and a series of cooling chambers. An operating data sheet is located in Appendix B and the mechanical design is shown on Drawing LTGC-1.

The blower that forces cooling air through the LT gas cooler is a 20 hp Fan Engineering 5.5 BCS. The blower is capable of providing 17,054 cfm at a static pressure of 3.6 inches water column. The amount of air delivered by the blower is determined by the LT gas cooler exit temperature. As the temperature changes, the output signal of the LT gas cooler temperature controller varies the damper on the blower inlet to control air flow. A thermocouple in the exit duct from the gas cooler provides the input to the LT gas cooler temperature controller. This control loop is T-901 on the Functional Process Control Diagram (SK 88-07).

The LT gas cooler is equipped with a sonic horn to remove particles from the exchanger plates. The horn emits sound pressure waves with sufficient vibrational energy to shear deposits from the surface of the plates, it is operated by compressed air. The frequency of the sound waves and the duration of the cleaning cycle are adjustable from a local panel. Adjustments are made based on the temperature differential across the LT gas cooler. The sonic horn is an Envirocare #AH 30.

Particles and residue are removed from the LT gas cooler by a double chamber dumping valve. The valve has two gates that are electric motor driven. Only one gate is open at any time so the vacuum in the LT gas cooler is maintained.

2.1.6 Cyclone

Combustion gases exit the low temperature gas cooler and enter the cyclone through a 20-inch-diameter steel duct.

The cyclone is a Duron type VM model 700/150, size 165 with a 20-inch inlet and outlet. The diameter of the cyclone is 43 inches and the inlet area is 1.65 square feet. The cyclone is fabricated from 3/16-inch-thick carbon steel.

Residue is removed from the cyclone collection hopper through an air tight slide gate valve. The slide gate valve is kept closed during operation and manually open for clean-out after shutdown. The gas pressure drop across the cyclone at normal flowrates is 2 to 5 inches water column.

2.1.7 Baghouse

Combustion gases leave the cyclone and enter the baghouse by a 20-inch-diameter steel duct. The baghouse is a rectangular enclosure 6 feet by 6 feet wide and 15 feet tall. It contains 100 bags which are 4.5 inches in diameter and 8 feet long. This results in a total filter area of approximately 950 square feet and an air-to-cloth ratio of 5.0. The bag material is Nomex felt and is silicone treated, heat set, and flameproofed.

The dust laden combustion gas stream enters the baghouse near the bottom of a hopper where it is dispersed evenly along the rows of bags (Figure 2-6). The combustion gas flows up through the filter bags and collects in the clean gas plenum, or exhaust manifold. As particles build up on the bags, the porosity of the bags is reduced creating a higher differential pressure between the dirty side and the clean side of the bags. This increased pressure drop across the bags reduces combustion gas flow through the baghouse.

The baghouse pressure drop increase is limited by periodically cleaning the bags. The baghouse has a jet-pulse cleaning system which operates by inducing momentary surges of high pressure air in the reverse direction to normal air flow. This flexes the bags outward and dislodges the dust particles causing them to fall into the hopper below. The bag cleaning is controlled automatically by a timing device which actuates one of a series of valves at a preset interval to clean one row of filter bags at a time.

The discharge temperature of the baghouse is measured by a thermocouple installed in the duct downstream of the baghouse. This temperature is indicated and recorded at the main control panel. Additionally a high temperature at the baghouse exit is alarmed in the main control panel. (This is set at ______°F and indicates a fire situation.)

Differential pressure (DP) also is monitored across the baghouse with low and high DP alarms set at 2 inches and 6 inches, respectively. A DP below 2 inches indicates a ruptured bag, while a DP higher than 6 inches indicates excessive fouling of the bags.

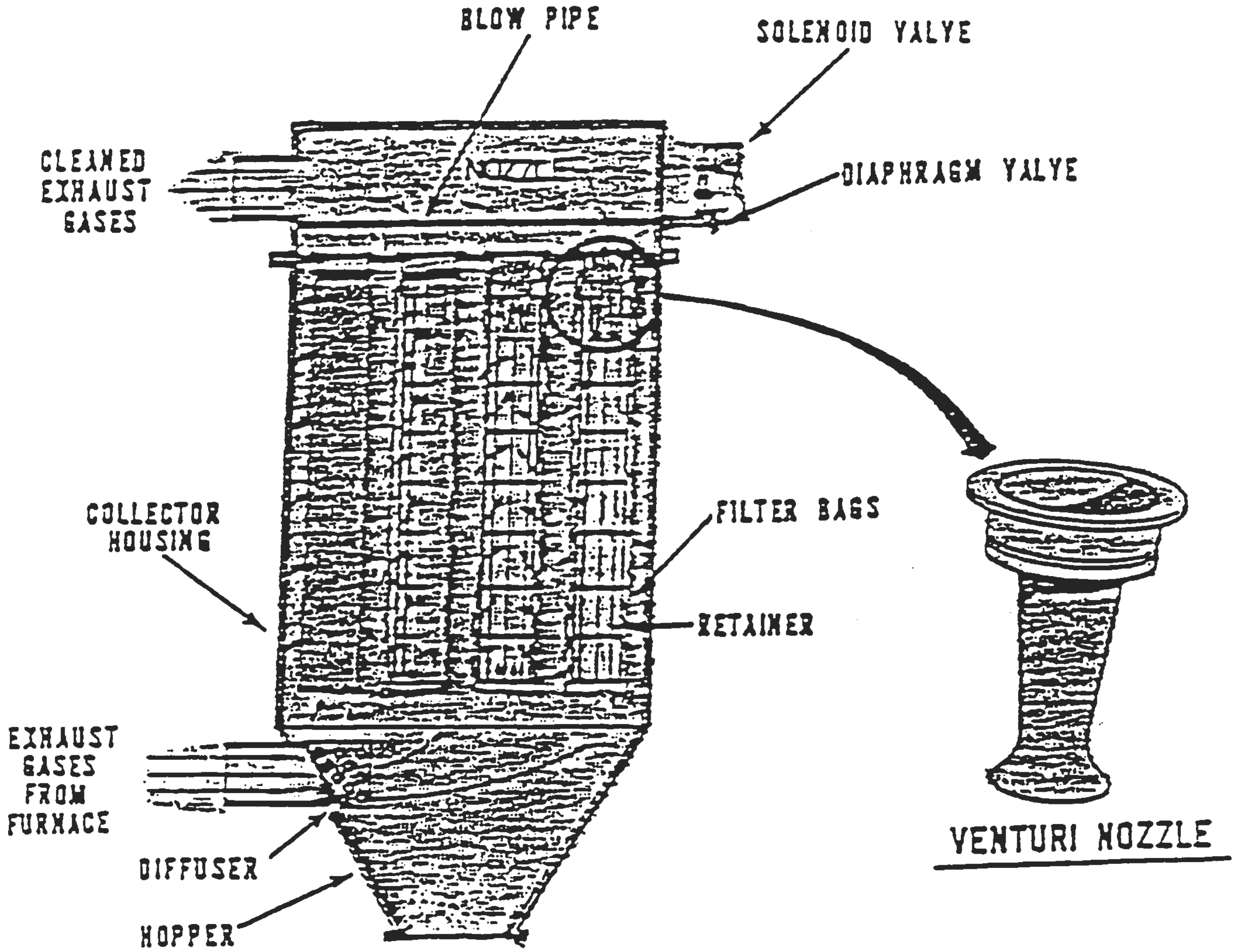


FIGURE 2-6 Baghouse Operation - Cutaway View

The baghouse is equipped with isolation and bypass valves. The isolation valves are located in the duct immediately upstream and downstream of the baghouse. The bypass valve is located in the baghouse bypass duct. These three valves operate in unison, i.e., when the bypass valve is closed, the isolation valves are open and vise versa. The baghouse is bypassed only under the following conditions: (a) when the exit temperature measurement fails, (b) during high baghouse temperature, and (c) during startup to protect the bags from moisture condensation and corrosion. The bypass is interlocked with the waste feed system so that waste cannot be fed if the baghouse is bypassed.

2.1.8 Induced Draft Fan

Combustion gases are drafted through the entire incineration system by the induced draft (ID) fan located downstream from the baghouse. The baghouse and ID fan are connected by a 20-inch-diameter steel duct. Under normal operating conditions, the total system pressure drop is 25 inches water column at 4000 scfm. The ID fan must be operating for the AWFSO interlocks to clear, allowing waste to be incinerated.

The ID fan is belt driven by a 50 hp, 1750 rpm electric motor. The capacity of the ID fan is 6700 acfm at 30 inches water column. The ID fan is designed to operate at 300°F. The ID fan information with performance curves is given in Appendix B.

A damper is installed in the duct upstream of the ID fan. This damper controls the amount of combustion gas that the fan pulls through the system. The damper is operated by an electric actuator which receives a signal from the kiln pressure controller. This loop is discussed in paragraph 2.2.2 of this subsection.

2.1.9 Exhaust Stack

Combustion gas from the ID fan is discharged into the exhaust stack and then to the atmosphere. The stack is 20 inches in diameter and 30 feet high.

The stack has various instrument ports. The ports for continuous gas analyzers and gas velocity are located at approximately 20 feet above grade. The gas analyzer port services the sampling system which supplies the continuous oxygen and carbon monoxide analyzers. These analyzers are used to indicate incinerator performance and are interlocked with the AWFSO. The gas velocity port accommodates probes which measure gas velocity, temperature and pressure in the stack. This information provides an indication of gas residence time in the incinerator and is interlocked with AWFSO.

The stack has other ports at approximately 20 feet above grade. These ports will be used during the trial bum to make measurements and extract stack samples.

2.2 Description of Instrumentation

2.2.1 Measurement Parameters and Methods

The following paragraphs discuss the different incineration process parameters to be measured and the techniques employed to make the measurements.

Temperature is the most common process measurement. Temperatures throughout the incinerator are controlled, recorded, indicated and alarmed. Type K (Chromel-Alumel) thermocouples are used for temperature measurement. Thermocouples are installed in the duct downstream from the major components. The temperature range of the different measurements depend on where in the incinerator the thermocouple is installed.

Pressure and differential pressure are measured at various locations in the incineration system. The kiln exit pressure measurement is actually a vacuum measurement. The scale is inches of water column and the value represents the number of inches of water column below atmospheric pressure. A pressure transmitter converts the vacuum measurement into an electronic signal that is transmitted to a remote device. Differential pressure is also measured in inches of water column. Differential pressure measurements are used to indicate the pressure drop across major components in the incineration system. Differential pressure is measured with a local pressure gauge or a pressure transmitter which transmits an electronic signal that is proportional to the differential pressure being measured.

The total fuel oil flow to the incinerator is measured by a flowmeter. The flowmeter is located in the fuel oil piping in the incinerator area, and is installed prior to the piping split to the kiln burner and afterburner burner. The flowmeter is a positive displacement type that transmits an electronic signal to the main control panel for recording.

Stack gas velocity is measured by sensors installed in the exhaust stack. The sensors measure gas velocity and temperature. The velocity sensor is a S-type pitot tube positioned to sense the average gas velocity in the stack. The pitot tube measures the differential pressure between stack static pressure and impact pressure created by the gas velocity. A type K thermocouple is used to measure stack gas temperature. Both sensors are connected to transmitters which transmit signals to a signal conditioning device. This device receives the signals, performs various calculations and produces an output which represents the temperature compensated stack gas velocity. These data are recorded at the main control panel. The stack gas velocity measurement system is manufactured by EMRC. Appendix B contains information on this system.

The incinerator is equipped with a continuous emissions monitoring (CEM) package which measures oxygen and carbon monoxide (CO) in the stack gas. The CEM package includes a sampling system which continuously pulls a stack gas sample and transports it to the analyzers. The sample extraction point is located in the stack approximately 20 feet above grade. The following components are included in the sampling system:

- Sample extraction probe with continuous opening the length of the probe
- Heat traced sample lines
- Calibration ports
- Refrigerated condenser for water vapor removal
- Sample pump
- Filters
- Flowmeters for each analyzer

The CEM package includes automatic calibration which allows the analyzers to be calibrated periodically without operator intervention. Appendix B contains the system description and drawing.

The analyzer used to continuously measure the concentration of oxygen in the stack gas is located in the analyzer panel in the feed room. It is a Rosemount/Beckman 755 oxygen analyzer which utilizes the paramagnetic measurement technique. Additionally,analyzer is a multi-range unit which includes a 0-25% scale. Appendix B contains the description and specifications for this analyzer.

The output signal from the analyzer is recorded at the main control panel and is used by the computer system to correct the CO measurement to 7% oxygen content in the stack gas.

The parts per million (ppm) level of CO in the stack gas is continuously monitored by a CO analyzer located in the analyzer panel. The CO analyzer is a Rosemount/Beckman 880 non-dispersive infrared (NDIR) analyzer. The analyzer is a dual range model which includes a 0-200 ppm and a 0-3000 ppm range. Manufacturer's information with specifications is included in Appendix B.

The output signal from the analyzer is corrected to 7% oxygen by the computer system. The corrected CO value is recorded, used for AWFSO interlocking and used to limit feedrate during high CO conditions.

2.2.2 Panel Instrumentation

The panel instrumentation includes the devices located in the main control panel or in local panels throughout the incineration system. Instruments which control, indicate, record and alarm process parameters are considered panel instrumentation. The following paragraphs will describe the equipment employed to perform the various functions listed above.

The incinerator is equipped with process controllers to control process parameters. A process controller receives an analog signal from a transmitter which represents the value of the process parameter or variable (PV) being measured. The process controller compares the PV with the set point (SP), which is the desired value of the process variable. If an error between the PV and the SP exists, the process controller generates an output signal which is proportional to the error. The output signal is transmitted to a final control element which adjusts the process by some method to obtain the SP. The final control element may be a control valve, a damper or a variable motor speed drive.

The incinerator uses process controllers to control the kiln temperature (TIC-601), kiln draft (PIC-1201), afterburner temperature (TIC-701) and low temperature gas cooler exit temperature (TIC-901). The process controllers also communicate with the computer system which is described later. The control loops which utilize process controllers are shown on the Functional Process Control Diagram (SK 88-07). The incinerator uses Honeywell UDC 3000 process controllers which are described in Appendix B.

The incinerator is equipped with burner control systems to monitor and control the kiln and afterburner burners. A burner controller is a sequence controller which supervises the pre-ignition air purge, ignition, main flame operation and post operation air purge. The burner controller monitors pre-ignition interlocks such as combustion air availability, fuel oil pressure and ID fan status. The flame status is monitored by a flame detector. Burner controller outputs spark the flame ignitor during ignition, open the pilot valve during ignition and open the fuel oil safety shut-off valves during main flame operation. The burner controller systems are FM approved flame safety systems. Honeywell BC 7000 burner controllers are used. Honeywell information concerning the burner controller is included in Appendix B.

A multipoint digital recorder is used to record process parameters. The recorder accepts analog input signals from transmitters which represent the value of the process parameter being measured. The recorder is capable of recording 14 process parameters on an input value versus time scale. The recorder also communicates with the computer system. Information on the recorder, a Honeywell DPR 1500, is included in Appendix B. The following is a list of the process parameters that are recorded:

- Total fuel oil flow, FR-101
- Kiln temperature, FR-601
- Kiln draft, PR-1201
- Afterburner temperature, TR-701
- High temperature gas cooler exit temperature, TR-801
- Low temperature gas cooler exit temperature, TR-901
- Baghouse differential pressure, PDR-1001
- Baghouse exit temperature, TR-1002
- Stack gas velocity, FR-1401

- Stack gas oxygen concentration, AR-1301
- Stack gas CO concentration, AR-1301

The baghouse status (on-line or standby) is not usually recorded, however, this information is stored internally on the computer system and can be accessed as required. Logic control for the incinerator is performed by a programmable logic controller (PLC). The PLC receives both discrete (on/off) inputs from switches and analog inputs from transmitters. The PLC operates motor starters, AWFSO and other interlocks, and alarms by employing configurable functions of math, counter, sequence, relay and time. The PLC is a Honeywell IPC 620 system complete with discrete and analog I/O and a data communication link so information can be shared with the computer system. Information on the PLC system is supplied in Appendix B.

The computer system is a personal computer operating station (PCOS) which provides centralized and integrated data management, process graphics, operator interface and report generation. Through a serial data link, the PCOS communicates with the process controllers, PLC and recorder. All process parameters and information contained in these devices are available to the PCOS. The PCOS generates reports, logs data, develops historical trends, displays process parameters and alarms process parameters based on information gathered from the process controllers, PLC and recorder. One of the primary functions of the PCOS is to record process data for internal use and regulatory compliance. The PCOS includes the following items: personal computer with keyboard and color graphics monitor, line printer and distributed automation and control software. Information on the PCOS is supplied in Appendix B.

Table 2-2 is the functional chart of process conditions which list the functions performed by the panel instrumentation on each process measurement.

2.2.3 Automatic waste feed shut Off (AWFSO) System

Certain process conditions are required before munitions can be fed into the incinerator. The required conditions include minimum and maximum values of some process parameters, status of certain motors, status of burner flames, and operability of certain instruments. If waste is being fed and the incinerator deviates from any of the required conditions, waste is automatically shut off. When waste is automatically shut off, the waste loading conveyor is stopped instantly but the kiln feed conveyor continues to run so that any munitions in the kiln area will be loaded into the kiln. Table 2-3 on the following page lists the process conditions which automatically shut off waste to the incinerator.

TABLE 2-2
FUNCTIONAL CHART OF PROCESS CONDITIONS

Process Conditions	Loop No.	Indicated	Recorded	Controlled	High Alarm	Low Alarm	AWFSO
Fuel Oil Flow	F-101		●				
Waste Feed Rate	W-501	●	●	●			●
Kiln Rotational Speed	S-602	●		●			●
Kiln Temperature	T-601	●	●	●	●	●	●
Kiln Flame	B-601	●			●		●
Kiln Residue Conveyor		●			●		●
Kiln Pressure	P-1201	●	●	●	●	●	●
Afterburner Temperature	T-701	●	●	●	●	●	●
Afterburner Flame	B-1002	●			●		●
High Temperature Gas Cooler Exit Temperature	T-801	●	●		●	●	●
Low Temperature Gas Cooler Exit Temperature	T-901	●	●	●	●	●	●
Baghouse Pressure Drop	PD-1001	●	●		●	●	●
Baghouse Exit Temperature	T-1002	●	●		●	●	●
Baghouse Bypass		●					●

TABLE 2-2

FUNCTIONAL CHART OF PROCESS CONDITIONS
(Cont'd)

Process Conditions	Loop No.	Indicated	Recorded	Controlled	High Alarm	Low Alarm	AWFSO
ID Fan		●					●
Exhause Stack Gas Velocity	F-1401	●	●		●		●
Exhaust Stack Temperature	T-1401	●	●				
Exhaust Stack Pressure	P-1401	●	●				
Stack Oxygen Concentration	AR-1301	●	●		●		
Stack Carbon Monixide Concentration	AR-1301	●	●		●	●	●

TABLE 2-3

AUTOMATIC WASTE FEED SHUT-OFF CONDITIONS AND VALUES

Condition	Minimum Value	Maximum Value
Carbon Monoxide in Exhause Stack	None	100 ppm (Note 1)
Afterburner Temperature	1200 °F	1800 °F
Kiln Temperature	300-350 °F (Note 2)	1100 °F
Kiln Pressure	None	-0.08 inches WC
Waste Feed Rate	None	Waste Specific
Gas Velocity in Exhaust Stack	None	50 fps
Pressure drop across Baghouse	2 in. wc	6 in. wc
HT Gas Cooler Exit Temperature	None	850 °F
LT Gas Cooler Exit Temperature	None	350 °F
Kiln Flameout		
Afterburner Flameout		
Bypass Baghouse		
Kiln Rotation Stops		
Kiln Residue Conveyor Stops		
ID Fan Stops		
Oxygen Analyzer Failure		
Carbon Monoxide Analyzer Failure		
Failure of Data Recorder		
Failure of any Temperature Monitoring System		
Failure of the Automatic Waste Feed Monitoring System		
Failure of any Process Controller		
Baghouse Differential Pressure Transmitter Failure		

NOTES:

1. The Carbon Monoxide measurement is corrected to 7% Oxygen. Waste feed is shut off when the rolling average of the CO corrected for O_2 on a dry basis is above 100 ppm. The waste feed can only be restarted when the rolling average drops below 100 ppm

2. Munition specific.

2.3 Operating Procedures

This subsection outlines the procedures used to operate the incineration system. The description presents an overview of the operating procedures and is not intended to be used to operate the incinerator. The incinerator operational manual and the stand operating procedures (SOP) contain more detail and are the official documents used to operate the incinerator.

The different operational items to be performed are listed for each of the various operating procedures. The following procedures are covered:

- Startup
- Operation
- Shutdown
- Scrap and residue handling
- Baghouse bypass

2.3.1 Startup Procedures

- Perform operational inspection and complete pre-startup check list.

The following procedures will be performed automatically upon automatic start-up but would be conducted in this manner if manual start-up were to be undertaken.

- Bypass the baghouse.
- Start the ID fan with the kiln pressure controller in manual.
- Start the gas cooler blowers with the LT gas cooler motor speed controller in manual.
- Start the air compressor.
- Start the fuel oil pump and open the hand valves to the burners.
- Start the afterburner combustion air blower.
- Place the afterburner temperature controller in manual and slightly open the control valve.
- Ignite the afterburner burner.
- Start the kiln rotation.
- Start the kiln combustion air blower.
- Place the kiln temperature controller in manual and slightly open the control valve.
- Ignite the kiln burner.
- Adjust the set points on the process controllers and place the controls in the automatic mode.
- Date and sign the recorder chart. Verify all recorded conditions are being correctly recorded.
- Enter the type of munitions into the computer system.
- Adjust the rotation speed of kiln for the type of munitions to be fed.

- Adjust the kiln temperature set point for the type of munitions to be fed.
- Start the waste loading, waste feed, and residue conveyors.
- Start the baghouse bag cleaning cycle.
- Open the baghouse block valves and close the baghouse bypass valve.
- Start the gas cooler sonic cleaners.
- Close the kiln barrier walls.
- Feed the munitions at specified feedrate.

Note that no waste is fed to the kiln until the baghouse in on-line.

2.3.2 Operation Procedures

These procedures are to be performed while the incinerator is burning munitions.

- Monitor the main control panel closely to
  - Monitor process conditions
  - Verify that correct recording and data logging are being performed
  - Verify that control functions are being performed
  - Handle alarm conditions as required
- Inspect exhaust stack emissions hourly (minimum).
- Check all local indicators on incinerator for proper values.
- Inspect the operation of rotating equipment outside of kiln barrier walls.

2.3.3 Shutdown Procedures

The following procedures will be performed during automatic shutdown (These procedures can be initiated manually or as an automatic response from the AWFSO system):

- Stop waste feed to kiln.
- Maintain all other operating conditions, including kiln and afterburner temperature, for 15 minutes (minimum) or until kiln residue conveyor is empty, whichever is greater.
- Place process controllers in manual.
- Shut off the kiln burner flame but keep combustion air blower on and combustion air valve open.
- Shut off the afterburner burner flame but keep combustion air blower on and combustion air valve open.
- Shutdown fuel oil pump.
- Open ID fan damper fully.

- After kiln temperature is below 400°F and afterburner temperature is below 600°F, the following equipment is shutdown:

  - Kiln combustion air blower
  - Afterburner combustion air blower
  - ID fan
  - Gas cooler blowers
  - Baghouse residue valve
  - Gas cooler residue valves
  - Kiln rotation drive
  - Kiln residue conveyor

Conditions which would initiate an automatic shutdown are discussed in Section 2.2.3 and are shown on Table 2-3. It is important to note that kiln and afterburner conditions are maintained until all the waste is incinerated. This is for safety and to ensure continued destruction of the hazardous waste.

2.3.4 Scrap and Residue Handling

Scrap and residue will not be handled until cooled and the kiln residue conveyor has been observed running empty. After the scrap and residue has completely cooled, samples from each container will be inspected for complete deactivation. The scrap will be reprocessed, if required. Any scrap accumulated after an emergency shutdown will be reprocessed.

When different munitions are fed, a minimum 15-minute waiting period will be necessary and the kiln residue conveyor must run empty before scrap containers can be changed. Scrap containers must be changed to separate classes of scrap.

2.3.5 Baghouse Bypass

The baghouse is bypassed only under the following conditions:

- exit temperature measurement failure
- high baghouse temperature alarm
- startup operations

The bypass is interlocked with the AWFSO system so that waste cannot be fed if the baghouse is bypassed.

SECTION 3

WASTE CHARACTERIZATION

Most of the munition items and bulk explosives that may be incinerated at the facility are Class A, B and C explosives. These materials include small arms ammunition, propellants, artillery ammunition, rockets, boosters, impulse cartridges, fuzes and numerous components that are used in the assembly of conventional munitions. Aged or obsolete batches of these materials are periodically shipped to the incineration facility, at which point they become "wastes" as defined by RCRA.

All of these wastes are bulk solids or end-item munitions. They are all fed to the rotary kiln by the conveyor system described in Section 2. No liquid wastes are burned in the incinerator.

Ninety-eight types of munitions have been identified as potential candidates for incineration at SEAD. It is important to note that only those munitions identified as part of TBP will be incinerated and that all of these munitions have been completely characterized. No uncharacterized munitions will be accepted at SEAD for incineration. For purposes of discussion, these munition items have been divided into three categories - groups - I, II, and Class C.

Group I munitions includes those items for which chemical composition data are available and feed rates have been established. These feedrates have been determined through controlled experimentation by U.S. Army personnel and are mandatory standards for safe operation of the incinerator. These feedrates are never exceeded during the operation of the incinerator nor are multiple munition items burned simultaneously.

Group II munitions are chemically characterized but have not had standard feedrates or kiln operating conditions established as yet. The data presented in the following tables are "generic feedrates," or maximum feedrates based on the following criteria:

1. The ash yield rate cannot exceed the highest ash yield rate established in the trial burn.
2. The chlorine feedrate must be less than 2 lb/hr (to ensure maximum HCl generation rate less than 4 lb/hr).
3. The organic hazardous constituent feedrates cannot exceed the corresponding maximum POHC feedrates established in the trial burn.
4. The total propellant/explosive/pyrotechnic (PEP) feedrate must be less than 100 lb/hr.

The last criterion is a safety measure imposed by the US Army for waste munitions that have not previously been incinerated.

It is important to note that the generic feedrates for Group II items are interim limits established for regulatory compliance purposes. These feedrates will not be exceeded during any tests conducted by U.S. Army personnel. The standard feedrates that will ultimately be established for these items will not exceed the generic feedrates, although they may be substantially lower due to other operational considerations.

Class C munitions represent small ball ammunition which is not considered a hazardous waste by the EPA. Class C munition will also be burned in the incinerator and has been included for completeness.

The following tables (3-1 through 3-6) list the 98 munitions that will be incinerated, including model number, along with the standardized feed rates. Kiln temperature and rotation rates for standard operation are also indicated where available. In addition, the tables also list the thermal input rate, ash yield rate, chlorine feed rate, the organic hazardous constituent feed rates, metal hazardous constituent feed rates and the total hazardous metals feed rates for each munition item. This data set provides the basis for selecting trial burn wastes, as described in Section 4.

The heating value, ash content, chlorine content and organic hazardous constituent data in the tables are derived from the detailed waste characterization data in Appendix C. Tables C-1 and C-2 provide chemical compositions for the munition items. These data are based on military specifications for manufacture of the munitions and are thus quite accurate. Table C-3 presents chlorine, ash and heating value calculations for Class C munitions. Table C-4 presents ash yield, chlorine content, and higher heating value data for each chemical compound used in the munition formulations. The ash yields and heating values are based on thermodynamic reaction pathways for the munitions in the incinerator environment. **[Table C-5 lists missing data from Table C-4. This is for information purposes for this draft only and will not be included in the final submittal.]**

Table 3-1

	Group - I Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
1	20mm,HET	MK-4	400	1.8	900	92.89	4,551	422,768	0.0039	0.36
2	20mm,HEI	M56A3	400	1.8	900	98.22	5,625	552,544	0.1416	13.91
3	20mm,INC	M-96	400	1.8	630	57.47	4,745	272,728	0.2781	15.98
4	20mm,HEI/DB	M97A2	400	1.8	900	82.16	5,733	471,025	0.1388	11.41
5	20mm,HEI/SB	M97A2	400	1.8	900	82.16	5,296	435,104	0.1343	11.03
6	20mm,HEI	M210	400	1.8	900	83.44	5,773	480,949	0.1624	13.53
7	40mm,APT	M81	400	1.5	950	19.05	6,710	127,848	0.2289	4.36
8	40mm,CTG	M385	400	1.5	660	6.53	4,797	31,286	0.0188	0.12
9	40mm,CTG	M407			660	8.36	821	6,871	0.2270	1.90
10	76mm,HVTPT	M315A1	400	1.0	660	0.00	2,254	3	0.4766	0.00
11	76mm,APT	M339	400	1.0	330	0.00	2,254	2	0.4766	0.00
12	Fuzes	MK-27	400	1.5	660	33.17	5,202	172,555	0.4632	15.36
13	Fuzes	MK31, MD2			600	4.65	4,885	22,735	0.0660	0.31
14	Pnt.Deton	M48			660	0.58	1,341	774	0.7832	0.45
15	Fuze Deton	M66A1	300	1.2	660	10.13	4,721	47,807	0.2662	2.70

Table 3–1

	Group – I Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
16	Fuze Deton	M66A2	300	1.2	660	10.13	4,721	47,807	0.2662	2.70
17	Grenade Fuze	M204A2			1,175	0.06	2,701	161	0.6686	0.04
18	Grenade Fuze	M206			1,175	0.06	2,701	161	0.6686	0.04
19	Grenade Fuze	M213			1,175	0.06	2,701	161	0.6686	0.04
20	Grenade Fuze	M215			1,175	0.06	2,701	161	0.6686	0.04
21	Grenade Fuze	M502	400	1.7	440	20.86	5,171	107,888	0.0162	0.34
22	Pnt.Deton	M557	400	1.7	440	24.01	5,730	137,557	0.0181	0.44
23	Pnt.Deton	M572			440	24.01	5,730	137,557	0.0181	0.44
24	Rockmotor Ignitors	M20A1			660	5.48	2,419	13,250	0.4106	2.25
25	Rockmotor Ignitors	MK–117	350	1.2	2,280	9.77	2,401	23,461	0.4107	4.01
26	Rockmotor Ignitors	MK–118	350	1.2	2,280	9.77	2,401	23,461	0.4107	4.01
27	Rockmotor Ignitors	MK125–5	300	2.7	6,600	9.43	2,401	22,638	0.4107	3.87
28	Motor 3.5"		400	1.0	240	86.40	5,116	442,016	0.0316	2.73

Table 3–1

	Group – I Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
29	Eject Crtg	CCU–1/B	400	2.5	6,600	7.82	5,764	45,049	0.4172	3.26
30	Booster	M21A4	400	1.5	440	20.20	5,216	105,336	0.0084	0.17
31	Booster	MK39–MD0			480	28.51	5,261	150,001	0.0000	0.00
32	Dentent		400	1.5	22,500	32.14	5,261	169,104	0.0000	0.00
33	Detonator	M17			19,500	13.33	2,197	29,275	0.5692	7.59
34	Detonator	M22			5,860	3.49	2,192	7,650	0.5566	1.94
35	Detonator	M24			19,500	10.86	1,119	12,154	0.7499	8.15
36	Detonator	M55	400		19,500	3.65	1,824	6,667	0.5647	2.06
37	Impul Ctg	MK15–MD0	400	1.5	45,000	1.67	2,331	3,895	0.4401	0.74
38	Cutter Ctg.	M21			2,640	0.81	3,824	3,101	0.1951	0.16
39	Cutter Ctg.	M22			2,640	0.81	3,824	3,101	0.1951	0.16
40	Fin Assy w/primer	81MM MORT	300	2.0	2,640	46.71	5,339	249,393	0.0106	0.50
41	Propellant	M1, MP			240 LB/HR	240.00	5,301	1,272,228	0.0000	0.00
42	Propellant	M7			100 LB/HR	100.00	5,116	511,600	0.0316	3.16

Table 3–1

	Group – II Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
43	Primer, PERC	M26			50,000(C)	12.86	1,128	14,504	0.6003	7.72
44	Primer, PERC	M47			1200(A)	51.60	2,398	123,740	0.4111	21.21
45	Primer, PERC	M68			1200(A)	51.60	2,398	123,740	0.4111	21.21
46	Primer, PERC	M79			1000(A)	54.43	2,399	130,562	0.4110	22.37
47	Primer, PERC	M80A1			780 (A)	92.71	3,220	298,526	0.2458	22.61
48	Fuze, Time	M65A1			13000 (A)	55.06	2,401	132,206	0.4107	22.61
49	Pnt.Deton	M78A1			1900(E)	96.60	5,151	497,633	0.0212	2.05
50	Base Deton	M91A1			1900(E)	95.92	5,137	492,719	0.0915	8.77
51	Pl B. DET	M509A1			5500(E)	98.51	5,158	508,145	0.0118	1.16
52	Fuze, Prox	M513A1			1800(E)	99.85	5,235	522,702	0.0043	0.43
53	Pnt.Deton	M521			34000(A)	37.20	1,895	70,515	0.6007	22.35
54	Pnt.Deton	M525			2500(E)	96.43	4,108	396,174	0.0106	1.02
55	Pnt.Deton	M564			1900(E)	98.18	4,085	401,073	0.0278	2.73
56	Simulator projectile	M74			500(A)	39.06	3,471	135,580	0.5557	21.71

Table 3–1

	Group – II Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
57	deleted									
58	deleted									
59	Signal ILL	M158			475 (A)	38.74	2,996	116,085	0.5877	22.77
60	Rocket–3.5"	M29A2			270(E)	99.44	5,055	502,673	0.0401	3.99
61	Mine Activ	M1			14800(E)	99.76	4,844	483,197	0.0931	9.29
62	Fuze Booster	M125A1			1800(E)	95.66	5,602	535,894	0.0043	0.41
63	Ignit. CTG	M5A2			17400	99.43	5,343	531,237	0.0083	0.83
64	Delay Plung	M1			105000(A)	32.55	1,347	43,842	0.6936	22.58

Table 3–1

	Class c Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
65	5.56 mm cart.	M195			22,550	88.07				
66	5.56 mm cart.	M200			22,550	23.79				
67	7.62 mm cart.	M61			22,550	133.71				
68	7.62 mm cart.	M62			22,500	146.57				
69	7.62 mm cart.	M64			22,500	118.61				
70	7.62 mm cart.	M82			22,500	50.14				
71	50 cal. cart.	M2			8,000	271.20				
72	50 cal. cart.	M8			8,000	288.34				
73	50 cal. cart.	M20			8,000	279.20				
74	50 cal. cart.	M1			8,000	55.20				
75	50 cal. cart.	Tracer			6,750	306.93				
76	30 cal. cart.	Tracer			22,500	214.07				
77	30 cal. cart.	M2			22,500	178.71				
78	30 cal. cart.	M1909			22,500	40.50				

Table 3–1

	Class c Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
79	20 mm cart.	HEI–s.base			900	98.70				
80	20 mm cart.	M53			1,200	118.80				
81	20 mm cart.	M96			900	82.11				
82	Primers	M28B2			2,700	116.10				
83	Primers	M34			22,500	1.90				
84	Primers	40A2			1,350	52.76				
85	Primers	M57			660	6.22				
86	Primers	M71			22,500	11.31				
87	Primers	M82			22,500	2.02				
88	Fuzes	M66A1/A2			675	10.36				
89	Fuzes	MK27*			440	22.11				
90	Fuzes	M557			440	22.36				
91	Fuzes	M501			660	0.58				
92	Fuzes	M502			450	21.34				
93	Fuzes	M564			440	22.74				

Table 3–1

	Class c Munition	Model Number	Min Kiln Temp (F)	Kiln Speed (RPM)	Max Items Feedrate Items/hr	Max PEP Feedrate LB/hr	Heating Value BTU/LB	Max Thermal Input BTU/hr	Ash LB/LB	Max Ash Feedrate LB/hr
94	Fuzes	M605			32	0.08				
95	Miscellaneous	M21A4			440	20.20				
96	Miscellaneous	Detent			22,500	32.14				
97	Miscellaneous	MK117/MK118			2,280	9.77				
98	Miscellaneous	MK125–5			6,600	9.43				

Table 3-2

	Group - I Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
1	20mm,HET	MK-4	0.0000	0.0000	0.8000				
2	20mm,HEI	M56A3	0.0000	0.0000	0.7000	4.24	7.43	0.24	
3	20mm,INC	M-96	0.0347	1.9945	0.3360				
4	20mm,HEI/DB	M97A2	0.0000	0.0000	0.9800	6.20	7.18	0.65	
5	20mm,HEI/SB	M97A2	0.0000	0.0000	0.8462	0.01	0.00	6.20	
6	20mm,HEI	M210	0.0061	0.5111	0.9700	6.17	7.14	0.65	
7	40mm,APT	M81	0.1044	1.9892					
8	40mm,CTG	M385	0.0000	0.0000			1.03		
9	40mm,CTG	M407	0.0610	0.5104			0.20		
10	76mm,HVTPT	M315A1	0.0000	0.0000					
11	76mm,APT	M339	0.0000	0.0000					
12	Fuzes	MK-27	0.0001	0.0038					
13	Fuzes	MK31, MD2	0.0000	0.0000					
14	Pnt.Deton	M48	0.0160	0.0092					
15	Fuze Deton	M66A1	0.0314	0.3183					

Table 3−2

	Group − I Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
16	Fuze Deton	M66A2	0.0314	0.3183					
17	Grenade Fuze	M204A2	0.0000	0.0000					
18	Grenade Fuze	M206	0.0000	0.0000					
19	Grenade Fuze	M213	0.0000	0.0000					
20	Grenade Fuze	M215	0.0000	0.0000					
21	Grenade Fuze	M502	0.0002	0.0049					
22	Pnt.Deton	M557	0.0002	0.0060					
23	Pnt.Deton	M572	0.0002	0.0060					
24	Rockmotor Ignitors	M20A1	0.0021	0.0114					
25	Rockmotor Ignitors	MK−117	0.0000	0.0000					
26	Rockmotor Ignitors	MK−118	0.0000	0.0000					
27	Rockmotor Ignitors	MK125−5	0.0000	0.0000					
28	Motor 3.5"		0.0200	1.7246			30.67		

Table 3-2

	Group - I Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
29	Eject Crtg	CCU-1/B	0.0000	0.0000			1.20		
30	Booster	M21A4	0.0000	0.0000					
31	Booster	MK39-MD0	0.0000	0.0000					
32	Dentent		0.0000	0.0000					
33	Detonator	M17	0.0000	0.0000					
34	Detonator	M22	0.0180	0.0630					
35	Detonator	M24	0.0260	0.2821					
36	Detonator	M55	0.0000	0.0000					
37	Impul Ctg	MK15-MD0	0.0000	0.0000					
38	Cutter Ctg.	M21	0.0000	0.0000	0.0053		0.05		
39	Cutter Ctg.	M22	0.0000	0.0000	0.0053		0.05		
40	Fin Assy w/primer	81MM MORT	0.0005	0.0223	0.3500		18.62		
41	Propellant	M1, MP	0.0000	0.0000	2.9000	14.40		28.80	
42	Propellant	M7	0.0200	2.0000			35.52		

Table 3–2

	Group – II Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
43	Primer, PERC	M26	0.1527	1.9635					
44	Primer, PERC	M47	0.0005	0.0263					
45	Primer, PERC	M68	0.0005	0.0263					
46	Primer, PERC	M79	0.0004	0.0219					
47	Primer, PERC	M80A1	0.0004	0.0350					
48	Fuze, Time	M65A1	0.0000	0.0000					
49	Pnt.Deton	M78A1	0.0003	0.0288					
50	Base Deton	M91A1	0.0044	0.4219					
51	Pl B. DET	M509A1	0.0000	0.0000					
52	Fuze, Prox	M513A1	0.0000	0.0000					
53	Pnt.Deton	M521	0.0176	0.6534					
54	Pnt.Deton	M525	0.0003	0.0310					
55	Pnt.Deton	M564	0.0034	0.3329					
56	Simulator projectile	M74	0.0000	0.0000					

Table 3-2

	Group – II Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
57	deleted								
58	deleted								
59	Signal ILL	M158	0.0006	0.0244					
60	Rocket–3.5"	M29A2	0.0196	1.9447			34.51		
61	Mine Activ	M1	0.0082	0.8196					
62	Fuze Booster	M125A1	0.0000	0.0000					
63	Ignit. CTG	M5A2	0.0000	0.0000			39.77		
64	Delay Plung	M1	0.0158	0.5134					

Table 3–2

	Class c Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
65	5.56 mm cart.	M195			1.1300			8.68	
66	5.56 mm cart.	M200			0.3400	0.23	4.27	0.23	
67	7.62 mm cart.	M61			1.9800	9.22	14.49	1.32	
68	7.62 mm cart.	M62			1.8500	8.62	13.54	1.23	
69	7.62 mm cart.	M64			0.7700			8.75	
70	7.62 mm cart.	M82			0.7200	0.72	8.66	2.42	
71	50 cal. cart.	M2			4.0400	6.85	29.53	26.85	
72	50 cal. cart.	M8			4.0400	26.84	29.56	26.84	
73	50 cal. cart.	M20			3.2100	n/a		24.79	
74	50 cal. cart.	M1			0.7900	5.16	5.78	0.52	
75	50 cal. cart.	Tracer			3.0700			23.57	
76	30 cal. cart.	Tracer			2.7600	18.39	20.23	16.55	
77	30 cal. cart.	M2			1.9500	14.14	16.80	12.37	
78	30 cal. cart.	M1909			0.5800	1.16	4.63	0.38	

Table 3-2

	Class c Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
79	20 mm cart.	HEI-s.base			1.25	7.94	9.19	7.94	
80	20 mm cart.	M53			1.5600	9.88	11.44	1.05	
81	20 mm cart.	M96			0.4800				
82	Primers	M28B2							
83	Primers	M34							
84	Primers	40A2							
85	Primers	M57							
86	Primers	M71							
87	Primers	M82							
88	Fuzes	M66A1/A2							
89	Fuzes	MK27*							
90	Fuzes	M557							
91	Fuzes	M501							
92	Fuzes	M502							
93	Fuzes	M564							

Table 3-2

	Class c Munition	Model Number	Chlorine LB/LB	Max Chlorine Feedrate LB/hr	Potential POHC DPA LB/hr	Potential POHC DBP LB/hr	Potential POHC NG LB/hr	Potential POHC DNT LB/hr	
94	Fuzes	M605							
95	Miscellaneous	M21A4							
96	Miscellaneous	Detent							
97	Miscellaneous	MK117/MK118							
98	Miscellaneous	MK125-5							

Table 3-3

	Group - I Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
1	20mm,HET	MK-4							
2	20mm,HEI	M56A3	0.0196	0.0193	0.0138				
3	20mm,INC	M-96	0.0400	0.2296	0.1647				
4	20mm,HEI/DB	M97A2	0.0200	0.0164	0.0118				
5	20mm,HEI/SB	M97A2	0.0200	0.0164	0.0118				
6	20mm,HEI	M210	0.0694	0.0579	0.0415				
7	40mm,APT	M81	0.0564	0.0020	0.0014				
8	40mm,CTG	M385	0.0834	0.0070	0.0050				
9	40mm,CTG	M407							
10	76mm,HVTPT	M315A1							
11	76mm,APT	M339							
12	Fuzes	MK-27	0.0398	0.0132	0.0095				
13	Fuzes	MK31, MD2	0.3315	0.0154	0.0110				
14	Pnt.Deton	M48	6.3725	0.0368	0.0264			6.7810	0.0391
15	Fuze Deton	M66A1							

Table 3-3

	Group – I Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
16	Fuze Deton	M66A2							
17	Grenade Fuze	M204A2	11.2676	0.0067	0.0048				
18	Grenade Fuze	M206	11.2676	0.0067	0.0048				
19	Grenade Fuze	M213	11.2676	0.0067	0.0048				
20	Grenade Fuze	M215	11.2676	0.0067	0.0048				
21	Grenade Fuze	M502	0.0994	0.0207	0.0148				
22	Pnt.Deton	M557	0.1021	0.0245	0.0176			0.1087	0.0261
23	Pnt.Deton	M572	0.1021	0.0245	0.0176			0.1087	0.0261
24	Rockmotor Ignitors	M20A1							
25	Rockmotor Ignitors	MK–117							
26	Rockmotor Ignitors	MK–118							
27	Rockmotor Ignitors	MK125–5							
28	Motor 3.5"								

Table 3-3

	Group – I Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
29	Eject Crtg	CCU-1/B							
30	Booster	M21A4							
31	Booster	MK39-MD0							
32	Dentent								
33	Detonator	M17							
34	Detonator	M22	6.2350	0.2177	0.1561				
35	Detonator	M24	8.4744	0.9750	0.6993				
36	Detonator	M55	2.2866	0.0836	0.0600				
37	Impul Ctg	MK15-MD0							
38	Cutter Ctg.	M21	4.7442	0.1020	0.0732				
39	Cutter Ctg.	M22	4.7442	0.1020	0.0732				
40	Fin Assy w/primer	81MM MORT	0.0533	0.0249	0.0179				
41	Propellant	M1, MP							
42	Propellant	M7							

Table 3–3

	Group – II Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
43	Primer, PERC	M26	17.2222	2.2143	1.5881				
44	Primer, PERC	M47	0.0565	0.0291	0.0209				
45	Primer, PERC	M68	0.0565	0.0291	0.0209				
46	Primer, PERC	M79	0.0446	0.0243	0.0174				
47	Primer, PERC	M80A1							
48	Fuze, Time	M65A1							
49	Pnt.Deton	M78A1	0.1158	0.1118	0.0802			0.0933	0.3320
50	Base Deton	M91A1	0.1602	0.1536	0.1102				
51	PI B. DET	M509A1							
52	Fuze, Prox	M513A1							
53	Pnt.Deton	M521	5.1044	0.1899	0.1362				
54	Pnt.Deton	M525	0.1111	0.1071	0.0768				
55	Pnt.Deton	M564	0.3622	0.3556	0.2550				
56	Simulator projectile	M74							

Table 3–3

	Group – II Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
57	deleted								
58	deleted								
59	Signal ILL	M158	0.0298	0.0115	0.0082				
60	Rocket–3.5"	M29A2							
61	Mine Activ	M1							
62	Fuze	M125A1							
	Booster								
63	Ignit. CTG	M5A2							
64	Delay Plung	M1	1.8433	0.6000	0.4303				

Table 3–3

	Class c Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
65	5.56 mm cart.	M195	0.2200	0.1900	0.1363				
66	5.56 mm cart.	M200	0.8000	0.1900	0.1363				
67	7.62 mm cart.	M61	0.2100	0.2800	0.2008				
68	7.62 mm cart.	M62	0.1700	0.2500	0.1793				
69	7.62 mm cart.	M64	0.1800	0.2300	0.1650				
70	7.62 mm cart.	M82	0.6000	0.3000	0.2152				
71	50 cal. cart.	M2	0.1200	0.3300	0.2367				
72	50 cal. cart.	M8	0.1100	0.3200	0.2295				
73	50 cal. cart.	M20	0.1100	0.3100	0.2223	0.9500	0.3800		
74	50 cal. cart.	M1	0.5700	0.3100	0.2223				
75	50 cal. cart.	Tracer	0.0900	0.2800	0.2008				
76	30 cal. cart.	Tracer	0.4400	0.9400	0.6742				
77	30 cal. cart.	M2	0.1000	0.1800	0.1291				
78	30 cal. cart.	M1909	0.7100	0.2900	0.2080				

Table 3–3

	Class c Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
79	20 mm cart.	HEI–s.base	0.07	0.0700	0.0502				
80	20 mm cart.	M53							
81	20 mm cart.	M96	0.0400	0.0300	0.0215				
82	Primers	M28B2	0.0600	0.0700	0.0502				
83	Primers	M34	15.2500	0.2900	0.2080				
84	Primers	40A2	0.0600	0.0300	0.0215				
85	Primers	M57	0.2600	0.0200	0.0143				
86	Primers	M71	1.9900	0.2300	0.1650				
87	Primers	M82	0.4500	0.0100	0.0072				
88	Fuzes	M66A1/A2							
89	Fuzes	MK27*	0.0400	0.2600	0.1865				
90	Fuzes	M557	0.12	0.0300	0.0215			0.09	0.02
91	Fuzes	M501	5.1000	0.0300	0.0215				
92	Fuzes	M502	0.1000	0.4700	0.3371				
93	Fuzes	M564	0.3900	0.0900	0.0645				

Table 3–3

	Class c Munition	Model Number	Antimony Trisulfide % PEP	Antimony Trisulfide LB/hr	Total Antimony LB/hr	Barium Carbonate % PEP	Barium Carbonate LB/hr	Barium Chromate % PEP	Barium Chromate LB/hr
94	Fuzes	M605	0.2300	<.0100	<.0100			24.7500	0.0200
95	Miscellaneous	M21A4							
96	Miscellaneous	Detent							
97	Miscellaneous	MK117/MK118							
98	Miscellaneous	MK125–5							

Table 3-4

	Group – I Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
1	20mm,HET	MK–4							
2	20mm,HEI	M56A3	0.1702	0.0167					0.01
3	20mm,INC	M–96							
4	20mm,HEI/DB	M97A2	0.0200	0.1643					0.09
5	20mm,HEI/SB	M97A2	0.0200	0.1643					0.09
6	20mm,HEI	M210	0.1003	0.0836					0.04
7	40mm,APT	M81							
8	40mm,CTG	M385	1.6826	0.1097					0.06
9	40mm,CTG	M407	0.1466	0.0123					0.01
10	76mm,HVTPT	M315A1							
11	76mm,APT	M339							
12	Fuzes	MK–27							
13	Fuzes	MK31, MD2	0.5157	0.0240					0.01
14	Pnt.Deton	M48							0.02
15	Fuze Deton	M66A1							

Table 3–4

	Group – I Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
16	Fuze Deton	M66A2							
17	Grenade Fuze	M204A2	22.5352	0.0134					0.01
18	Grenade Fuze	M206	22.5352	0.0134					0.01
19	Grenade Fuze	M213	22.5352	0.0134					
20	Grenade Fuze	M215	22.5352	0.0134					
21	Grenade Fuze	M502	0.0392	0.0082					
22	Pnt.Deton	M557	0.0157	0.0038			1.95	0.4677	0.11
23	Pnt.Deton	M572	0.0157	0.0038			1.95	0.4677	0.11
24	Rockmotor Ignitors	M20A1							
25	Rockmotor Ignitors	MK–117							
26	Rockmotor Ignitors	MK–118							
27	Rockmotor Ignitors	MK125–5							
28	Motor 3.5"								

Table 3–4

	Group – I Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
29	Eject Crtg	CCU–1/B							
30	Booster	M21A4							
31	Booster	MK39–MD0							
32	Dentent								
33	Detonator	M17							
34	Detonator	M22							
35	Detonator	M24							
36	Detonator	M55	3.8110	0.1393					0.07
37	Impul Ctg	MK15–MD0							
38	Cutter Ctg.	M21	10.3256	0.0837					0.04
39	Cutter Ctg.	M22	10.3256	0.0837					0.04
40	Fin Assy w/primer	81MM MORT							
41	Propellant	M1, MP							
42	Propellant	M7							

Table 3–4

	Group – II Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
43	Primer, PERC	M26							
44	Primer, PERC	M47							
45	Primer, PERC	M68							
46	Primer, PERC	M79							
47	Primer, PERC	M80A1							
48	Fuze, Time	M65A1							
49	Pnt.Deton	M78A1	0.0169	0.0163					0.19
50	Base Deton	M91A1							
51	PI B. DET	M509A1							
52	Fuze, Prox	M513A1							
53	Pnt.Deton	M521							
54	Pnt.Deton	M525	0.0166	0.0163					0.01
55	Pnt.Deton	M564							
56	Simulator projectile	M74							

Table 3–4

	Group – II Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
57	deleted								
58	deleted								
59	Signal ILL	M158							
60	Rocket–3.5"	M29A2							
61	Mine Activ	M1							
62	Fuze	M125A1							
	Booster								
63	Ignit. CTG	M5A2							
64	Delay Plung	M1							

Table 3–4

	Class c Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
65	5.56 mm cart.	M195	0.4600	0.41					0.22
66	5.56 mm cart.	M200	3.1200	0.74					
67	7.62 mm cart.	M61	0.4500	0.60					0.32
68	7.62 mm cart.	M62	0.3500	0.51					0.27
69	7.62 mm cart.	M64	0.3900	0.51					0.27
70	7.62 mm cart.	M82	1.5500	0.78					0.41
71	50 cal. cart.	M2	0.4200	1.14					0.60
72	50 cal. cart.	M8	3.3700	9.72					5.11
73	50 cal. cart.	M20	2.9200	8.15	0.99	2.76			6.72
74	50 cal. cart.	M1	2.0600	1.14					0.60
75	50 cal. cart.	Tracer	0.3400	1.04	3.15	9.67			8.39
76	30 cal. cart.	Tracer	0.9400	2.01	4.18	8.95			8.31
77	30 cal. cart.	M2	0.3500	0.63					0.33
78	30 cal. cart.	M1909	6.2900	2.55					1.34

Table 3-4

	Class c Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
79	20 mm cart.	HEI-s.base	1.88	1.86					0.98
80	20 mm cart.	M53	1.9500	2.32					
81	20 mm cart.	M96							
82	Primers	M28B2							
83	Primers	M34	32.2000	0.61					
84	Primers	40A2							
85	Primers	M57							
86	Primers	M71							
87	Primers	M82							
88	Fuzes	M66A1/A2							
89	Fuzes	MK27*							
90	Fuzes	M557	0.02	<0.01					0.01
91	Fuzes	M501	2.0700	0.01					
92	Fuzes	M502	0.0400	0.01					
93	Fuzes	M564	0.0200	<0.01					

Table 3–4

	Class c Munition	Model Number	Barium Nitrate % PEP	Barium Nitrate LB/hr	Barium Peroxide % PEP	Barium Peroxide LB/hr	Barium Stearate % PEP	Barium Stearate LB/hr	Total Barium LB/hr
94	Fuzes	M605	0.5000	<0.01					0.01
95	Miscellaneous	M21A4							
96	Miscellaneous	Detent							
97	Miscellaneous	MK117/MK118							
98	Miscellaneous	MK125–5							

Table 3–5

	Group – I Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
1	20mm,HET	MK–4				0.5121	0.4757		
2	20mm,HEI	M56A3				0.7696	0.7560		
3	20mm,INC	M–96							
4	20mm,HEI/DB	M97A2				0.2000	0.1643		
5	20mm,HEI/SB	M97A2				0.2000	0.1643		
6	20mm,HEI	M210				0.1898	0.1581		
7	40mm,APT	M81							
8	40mm,CTG	M385							
9	40mm,CTG	M407				0.9392	0.0785		
10	76mm,HVTPT	M315A1							
11	76mm,APT	M339							
12	Fuzes	MK–27				1.3501	0.4479		
13	Fuzes	MK31, MD2				7.1639	0.3334		
14	Pnt.Deton	M48			0.0080				
15	Fuze Deton	M66A1				3.2495	0.3291		

Table 3-5

	Group – I Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
16	Fuze Deton	M66A2				3.2495	0.3291		
17	Grenade Fuze	M204A2							
18	Grenade Fuze	M206							
19	Grenade Fuze	M213							
20	Grenade Fuze	M215							
21	Grenade Fuze	M502				1.8500	0.3859		
22	Pnt.Deton	M557			0.0054	1.2228	0.2935		
23	Pnt.Deton	M572			0.0054	1.2228	0.2935		
24	Rockmotor Ignitors	M20A1							
25	Rockmotor Ignitors	MK–117							
26	Rockmotor Ignitors	MK–118							
27	Rockmotor Ignitors	MK125–5							
28	Motor 3.5"								

Table 3–5

	Group – I Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
29	Eject Crtg	CCU–1/B							
30	Booster	M21A4				1.0987	0.2219		
31	Booster	MK39–MD0							
32	Dentent								
33	Detonator	M17				74.2057	9.8893		
34	Detonator	M22				60.6715	2.1180		
35	Detonator	M24				80.7692	8.7750		
36	Detonator	M55				63.2622	2.3121		
37	Impul Ctg	MK15–MD0							
38	Cutter Ctg.	M21							
39	Cutter Ctg.	M22							
40	Fin Assy w/primer	81MM MORT							
41	Propellant	M1, MP							
42	Propellant	M7							

Table 3–5

	Group – II Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
43	Primer, PERC	M26				5.0000	0.6429		
44	Primer, PERC	M47							
45	Primer, PERC	M68							
46	Primer, PERC	M79							
47	Primer, PERC	M80A1							
48	Fuze, Time	M65A1							
49	Pnt.Deton	M78A1			0.0682	2.3240	2.2450		
50	Base Deton	M91A1				0.1361	0.1306		
51	PI B. DET	M509A1				1.5393	1.5164		
52	Fuze, Prox	M513A1				6.5666	0.5657		
53	Pnt.Deton	M521				63.7076	2.3703		
54	Pnt.Deton	M525				1.1667	1.1250		
55	Pnt.Deton	M564				1.9795	1.9939		
56	Simulator projectile	M74							

Table 3–5

	Group – II Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
57	deleted								
58	deleted								
59	Signal ILL	M158							
60	Rocket–3.5"	M29A2							
61	Mine Activ	M1				8.3503	8.3303		
62	Fuze	M125A1							
	Booster								
63	Ignit. CTG	M5A2							
64	Delay Plung	M1				76.6369	24.7500		

Table 3–5

	Class c Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
65	5.56 mm cart.	M195							
66	5.56 mm cart.	M200							
67	7.62 mm cart.	M61							
68	7.62 mm cart.	M62							
69	7.62 mm cart.	M64							
70	7.62 mm cart.	M82							
71	50 cal. cart.	M2	0.0700	0.1900	0.0543				
72	50 cal. cart.	M8	0.0600	0.1700	0.0486				
73	50 cal. cart.	M20	0.0700	0.2000	0.0571				
74	50 cal. cart.	M1	0.3300	0.1800	0.0514				
75	50 cal. cart.	Tracer	0.0500	0.1500	0.0429				
76	30 cal. cart.	Tracer						0.09	0.09
77	30 cal. cart.	M2							
78	30 cal. cart.	M1909							

Table 3–5

	Class c Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
79	20 mm cart.	HEI–s.base				0.20	0.38		
80	20 mm cart.	M53							
81	20 mm cart.	M96							
82	Primers	M28B2							
83	Primers	M34							
84	Primers	40A2							
85	Primers	M57							
86	Primers	M71							
87	Primers	M82							
88	Fuzes	M66A1/A2							
89	Fuzes	MK27*							
90	Fuzes	M557			0.0041				
91	Fuzes	M501							
92	Fuzes	M502							
93	Fuzes	M564							

Table 3–5

	Class c Munition	Model Number	Aluminum Dichromate % PEP	Aluminum Dichromate LB/hr	Total Chromium LB/hr	Lead Azide % PEP	Lead Azide LB/hr	Lead Dioxide % PEP	Lead Dioxide LB/hr
94	Fuzes	M605			0.0041				
95	Miscellaneous	M21A4				1.1000	0.22		
96	Miscellaneous	Detent							
97	Miscellaneous	MK117/MK118							
98	Miscellaneous	MK125–5							

Table 3–6

	Group – I Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
1	20mm,HET	MK–4							0.3385
2	20mm,HEI	M56A3			0.1707	0.1671			0.6118
3	20mm,INC	M–96					0.0800	0.0460	0.0291
4	20mm,HEI/DB	M97A2			0.2000	0.1643			0.1896
5	20mm,HEI/SB	M97A2			0.2000	0.1643			0.1896
6	20mm,HEI	M210			0.1296	0.1080			0.1603
7	40mm,APT	M81							
8	40mm,CTG	M385			0.2819	0.0184			0.0081
9	40mm,CTG	M407			0.3247	0.0272			0.0679
10	76mm,HVTPT	M315A1			100.0000	0.0014			0.0006
11	76mm,APT	M339			100.0000	0.0007			0.0003
12	Fuzes	MK–27							0.3187
13	Fuzes	MK31, MD2			1.1050	0.0514			0.2600
14	Pnt.Deton	M48							
15	Fuze Deton	M66A1							0.2342

Table 3-6

	Group - I Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
16	Fuze Deton	M66A2							0.2342
17	Grenade Fuze	M204A2			53.5211	0.0319			
18	Grenade Fuze	M206			53.5211	0.0319			0.0141
19	Grenade Fuze	M213			53.5211	0.0319			0.0141
20	Grenade Fuze	M215			53.5211	0.0319			0.0141
21	Grenade Fuze	M502							0.2746
22	Pnt.Deton	M557			0.0314	0.0075			0.2121
23	Pnt.Deton	M572			0.0314	0.0075			0.2121
24	Rockmotor Ignitors	M20A1					0.5822	0.0321	0.0203
25	Rockmotor Ignitors	MK-117							
26	Rockmotor Ignitors	MK-118							
27	Rockmotor Ignitors	MK125-5							
28	Motor 3.5"								

Table 3-6

	Group – I Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
29	Eject Crtg	CCU-1/B							
30	Booster	M21A4							0.1579
31	Booster	MK39-MD0							
32	Dentent								
33	Detonator	M17							7.0362
34	Detonator	M22							1.5070
35	Detonator	M24							6.2434
36	Detonator	M55			6.8598	0.2507			1.7560
37	Impul Ctg	MK15-MD0			44.6154	0.7457			0.3300
38	Cutter Ctg.	M21			11.7674	0.0954			0.0422
39	Cutter Ctg.	M22			11.7674	0.0954			0.0422
40	Fin Assy w/primer	81MM MORT					0.1558	0.0728	0.0461
41	Propellant	M1, MP							
42	Propellant	M7							

Table 3–6

	Group – II Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
43	Primer, PERC	M26					25.0000	3.2143	2.4930
44	Primer, PERC	M47					0.0831	0.0429	0.0272
45	Primer, PERC	M68					0.0831	0.0429	0.0272
46	Primer, PERC	M79					0.0656	0.0357	0.0226
47	Primer, PERC	M80A1					0.1049	0.0973	0.0616
48	Fuze, Time	M65A1							
49	Pnt.Deton	M78A1			0.0337	0.0326			1.6117
50	Base Deton	M91A1							0.0929
51	PI B. DET	M509A1							1.0789
52	Fuze, Prox	M513A1							0.4025
53	Pnt.Deton	M521			0.7311	0.0272			1.6985
54	Pnt.Deton	M525							0.8004
55	Pnt.Deton	M564			0.0332	0.0326	0.5529	0.5429	1.7769
56	Simulator projectile	M74							

Table 3–6

	Group – II Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
57	deleted								
58	deleted								
59	Signal ILL	M158					0.0438	0.0170	0.0108
60	Rocket–3.5"	M29A2					0.0132	0.3400	0.2153
61	Mine Activ	M1					2.3398	2.3342	7.4053
62	Fuze	M125A1							
	Booster								
63	Ignit. CTG	M5A2							
64	Delay Plung	M1					2.7650	0.9000	18.1796

Table 3–6

	Class c Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
65	5.56 mm cart.	M195			0.5500	0.4800			0.2124
66	5.56 mm cart.	M200			2.0200	0.4800			0.2124
67	7.62 mm cart.	M61			0.5400	0.7200			0.3186
68	7.62 mm cart.	M62			0.4200	0.6200			0.2744
69	7.62 mm cart.	M64			0.4600	0.6000			0.2655
70	7.62 mm cart.	M82			1.5100	0.7600			0.3363
71	50 cal. cart.	M2			0.3700	1.0000			0.4425
72	50 cal. cart.	M8			0.3400	0.9800			0.4337
73	50 cal. cart.	M20			0.3500	0.9800			0.4337
74	50 cal. cart.	M1			1.8000	0.9900			0.4381
75	50 cal. cart.	Tracer			6.3000	0.9200			0.4071
76	30 cal. cart.	Tracer	0.09	0.1900	1.1200	2.3900			1.1355
77	30 cal. cart.	M2	0.10	0.1800	0.4000	0.7100			0.3142
78	30 cal. cart.	M1909			1.7600	0.7100			0.3142

Table 3–6

	Class c Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
79	20 mm cart.	HEI–s.base			0.20	0.38			0.4385
80	20 mm cart.	M53							
81	20 mm cart.	M96					0.08	0.07	0.0443
82	Primers	M28B2					0.08	0.09	0.0570
83	Primers	M34			37.2900	0.7100			0.3142
84	Primers	40A2					0.09	0.05	0.0317
85	Primers	M57					0.38	0.02	0.0127
86	Primers	M71					2.84	0.32	0.2027
87	Primers	M82					0.66	0.01	0.0063
88	Fuzes	M66A1/A2							
89	Fuzes	MK27*							
90	Fuzes	M557			0.03	0.01			0.0044
91	Fuzes	M501			4.8400	0.0300			0.0133
92	Fuzes	M502			0.0900	0.0200			0.0089
93	Fuzes	M564			0.0300	0.0100	0.55	0.13	0.0868

Table 3–6

	Class c Munition	Model Number	Lead Peroxide % PEP	Lead Peroxide LB/hr	Lead Styphnate % PEP	Lead Styphnate LB/hr	Lead Thiocyanate % PEP	Lead Thiocyanate LB/hr	Total Lead LB/hr
94	Fuzes	M605			1.2000	<0.01			0.0000
95	Miscellaneous	M21A4							0.1565
96	Miscellaneous	Detent							
97	Miscellaneous	MK117/MK118							
98	Miscellaneous	MK125–5							

SECTION 4

TRIAL BURN WASTE SELECTION

4.1 Permitting Criteria

Due to the extremely large number and variety of wastes listed in Section 3, it is requested that feed rate limitations in the permit be established for those constituents in the waste feed that impact upon the levels of controlled emissions, namely POHCs, particulates, HCl, metals, Dioxin and Furan precusors. These limitations will be based on the results of a trial burn in which feed items are selected using the following criteria:

1. POHC Emissions and DRE. The feed items selected for POHC testing and DRE determination should contain the most difficult to incinerate POHCs (having the lowest heat of combustion and thermal stability at low oxygen ($TSLoO_2$) index and should be fed at rates which will produce the highest feed rates for the POHCs in question. It is also important that the POHC selected not be a product of incomplete combustion (PIC) or a known problem POHC (from the article - "Developing a Trial Burn Plan, seminars for Hazardous Waste Incinerator Permit writers, inspectors and operators," EPA/625/4-87/017). Having met the DRE requirement under these conditions, one can assume that any POHC with a higher heat of combustion and $TSLoO_2$ and a lower feed rate would also meet the DRE requirements.

2. Particulate Emissions. The feed item selected for determining particulate emissions should have the greatest potential to generate particulate matter (i.e., the highest ash yield rate). Having met the particulate emission limits with the waste stream most likely to generate the highest emissions, it can be assumed that feeding a waste with a lower ash yield rate would not result in emissions exceeding the applicable limits.

3. HCl Emissions. The feed item selected for determining HCl emissions should have a chlorine feed rate which could result in the maximum potential HCl emissions. If the HCl emissions limit of 4 pounds per hour is not exceeded for the waste item having the highest chlorine feed rate (and thus the highest potential HCl emissions), one can assume that feeding waste with a lower chlorine feed rate would not result in HCl emissions greater than 4 pounds per hour.

4. Metal Emissions. The feed items selected for determining metal emissions should have a feed rate which could result in the maximum potential metal emissions. Different metals have different partition coefficients and should be tested separately. Organo-metallic compounds are of a special concern, since these also are generally more volatile. Therefore, it is essential to select feed items with the highest feed rates for each organic metallic compound. The presence of chlorides can affect metal emission since some metal chlorides are more volatile than their oxide counterparts. If the metal chloride has a higher volatility than its oxide counterpart, the waste feed should also have a stiochiometrically significant amount of chlorides present. If the conditions are met with the highest metal feed rates and in the presence of chlorides (if applicable), and if each organic-metallic compound is tested, it can be assumed that feeding waste with lower metal feed rates and lower chloride concentrations (if applicable) would not result in emissions exceeding the application limits.

5. Dioxins and Furans. The feed item selected for determining Dioxin and Furan emissions should have the maximum precusor to Dioxin and Furans feed rate and a stoichiometrically significant amount of chlorides presents. Having met Dioxin and Furan emission rate limits with the item with the highest precusor feed rate, it can be assumed that items with a lower precusor feed rate would also meet emission rate limits.

Other criteria which will be used as a basis for the selection of trial burn waste feed items includes.

6. Mass Feedrate. The item with the maximum waste feed rate will be selected as a waste feed item.

7. Total Thermal Input. The item with the highest total thermal input will be selected as a waste feed item.

The following items are a regulatory concern but will not be used as a basis for trial burn waste selection:

8. PIC Emissions. Rather than selecting a specific item for determining PICs emissions, PICs will be monitored as part of each trial burn test.

9. NO_x Emissions. Rather than selecting a specific item for determining NO_x emissions, NO_x will be monitored as part of each trial burn test.

10. SOx Emissions. SO_x emissions will be controlled by limiting, on an annual basis, the total mass of sulfur containing compounds which are fed to the deactivation furnace, pursuant to all applicable state and federal regulators.

4.2 POHC Waste Feed Item Selection

The chemical composition of the feed items, as shown on Table 4-1 and as listed in Appendix C, Table C-1, were compared to the list of hazardous constituents found in 40 CFR 261, Appendix VIII. A list of hazardous constituents from among those listed in Appendix VIII, which are present in the waste feed, are tabulated in Table 4-2.

TABLE 4-1

COMPONENT CHEMICAL COMPOSITIONS

Constituent	Chemical Formula
Acetylene Black	C
Aluminum	Al
Ammonium Nitrate	NH_4NO_3
Antimony Sulfide	? Does not exist
Antimony Trisulfide	Sb_2S_3
Asphaltum	Unknown
Barium Carbonate	$Ba(CO_3)_2$
Barium Chromate	$BaCrO_4$
Barium Nitrate	$Ba(NO_3)_2$
Barium Peroxide	BaO_2
Barium Stearate	$Ba(C_{18}H_{35}O_2)_2$
Boron Powder	B
Black Powder	74% - KNO_3, 10.4% - S, 15.6% C
Calcium Carbonate	$CaCO_3$
Calcium Resinate	$CaC_{40}H_{58}O_4$
Calcium Silicide	$CaSi_2$
Calcium Stearate	$Ca(C_{18}H_{35}O_2)_2$
Carbon Black	C
Carborundum	SiC & Al_2O_3
Charcoal	C
Dibutylphthalate	$C_6H_4(COOC_4H_9)_2$
Diphenylphthalate	$C_6H_4(COOC_6H_5)_2$
Dichromated Aluminum Powder	$Al_2(Cr0_7)_3$
Dinitrotouluene	$C_6H_3CH_3(NO_2)_2$
Diphenylamine	$(C_6H_5)_2NH$
Ethyl Centralite	$C_{17}H_{20}N_{20}$
Egyptian Lacquer	Unknown
Fuze Powder	Unknown
Graphite	C
Gum Arabic	Complex Carbohydrates
Hexachlorobenzene	C_6Cl_6

TABLE 4-1

COMPONENT CHEMICAL COMPOSITIONS
(Cont.)

Constituent	Chemical Formula
HMX	$C_4H_8N_8O_8$
Laquer	Nitrocellulose and soluent
Lead Azide	PbN_6
Lead Dioxide	PbO_2
Lead Peroxide	PbO?, Pb_20?
Lead Styphnate	$PbC_6H_3N_3O_9$
Lead Sulfocyanate	Lead thiocyanate?
Lead Thiocyanate	$Pb(SCN)_2$
Linseed Oil	Glycerides of fatty acids - $C_{21}H_{38}O_4$ (Typical)
Magnesium	Mg
Magnesium Aluminum Alloy	Mg_2Al
Magnesium Powder	Mg
Nitrocellulose	$C_6H_7O_5(NO_2)_3$
Nitroglycerin	$C_3H_5N_3O_9$
Oxamide	$NH_2COCONH_2$
Parlon Chlorinated Rubber	Unknown
PETN	$C_5H_8N_4O_{12}$
Polyethylene	$(CH_2)_n$
Poly Vinyl Alcohol	
Polyvinyl Chloride	$(C_2H_3Cl)_n$
Potassium Chlorate	$KClO_3$
Potassium Nitrate	KNO_3
Potassium Perchlorate	$KClO_4$
Potassium Sulfate	K_2SO_4
RDX	$C_3H_6N_6O_6$
Red Phosphorus	P
Silicone Carbide	SiC
Sodium Bicarbonate	$NaHCO_3$
Sodium Sulfate	Na_2SO_4
Strontium Nitrate	$Sr(NO_3)_2$

TABLE 4-1

COMPONENT CHEMICAL COMPOSITIONS
(Cont.)

Constituent	Chemical Formula
Strontium Oxalate	$SrC_2O_4 \cdot H_2O$
Strontium Peroxide	SrO_2
Sulfur	S
Tetracene	$C_2H_8N_{10}O$
Tetryl	$C_7H_5N_5O_8$
Tin Dioxide	SNO_2
Toludine Red	A family of organic Azo pigments - $CH_3C_6H_3NO_2N_2C_{10}H_5OHCONHC_6H_4NO_2$(typical)
Trinitroresorcinol	$C_6H(OH)_2(NO_2)_3$
Trinitrotoluene	$C_6H_2CH_3(NO_2)_3$
Vinyl Alcohol Acetate Resin	$(C_4H_6O_2)_n$
Wax	Long chain alkanes - C_nH_{2n+2}
Yellow Dye	Unknown
Zinc Stearate	$Zn(C_{18}H_{35}O_2)_2$
Zirconium	Zr

TABLE 4-2

APPENDIX VIII CHEMICAL CONSTITUENTS

Inorganic Compounds	Organic Compounds	Organo-Metallic Compounds
aluminum dichromate	dibutylphthalate (DBP)	barium stearate
antimony trisulfide	dinitrotoluene (DNT)*	lead styphanate
barium carbonate	diphenylamine (DPA)	
barium chromate	hexachlorobenzene (HCB)	
barium nitrate	nitroglycerine (NG)	
barium peroxide		
lead azide		
lead dioxide		
lead thiocyanate		

* 2,4 and 2,6 dinitrotoluene. The only other dinitrotoluene isomer discussed in this document is 3,4 dinitrotoluene (3,4-DNT) which is used as a spike. When this isomer is being discussed it will be referred to as 3,4-DNT. All other references to DNT within this document refer to the isomers 2,4-DNT and 2,6 DNT.

The purpose of identifying the compounds found in both the feed list and in Appendix VIII is to determine which compounds could be designated as waste feed items for the trial burn, including POHCs.

Table 4-3 shows the heats of combustion and thermal stability index for each potential POHC. (Toluene is also included as a possible POHC for the trial burn, though it is not a waste feed constituents for any of the munitions.)

TABLE 4-3

POHC RANKING

Compound	Heat of Combustion KCal/Gram	Thermal Stability Index Rank
DBP	7.34	261-265
DNT	4.68	168-173
DPA	9.09	42-44
NG	3.79	281
Toluene	10.14	35*

*Experimentally evaluated

The ranking of these compounds from lowest to highest heat of combustion would be NG, DNT, DBP, DPA and Toluene. The rank regarding the thermal stability index (TSI) would be Toluene, DPA, DNT, DBP and NG.

The two compounds that were selected as POHCs from amongst the waste feed constituents were DNT and NG. DBP was not chosen as a POHC because of its relatively high heat of combustion and high thermal stability index ranking. DPA was not chosen as a POHC because testing by the US Army Environmental Hygiene Agency indicates that adequate sampling methods for DPA (and DBP, for that matter) do not exist at this time. Therefore, DBP and DPA will not be designated as trial burn POHCs. (DPA is also listed as a problem POHC - "Hazardous Waste Incineration Measurement Guidance Manual," Volume III of the Hazardous Incineration Guidance Series, EPA 6/25/6-89/021).

Toluene, although not a waste constituent in itself, will also be selected as a POHC. The rational for selecting toluene is that a trial burn should be performed on a compound which is at least as difficult to incinerate as the most difficult hazardous waste constituent, which in this case is DPA.

Toluene has a TSI ranking of 35 as compared to DPAs ranking of 42 and also is the highest ranking Class 2 compound. Advantages of selecting Toluene are that its thermal stability index was determined experimentally rather than being derived and its relative low cost and availability.

Other potential Class 2 POHCs which have experimentally determined TSI rankings include Dichloroethane (TSI-42-44), trichloroethane (TSI-42-44) and tetrachloroethane (TSI 36). Each of these compounds has a TSI ranking higher that toluene, so there would be no real advantage in their selection.

NG and DNT were also selected as POHCs because of there relative abundance in the munitions which will be incinerated, and approved sampling methods. NG and DNT have also been selected as POHCs at other facilities, so there will be a basis for comparing SEADs incinerator performance versus other incinerator performances.

NG and DNT are not known PICs nor have they been identified as problem POHCs (Hazardous Waste Incineration Measurement Guidance Manual - Volume III of the Hazardous Waste Incineration Evidence Series, EPA/625/G-89/021).

Toluene will be added to waste feed item __ at the rate of 1.5 lb/hr. This procedure is discussed in Section 6.

For DNT and NG, the preferred items for testing are items 63 and 41 which yield 39.8 lb/hr of NG and 28.8 lb/hr of DNT, respectively.

4.3 PARTICULATE WASTE FEED ITEM SELECTION

The uncontrolled particulate emissions for the APE incinerators are proportional to the ash feedrate. In order to select a waste stream which would be representative of worst case particulate emissions , it is necessary to consider the ash yield data presented in Section 3. Based on these data, the logical choice is Item 59 (Signal ILL, Model M158) with a total ash feed rate of 22.8 lb/hr.

4.4 HCl TESTING CONSIDERATIONS

A determination of the HCl emission level is required by 40 CFR 270.62 (b)(6)(ii). However, from the data in the Tables presented in SECTION 3 none of the munition items has the potential to exceed the 4 lb/hr HCl emission rate based on stoichiometric chlorine content (feed rates of chlorine to the incinerator will not exceed 2 lb/hr). Moreover, the source of chlorine in most of the munitions is inorganic potassium perchlorate or chlorate. This chlorine will be largely converted KCl, rather than HCl, in the combustion process. Based on these considerations, HCl testing is excluded from the trial burn plan.

4.5 METAL WASTE FEED ITEMS SELECTION

Eleven metal hazardous waste constituents have been identified from the 98 waste feed items including two organo-metallic compounds. These are presented in Table 4-2. Waste feed items will be selected that contain the maximum feed rate of each inorganic hazardous metal and each organo-metallic compound.

In addition, for those metals which exhibit increased volatily in the presence of chlorides, chlorides should be present in the waste stream. Table 4-4 shows the relative volatility of the four metals of concern (antimony, barium, chromium, and lead) only Lead shows an increase in volatility in the presence of chlorides.

TABLE 4-4

RELATIVE VOLATILITY OF HAZARDOUS METALS[1]

	Volatility Temp °F [2]	
Metal	Chlorine = 0%	Chlorine = 0.5%
antimony	1220	1220
barium	1560	1680
chromium	2600	2600
lead	1160	5

(1) Adapted from Table 3-1, "Analysis of Metals in Trial Burn Tests - Case Study 1: Amoco Whiting Fluidized Bed Incinerator" by Energy and Environmental Research Corporation, January 5, 1989.

(2) Temperature at which the effective vapor pressure is 10^{-6} atm

For antimony, the preferred waste feed item for testing is Item 43 (Primer-PERC, Model M26) with a antimony Trisulfide feedrate of 2.2 lb/hr and a total antimony feedrate of 1.6 lb/hr.

For barium, two waste feed items have been selected, one for inorganic barium and one for organo-metallic barium. Item 75 (50 caliber cartridges, Model tracers), was selected for the maximum feed rate of inorganic barium with a total barium feed rate of 8.39 lb/hr. Item 22 or 23 (PNT Denton, Model 557 or M572) would both be suitable for organo-metallic barium testing. They each contain a feed rate of 0.48 lb/hr of barium stearate and a total barium feedrate of 0.11 lb/hr.

For chromium, the preferred waste feed item is Item 44 (PNT. Deton, Model M78A1) with a barium chromate feed rate of 0.3320 lb/hr and a total chromium feed rate of 0.0682 lb/hr.

For lead, two waste feed items have been selected, one for Inorganic lead and one for organo-metallic lead. Item 64 (Delay Plung, Model M1) was selected for the maximum feed rate of Inorganic lead with a total lead feedrate of 18.2 lb/hr. The chlorine feedrate for item 64 is 0.5134 lb/hr (1.6% of the total feed on a mass basis).

For organo-metallic lead, the preferred feed item is item 76 (30 caliber cartridges, Model tracer) with a total lead styphnate feed rate of 2.39 lb/hr and a total lead feedrate of 1.14 lb/hr.

4.6 DIOXIN AND FURANS WASTE FEED ITEM SELECTION

DPA, DBP and DNT are potential precursors in the formation of Dioxins and Furans (another potential precusor from the Component Chemical Composition List - Table 4-1, would be Diphenylphthalate.) Table 4-5 lists the most likely waste feed items for the formation of Dioxins and Furans. (This table was derived from the information found in Section 3.)

The waste feed item with the highest precusor feed rate is Item 72. However, the chlorine feedrate for this item is only 0.04 lb/hr. The next highest feed item in regards to the total precusor feed rate is item 76 with a total precusor feedrate of 42.19 lb/hr. It also has the maximum chlorine feed rate of any item at 2 lb/hr. Therefore, item 76 (30 caliber cartridges, Model tracer) is selected as the waste feed item for Dioxin and Furans.

4.7 MASS FEEDRATE WASTE FEED ITEM SELECTION

The feed item with the highest mass feed rate is Item 75 (50 caliber cartridge, tracer) with a total mass feed rate of 307 lb/hr. (This item was also selected for high inorganic barium, see Section 4.5)

4.8 TOTAL THERMAL INPUT WASTE FEED ITEM SELECTION

The feed item with the highest thermal input is item 41 (propelant, Model MI, MP) with a maximum thermal input of 1,272,000 Btu/hr. (This item was also selected for DNT DRE testing - see Section 4.4.)

TABLE 4-5

DIOXIN AND FURAN WASTE FEED SELECTION CANDIDATES

Item	DPA lb/hr	DBP lb/hr	DNT lb/hr	Total Precusor lb/hr	Cl lb/hr
6	0.97	6.17	0.65	7.79	0.51
68	1.85	8.62	1.23	11.70	1.84
72	4.04	26.84	26.84	57.72	0.04
73	3.21	-	24.79	28.00	0.35
75	3.07	-	-	3.07	UNKNOWN (>4.03)
76	2.60	17.35	22.24	42.19	2.00
79	1.25	7.94	7.94	17.13	0.66
80	1.56	9.88	1.05	12.49	0.72

SECTION 5

TRIAL BURN PROTOCOL

The trial burn will consist of a series of ten tests. The objectives of these tests are summarized in Table 5-1.

Operating conditions for the trial burn are summarized in Table 5-2. The "average" values in Table 5-2 are based on the results of material and energy balance calculations for the eleven test series. These material and energy balance calculations are summarized in the following material and energy balance diagrams. The detailed calculations and list of assumptions are presented in Appendix D.

The kiln and afterburner temperatures proposed in Table 5-2 for those tests which measure DREs and Dioxon and Furan concentrations, and which are concerned with organo-metallic compounds, are practical minimums for incinerator operation. The 1200°F afterburner temperature specification is considered the lowest temperature setpoint that would be used during normal operations. Thus, these tests will be conducted under the practical worst-case conditions.

In order to achieve these minimum temperatures while maintaining the highest possible combustion gas flowrates, both the afterburner and kiln burners will be operated at extremely lean air-to-fuel ratios. Air flows to both burners will be maximized with fuel feedrates adjusted by the kiln and afterburner temperature controllers.

For those tests which involve inorganic metallic compounds, the kiln and afterburner temperatures would be the highest allowable consistent with the safe and proper operation of the kiln. This will insure the maximum degree of volatilization. Thus, these tests will also be conducted under the practical worst-case conditions.

Finally, it should be realized that the upgraded APE incinerators are virtually new systems with respect to process operation and control. The addition of the afterburner significantly changes the operation of the downstream equipment. Thus, the proposed operating conditions may require some modification following pre-trial burn testing of the system.

TABLE 5-1

TRIAL BURN PROTOCOL

Test Series	Feed Item	Purpose
1.	Toulene	Maximum feed rate of most difficult to destroy PCHC
2.	Item 63 - Ignit. CTG M5A2	Maximum feed rate of NG for confirmational testing
3.	Item 41 - Propellant M1	Maximum feed rate of DNT for confirmational testing Maximum thermal input
4.	Item 59 - Signal ILL	Maximum ash feed rate for particulate testing
5.	Item 43 - Primer, Perc M26	Maximum feed rate of Antimony
6.	Item 75 - 50 cal. cart. Tracer	Maximum feed rate of inorganic Barium Maximum mass feed rate
7.	Item 22 or 23 - Pnt Deton M557 or M572	Maximum feed rate of organo-metallic Barium
8.	Item 49 - Pnt Deton M78A1	Maximum feed rate of chromium
9.	Item 64 - Delay Plung M1	Maximum feed rate of inorganic lead with high chlorine
10.	Item 76 - 30 cal. cart. Tracer	Maximum feed rate of organo-metallic lead Maximum feed rates of Dioxin and Furan Precusor

TABLE 5-2

TRIAL BURN OPERATIONS SUMMARY

Parameter		Est Series 1 Toluene Spike	Test Series 2 Item 63 M5A2	Test Series 3 Item 41 M1
Number of Runs		3	3	3
Kiln Outlet Temperature (°F)	Range Average			400 to 800 660
Afterburner Outlet Temp. (°F)	Range Average			1150 to 1250 1200
Stack Gas Velocity (fps)	Range Average			35 to 45 41
Kiln Pressure (in H_2O)		-.15 to -.25	-.15 to -.25	-.15 to -.25
Kiln Rotation (rpm)				2 to 3
Waste Feedrate ((lb/hr)				240
Waste Feedrate (items/hr)			17,400	N/A
Waste Feed Dimensions				
Baghouse Pressure Drop (in H_2O)		2.5 to 4.5	2.5 to 4.5	2.5 to 4.5
Cyclone Pressure Drop (in H_2O)		2 to 4	2 to 4	2 to 4
Baghouse Outlet Temp. (°F)				225 to 250
CO Level (ppm)				<100
Fuel Usage (gph)	Range Average			30 to 50 39
HTHE Exit Temp. (°F)				<850
LTHE Exit Temp. (°F)				<250

TABLE 5-2

TRIAL BURN OPERATIONS SUMMARY

Parameter		Test Series 4 Item 59 M158	Test Series 5 Item 43 M25	Test Series 6 Item 75 Tracer
Number of Runs		3	3	3
Kiln Outlet Temperature (°F)	Range Average			
Afterburner Outlet Temp. (°F)	Range Average			
Stack Gas Velocity (fps)	Range Average			
Kiln Pressure (in H_2O)		-.15 to -.25	-.15 to -.25	-.15 to -.25
Kiln Rotation (rpm)				
Waste Feedrate ((lb/hr)		38.74	12.86	306.93
Waste Feedrate (items/hr)		475	50,000	6,750
Waste Feed Dimensions				
Baghouse Pressure Drop (in H_2O)		2.5 to 4.5	2.5 to 4.5	2.5 to 4.5
Cyclone Pressure Drop (in H_2O)		2 to 4	2 to 4	2 to 4
Baghouse Outlet Temp. (°F)				
CO Level (ppm)				
Fuel Usage (gph)	Range Average			
HTHE Exit Temp. (°F)				
LTHE Exit Temp. (°F)				

TABLE 5-2

TRIAL BURN OPERATIONS SUMMARY

Parameter		Test Series 7 Item 22 or 23 M557 or M572	Test Series 8 Item 49 M78A1	Test Series 9 Item 64 M1
Number of Runs		3	3	3
Kiln Outlet Temperature (°F)	Range Average			
Afterburner Outlet Temp. (°F)	Range Average			
Stack Gas Velocity (fps)	Range Average			
Kiln Pressure (in H_2O)		-.15 to -.25	-.15 to -.25	-.15 to -.25
Kiln Rotation (rpm)				
Waste Feedrate ((lb/hr)		24.01	96.60	32.55
Waste Feedrate (items/hr)		440	1900	105,000
Waste Feed Dimensions				
Baghouse Pressure Drop (in H_2O)		2.5 to 4.5	2.5 to 4.5	2.5 to 4.5
Cyclone Pressure Drop (in H_2O)		2 to 4	2 to 4	2 to 4
Baghouse Outlet Temp. (°F)				
CO Level (ppm)				
Fuel Usage (gph)	Range Average			
HTHE Exit Temp. (°F)				
LTHE Exit Temp. (°F)				

TABLE 5-2

TRIAL BURN OPERATIONS SUMMARY

Parameter		Test Series 10 Item 75 Tracer		
Number of Runs		3		
Kiln Outlet Temperature (°F)	Range Average			
Afterburner Outlet Temp. (°F)	Range Average			
Stack Gas Velocity (fps)	Range Average			
Kiln Pressure (in H_2O)		-.15 to -.25		
Kiln Rotation (rpm)				
Waste Feedrate ((lb/hr)		214.07		
Waste Feedrate (items/hr)		22,500		
Waste Feed Dimensions				
Baghouse Pressure Drop (in H_2O)		2.5 to 4.5		
Cyclone Pressure Drop (in H_2O)		2 to 4		
Baghouse Outlet Temp. (°F)				
CO Level (ppm)				
Fuel Usage (gph)	Range Average			
HTHE Exit Temp. (°F)				
LTHE Exit Temp. (°F)				

SECTION 6

SAMPLING AND ANALYSIS PLAN

6.1 OVERVIEW

The Test Protocol is described in Section 5.

Each test series will consist of three valid runs with waste. The duration of each run varies depending on the required sampling procedure. Runs are considered invalid and will be repeated if they are out of isokinetics or do not pass post-test leak checks. Data generated during invalid runs will also be reported. Operational problems occurring during testing may also cause a run to be rejected. Such rejections will be considered on a case by case basis.

A summary of the sampling, sample recovery and preparation, and analytical methods required for the trial burn is provided in Table 6-1. A schematic of the sampling locations is shown in Drawing 6.1, page 6-10. Sampling equipment and procedures, analytical procedures, and QA/QC procedures are described in the following subsections.

6.2 SAMPLING PROCEDURES

6.2.1 Particulate Emissions Sampling

The particulate samples will be collected using the USEPA Reference Method (RM) 5 sampling train. The train is shown in Appendix E. The train consists of the following key components: a nozzle and glass/Pyrex lined, heated sampling probe; 90-degree connector; filter housing and glass fiber filter (all in a heated compartment); first and second impingers, with 100 mL of water, each; third impinger, dry; and a fourth impinger, with approximately 200 grams of silica gel.

Sampling will be conducted for a minimum of one hour as required by 40 CFR Part 60, Subpart E. A total of at least 30 dry standard cubic feet of gas will be collected. Traverse locations will be determined according to USEPA RM 1. Each traverse point will be sampled for a minimum of 2 minutes.

TABLE 6-1

TRIAL BURN TESTING SUMMARY

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
Stack Gas						
1.	Particulate	RM5	Continuous	All		
2.	Stack Gas Volumetric Flow Rate	RM2	Continuous	All		
3.	Temperature	RM2	Continuous	All		
4.	Moisture	RM4	Continuous	All		
5.	Combustion gases (CO_2,O_2CO)	RM3	Continuous	All		
6.	Toluene	Vost	Continuous	1		8240
7.	NG	AEHA MM5	Continuous	2		8250
8.	DNT	AEHA MM5	Continuous	3		8250
9.	Antimony	Multiple Metals Train	Continuous	5		7041
10.	Barium	Multiple Metals Train	Continuous	6 & 7		6010, 7080

TABLE 6-1
TRIAL BURN TESTING SUMMARY
(Cont'd)

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
11.	Chromium	Multiple Metals Trains	Continuous	8		6010, 7140, 7191
12.	Lead	Method 12	Continuous	9 & 10		6010, 7420, 7421
13.	Dioxins and Furans		Continuous	10		8280
14.	THC (PICS)	Method 25A	Continuous	All		
15.	NO_x		Continuous	All		
			Waste Feed			
16.	DNT	See Section 6.2.3	Composite See Section 6.2.3	3		See Section 6.2.3
			Fly Ash			
17.	Particulates, Mass			All		
18.	Particulates, size distribution		Composite	All		

TABLE 6-1
TRIAL BURN TESTING SUMMARY
(Cont'd)

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
19.	Toluene	Trowel Method (S007)	Composite	1	Method 5030	8240
20.	NG	Trowel Method (S007)	Composite	2	Method 3540	8250
21.	DNT	Trowel Method (S007)	Compsite	3	Method 3540	8250
22.	Antimony	Trowel Method (S007)	Composite	5		6010, 7040, 7041
23.	Barium	Trowel Method (S007)	Composite	6 & 7		6010, 7080
24.	Chromium	Trowel Method (S007)	Composite	8		6010, 7190, 7191
25.	Lead	Trowel Method (S007)	Composite	9 & 10		6010, 7420, 742

TABLE 6-1
TRIAL BURN TESTING SUMMARY
(Cont'd)

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
			Kiln Liquid Residue			
26.	Residue, Mass			All		
27.	Toluene	Trowel Method (S007)	Composite	1		8240
28.	NG	Trowel Method (S007)	Composite	2		8250
29.	DNT	Trowel Method (S007)	Composite	3		8250
30.	Antimony	Trowel Method (S007)	Composite	5		6010, 7040, 7041
31.	Barium	Trowel Method (S007)	Composite	6 & 7		6010, 7080
32.	Chromium	Trowel Method (S007)	Composite	8		6010, 7190, 7191

TABLE 6-1
TRIAL BURN TESTING SUMMARY
(Cont'd)

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
33.	Lead	Trowel Method (S007)	Composite	9 & 10		6010, 7420, 7421
			Kiln Solid Residue			
34.	Residue, Mass			All		
35.	Toluene	Trowel Method (S007)	Composite	1	Method 5030	8240
36.	NG	Trowel Method (S007)	Composite	2	Method 3540	8250
37.	DNT	Trowel Method (S007)	Composite	3	Method 3540	8250
38.	Antimony	Trowel Method (S007)	Composite	5		6010, 7040, 7041
39.	Barium	Trowel Method (S007)	Composite	6 & 7		6010, 7080

TABLE 6-1
TRIAL BURN TESTING SUMMARY
(Cont'd)

	Analysis Parameters	Sampling Method	Collection Frequency	Test Series	Sample Preparation	Analytical Method
40.	Chronium	Trowel Method (S007)	Composite	8		6010, 7190, 7191
41.	Lead	Trowel Method (S007)	Composite	9 & 10		6010, 7410, 7421

NOTES:

1. For test durations see Table 5-2.
2. For operational Data collected see Table 6-5.
3. Number of sucessful runs per test Series - 3.
4. Measurements and samples are for each run and are not composited.
5. Fly ash consists of ash from the HTGC, LTGC, Cyclone and Baghouse.

6.2.2 POHC Sampling for Destruction and Removal Efficiency Determination

The DRE tests for NG and DNT (Test Series 2 and 3) will use a RM 5 modified for POHC collection. The preferred method is one developed by the Army Environmental Hygiene Agency. This method is referred to as AEHA MM5, and has been accepted by EPA. EPA's memorandum accepting the AEHA MM5 is included in Appendix F.

The sampling train specified by AEHA MM5 is shown in Appendix E. Key features of this train include: identical front half as RM 5; first impinger, short stem, with 50 ml of distilled/deionized water; second impinger, medium stem, initially dry; third impinger, full length stem (modified Greenburg - Smith), initially dry resin package, 20 grams of XAD-2 resin (packed in 5 gram sections, each separated by glass wool); fourth impinger, modified Greenburg - Smith, initially dry; fifth impinger, modified Greenburg - Smith, silica gel.

The feed rate data indicate that a one hour sampling time per run will provide adequate quantities of NG and DNT in the recovered samples to demonstrate >99.99% destruction and removal efficiency. The calculations which show that the NG and DNT detection limits will be well exceeded in the one hour run are given in Appendix D. Traverse points and volume of gas through the equipment will be the same as specified in the particulate test above.

The DRE tests for Toluene will use a standard volatile organic sampling train (VOST), EPA Standard Method 0030. The total gas sample volume required for this test is 20 L collected at a rate of lL/min. The required flow rate of toluene to the kiln is calculated in Appendix D as 1.5 lb/hr.

6.2.3 Metal Emissions Sampling

Antimony, Barium and Chromium samples will be collected by using a multiple metals train as described in Appendix E, "Draft Metal Protocols" in Volume VI of the Hazardous Waste Incineration Guidance Series subtitled "Proposed Methods for Stack Emissions Measurement of CO, O_2, THC, HCl and Metals at Hazardous Waste Incinerators" dated November 1989.

Lead samples will be collected in accordance with EPA Method 12.

6.2.4 Dioxin and Furan Emission Sampling

This section will be provided at a later date.

6.2.5 Total Hydrocarbon Emissions Measurement

Total hydrocarbon emissions will be monitored continuously in accordance with the procedures defined in Appendix C, "Measurement of Total Hydrocarbons in Stack Gases from Hazardous Waste Incinerators, Boilers, and Industrial Furnaces" in Volume VI of the Hazardous Waste Incinerator Guidance Series entitled "Proposed Methods for Stack Emissions Measurement of CO, O_2, THC, HCl and Metals at Hazardous Waste Incinerators" dated November, 1989.

6.2.6 NO_x Emissions Measurement

This section will be provided at a later date.

6.2.7 Waste Feed Sampling

The selection of the waste feed items is described in Section 4. This material, with the exception of waste feed item 41 (Test Series 3), will not be sampled during the trial burn for two reasons. First, the cartridges would have to be dismantled for testing, which is inherently dangerous. Second, there is a high degree of quality control maintained in manufacturing the munitions which provides sufficient data for ash content. It is felt, however, that item 41, which is not a cartridge, can be safely sampled.

For M1 propellant (item 41) sampling, five pellets, each weighing approximately 0.2 grams, will be randomly taken from each run. These five samples will then be combined and weighed on an analytical balance (accurate to 1 mg) before being dissolved in 100 mL of ACN. After the propellant has been dissolved, a 20 mL aliquot will be removed for transport to the lab for analysis. This will be repeated three times so that three separate samples are obtained for analysis. (Method 8250 can then be used for the analysis.)

6.2.8 Residue Sampling

Fly ash samples will be collected from the high and low temperature gas coolers, cyclone, and baghouse. Two samples will be collected from the kiln. One will contain the liquid residues, while the other will contain the solids. Residue collected from the kiln will not be combined with the ash from the APCS. Thus, there will be three samples of residue collected for each residue test.

For each run, ash from each location will be collected in pre-weighed drums. For POHC tests, smaller containers such as pre-weighed buckets should be used. Containers will be weighed at the end of test runs.

Mass balances will be done for each run based on quantity of ash generated. After quantities are obtained for the mass balance determinations, composites will be made for each test as described above. The scrap metal generated during the particulate test will not be separated from the waste stream until after it is measured for the mass balance calculation. It may be separated at that point for disposal with the remaining ash to be analyzed as specified above.

In addition, residues will be analyzed for POHC, metals and particulate size distribution as shown on Table 6-1.

6.3 SAMPLE RECOVERIES, PREPARATION AND ANALYTICAL PROCEDURES

6.3.1 Sample Recovery Procedures

All sample recoveries will be conducted in the field, including particulate RM 5 and POHC AEHA MM5 sampling trains. Table 6-1 gives a summary of the sample recovery procedures.

6.3.2 Sample Preparation Procedures

Samples will be prepared for analysis in accordance with the procedures shown on Table 6-1.

6.3.3 Analytical Procedures

Table 6-1 gives the analytical procedures to be used for the samples collected during the trial burn tests. Additional information can be found in Appendix F, Analytical Procedures, and Appendix G, QA/QC Plan.

6.4 TOLUENE SPIKING PROCEDURES

This section will be provided at a later date.

6.5 QUALITY ASSURANCE

The Quality Assurance and Quality Control (QA/QC) Plan is described in detail in Appendix G. The plan consists of sampling and analytical methods for pretest and post-test equipment calibrations. It specifies methods and requirements for background runs and all reagents and collection media verification. In addition, surrogate and blind spikes are listed and explained. A brief summary of these QA procedures is given in Table 6-2.

The chain of custody procedures are given in Appendix G, QA/QC Plan. The plan will be followed during the trial burn to assure the traceability of the samples.

TABLE 6-2

QUALITY ASSURANCE SUMMARY

Measurement Device	Method/Standard	Reference
Meter box orifice and dry gas meter	Wet test meter	APTD-0576
Thermocouple	NBS reference thermometer	EPA-600/4-77-027b (reference 5)
Filter and probe wash	Analytical balance; filter & acetone blanks	EPA-600/4-77-27b
Pitot tube	Geometry	EPA-600/4-77-27b
Nozzle	Fowler caliper	EPA-600/4-77-27b
Orsat analyzer	Calibration gas	EPA-600/4-77-27b
AEHA MM5	Surrogate compound spikes; reagent and resin blanks; blind spikes	See QA/QC Plan

6.6 PROCESS MONITORING

Stack gas velocity and temperature will be monitored according to USEPA Reference Methods (RM) 1-3. Moisture will be collected and measured in all runs per RM 4 requirements to determine the moisture content in the stack gas. During each run, an integrated gas bag will be taken to determine combustion gas composition, specifically carbon monoxide, carbon dioxide and oxygen. Other process measurements for all test series will be waste and total fuel feedrates, burner air to fuel ratios, ash generation rates, CO and O2 by continuous monitor, temperatures, pressures, gas flowrate and kiln rotation rate. Table 6-5 lists the operational parameters to be monitored and recorded during testing. Refer to the Process Control Diagram in Appendix A and the Engineering Description section for process monitoring locations.

TABLE 6-3

OPERATIONAL PARAMETERS

Parameter	Method of Indication	Method of Recording
Item Feed Rate	Indicator Light	Disk/Printer
Kiln Rotation	Status Alarms	None
Kiln Exit Temperature	Monitor Display	Disk/Printer/Strip Chart
Afterburner Temperature	Monitor Display	Disk/Printer/Strip Chart
High Temperature Gas Cooler Exit Temperature	Monitor Display	Disk/Printer/Strip Chart
Low Temperature Gas Cooler Exit Temperature	Monitor Display	Disk/Printer/Strip Chart
Baghouse Exit Temperature	Monitor Display	Disk/Printer/Strip Chart
Baghouse Pressure Drop	Monitor Display	Disk/Printer/Strip Chart
Kiln Pressure	Monitor Display	Disk/Printer/Strip Chart
Corrected Carbon Monoxide Concentration	Monitor Display	Disk/Printer/Strip Chart
Combustion Gas Velocity	Monitor Display	Disk/Printer/Strip Chart
Oxygen Concentration	Monitor Display	Disk/Printer/Strip Chart
Fuel Oil Usage	Monitor Display	Disk/Printer

6.7 TRIAL BURN REPORT OUTLINE

The sampling and analysis test results will be incorporated with the operational and process data into a final report. This report will be submitted within 90-days of the trial burn completion. The following information in Table 6-4 will be provided in the final report.

TABLE 6-4

TRIAL BURN REPORT OUTLINE

Incinerator Performance

Particulate Emission Rates
POHC Emission Rates and Destruction and Removal Efficiencies
Combustion Gas Concentrations
Residue Samples: POHC Quantities, TCLP Test Results
POHC's and Particulate Material Balances

Operational Parameters and Data

Stack Gas Data
- Static Pressure
- Stack Gas Velocity
- Stack Gas Temperature
- Excess Air
- Moisture
- Corrected CO Concentration (high, low, avg., 60-minute rolling average)
- Oxygen Concentration (high, low, avg., 60-minute rolling average)

Ambient Air Data
- Temperature
- Barometric Pressure
- Moisture Content

Incinerator Data
- Feed Types
- Feed Rates (hourly average)
- Kiln Exit Temperature (high, low, avg.)
- Afterburner Residence Time (high, low, avg.)
- Afterburner Exit Temperature (high, low, avg.)
- Baghouse Pressure Drop (high, low, avg.)
- Baghouse Exit Temperature (high, low, avg.)
- Combustion Gas Velocity (high, low, avg.)
- Kiln Draft Pressure (high, low, avg.)
- Cyclone Pressure Drop (high, low, avg.)
- Auxiliary Fuel Usage (hourly avg.)
- Low Temp. Gas Cooler Exit Temp. (high, low, avg.)
- High Temp. Gas Cooler Exit Temp. (high, low, avg.)

Backup Data and Quality Control

Data Sheets
- Field Data
- Laboratory Data
- Chain of Custody
- Incinerator Operation (strip and computer)

Miscellaneous
- Equations and Nomenclature
- Waste Feed Analysis
- Quality Assurance Data

SECTION 7
AUTOMATIC WASTE FEED SHUT OFF TEST PROCEDURES

Process conditions which indicate how well the incinerator is destroying waste are continuously measured and recorded. These process conditions are also continuously input to the automatic waste feed shut off system (AWFSO). When any of these conditions deviate from acceptable limits which are established during the trial burn, the AWFSO system stops waste feed to the incinerator. The AWFSO conditions and proposed limits are listed in section 2.3.3 of this document.

The AWFSO system is tested weekly and tested prior to the trial burn tests to ensure proper operation. The test procedure are given in Table 7.1 on the following pages.

These same procedures will be used to test the AWFSO system prior to the trial burn.

TABLE 7.1

AUTOMATIC WASTE FEED SHUT-OFF TEST PROCEDURES

Prior to starting these procedures:

1. The incinerator is to be operating at full thermal conditions.
2. All AWFSO interlocks are to be cleared.
3. The waste loading conveyor is to be started but no munitions fed.

Stack gas carbon monoxide (CO):

1. Change the 1 hour averaging shutdown parameter in computer system to zero.
2. Introduce calibration gas of > 100 PPM into the analyzer sampling system (see Beckman Operation and Maintenance Manual for procedure). When the rolling average of the CO corrected for 0_2 on a dry basis is above 100 ppm:
   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.
3. Purge the sampling system with nitrogen. When the rolling average of the CO corrected for O_2 on a dry basis drops below 100 ppm:
   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.
4. Reset the 1 hour averaging shutdown parameter in the computer system to 1 hour.

Carbon monoxide analyzer failure:

1. Turn off power switch on CO analyzer:
   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Turn on CO analyzer power switch:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Oxygen analyzer failure:

1. Turn off power switch on oxygen analyzer:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Turn on oxygen analyzer power switch:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Baghouse bypass:

1. Actuate baghouse bypass:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Return baghouse bypass to normal:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Afterburner temperature:

1. Lower the set point on afterburner temperature controller to 1150 °F. When the afterburner temperature drops below 1200 °F:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Raise the set point on the afterburner temperature controller to the normal value (> 1200 °F). When the temperature reaches 1200 °F:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

3. Place afterburner temperature controller in manual. Disconnect the afterburner thermocouple. Connect a millivolt source to afterburner temperature transmitter (TT-701). Increase millivolt signal to the control instruments. When the simulated temperature reaches 1800 °F:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

4. Disconnect millivolt source and reconnect thermocouple. When temperature drops below 1800 °F:

   a. The Alarm will clear.
   b. The waste loading conveyor can be restarted.

Kiln temperature:

1. Lower the set point on kiln temperature controller to below the AWFSO interlock value. When the kiln temperature drops below the AWFSO interlock value:

   a. An alarm will be indicated.

   b. The waste loading conveyor will stop.

2. Raise the set point on the kiln temperature controller to the normal value. When the temperature reaches the AWFSO interlock value:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

3. Place kiln temperature controller in manual. Disconnect the kiln thermocouple. Connect a millivolt source to the kiln temperature transmitter (TT-601). Increase millivolt signal to the control instruments. When the simulated temperature reaches 1100 °F:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

4. Disconnect millivolt source and reconnect thermocouple. When temperature drops below 1100 °F:

   a. The Alarm will clear.
   b. The waste loading conveyor can be restarted.

Kiln pressure:

1. With an inclined manometer increase pressure on high pressure side of differential pressure transmitter. When the kiln pressure goes positive:

   a. An alarm will be indicated
   b. The waste loading conveyor will stop.

2. Disconnect manometer. If the kiln pressure returns to vacuum:

   a. The Alarm will clear
   b. The waste loading conveyor can be restarted.

Waste feed rate:

Place a weight in the waste feed monitoring system. Weight must be heavier than allowable munitions weight programmed into computer system. Attempt to start waste feed monitoring system. Computer system will not allow the weight to be fed to the conveyor.

Stack gas velocity:

1. With an inclined manometer increase pressure on high pressure side of differential pressure transmitter. Stack gas velocity signal will increase. When the simulated velocity reaches 50 feet/second:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Disconnect manometer. When velocity drops below 50 fps:

   a. The Alarm will clear.

   b. The waste loading conveyor can be restarted.

High temperature gas cooler exit temperature:

1. Disconnect the gas cooler exit thermocouple. Connect a millivolt source to the gas cooler exit temperature transmitter (TT-801). Increase millivolt signal to the control instruments. When the simulated temperature reaches 850 °F:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Disconnect millivolt source and reconnect thermocouple. When temperature drops below 850 °F:

   a. The Alarm will clear.
   b. The waste loading conveyor can be restarted.

Low temperature gas cooler exit temperature:

1. Place low temperature gas cooler temperature controller in manual. Disconnect the gas cooler exit thermocouple. Connect a millivolt source to the gas cooler exit temperature transmitter (TT-901). Increase millivolt signal to the control instruments. When the simulated temperature reaches 350 °F:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Disconnect millivolt source and reconnect thermocouple. When temperature drops below 350 °F:

   a. The Alarm will clear.
   b. The waste loading conveyor can be restarted.

Kiln burner flameout:

1. Close the block valve upstream of the safety shut-off valve on the oil line to the kiln burner. When the flame goes out:

   a. The safety shut-off valves will close.
   b. The flame supervisor will start post-purge.
   c. An alarm will be indicated.
   d. The waste loading conveyor will stop.

2. Re-ignite the burner.

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Afterburner burner flameout:

1. Close the block valve upstream of the safety shut-off valve on the oil line to the afterburner burner. When the flame goes out:

    a. The safety shut-off valves will close.
    b. The flame supervisor will start post-purge.
    c. An alarm will be indicated.
    d. The waste loading conveyor will stop.

2. Re-ignite the burner.

    a. The alarm will clear.
    b. The waste loading conveyor can be restarted.

Kiln rotation drive:

1. Turn off motor drive which rotates kiln. When kiln stops rotation:

    a. An alarm will be indicated.
    b. The waste loading conveyor will stop.

2. Restart the motor drive. When the kiln starts rotating:

    a. The alarm will clear.
    b. The waste loading conveyor can be restarted.

Kiln residue conveyor:

1. Turn off the kiln residue conveyor motor.

    a. An alarm will be indicated.
    b. The waste loading conveyor will stop.

2. Restart the kiln residue conveyor motor.

    a. The alarm will clear.
    b. The waste loading conveyor can be restarted.

ID Fan:

1. Turn off the ID fan motor.

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Restart the ID fan motor.

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Baghouse pressure drop:

1. Disconnect differential pressure transmitter wiring in main control panel and connect 4-20 milliamp calibrator. Vary milliamp signal until 2 inches WC is indicated on panel instruments:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

2. Vary milliamp signal until greater than 2 inches WC is located on panel instruments:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

3. Restart waste loading conveyor.

4. Increase milliamp signal until 6 inches WC is indicated on panel instruments:

   a. An alarm will be indicated.
   b. The waste loading conveyor will stop.

5. Disconnect calibrator and reconnect transmitter wiring. If differential pressure is between 2 and 6 inches of WC:

   a. The alarm will clear.
   b. The waste loading conveyor can be restarted.

Device failure:

1. Terminate electrical power to each of the following devices to be tested:

    a. An alarm will be indicated.
    b. The waste loading conveyor will stop.

2. Restore power to each of the devices:

    a. The alarm will clear.
    b. The waste loading conveyor can be restarted.

Devices to be tested:

- Multi-input recorder
- Honeywell process controllers
- Waste weighing system

Signal failure:

1. Disconnect signal return wire for the instrument signals to be tested:

    a. An alarm will be indicated.
    b. The waste loading conveyor will stop.

2. Reconnect signal return wire for the instrument signals to be tested:

    a. The alarm will clear.

    b. The waste loading conveyor can be restarted.

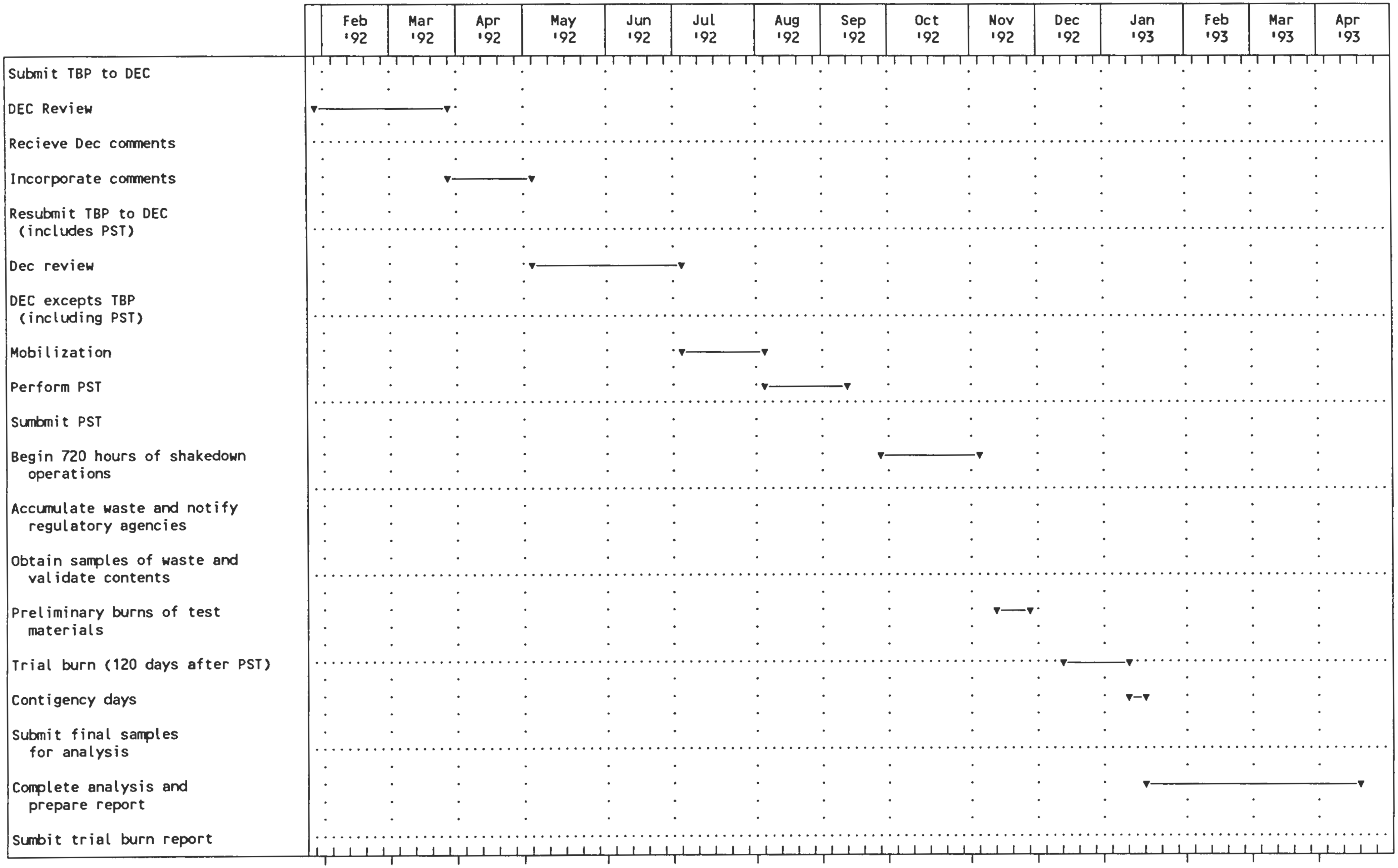
Instrument signals to be tested:

- Temperature inputs.
- Baghouse differential pressure transmitter.

8.0 TRIAL BURN TEST SCHEDULE

A specific date and schedule for the trial burn test cannot be established until the permit is issued. A proposed event schedule for the trial burn is given in Table 8.1. This schedule assumes that the trial burn plan is approved as described in this document.

Table 8-1
Seneca Trial Burn Plan Schedule
1345-085-8000



APPENDIX A

DRAWINGS

APPENDIX A

DRAWINGS

The following is a list of full size drawings which are located in map pockets in Appendix 14 of the RCRA Part B Permit Application.

Map Pocket	Drawing No.	Description	Figure No. (If Applicable)
01	AC-SK-87-12	Furnace Site (Proposed)	
02	AC-SK-88-55-01	Seneca Army Depot Layout	
03	AC-SK-88-55-02	SEAD - Furnace Site Layout, Sheet 1 SEAD - Furnace Site Elevation, Sheet 2 SEAD - Furnace Site Elevation, Sheet 3	D-8
04	SK-88-55-05	APE 1236 Upgrade - Site Enclosure Layout	
05	SK-88-07	Functional Process Control Diagram	D-11
06	ACT-377-200-12	Burner and Blower Assembly	D-10
07	11268-10-1	Afterburner (Southern Technologies) (3 Sheets)	D-12
08		High Temperature Gas Cooler Low Temperature Gas Cooler	D-13 D-14
09		Cyclone	D-15
10		Baghouse	D-16
11	SK-89-09-00	Data List	
12	SK-89-09-01	Waste Feed Rate Monitoring System, General Assembly	D-9
13	SK-89-09-02	Outer Frame Assembly, Sheet 1 Outer Frame Details, Sheet 2 Outer Frame Details, Sheet 3 Outer Frame Details, Sheet 4	

14	SK-89-09-03	Inner Frame Assembly
14	SK-89-09-04	Inner Frame Details
15	SK-89-09-05	Transfer Assembly
16	SK-89-09-06	Push Off Box Details
17	SK-89-09-07	TT-B Weight Scale Frame Details
18	SK-89-09-08	Series 1000 Weigh Scale Frame Details
19	SK-89-09-09	Scale Top Assembly
20	SK-89-09-10	Chute Assembly Details, Sheets 1 and 2
21	SK-89-09-11	Swing Door Assembly and Details
22	SK-89-09-12	Sliding Door Assembly
23	SK-89-09-13	Door Lock Assembly
24	SK-89-09-14	Window Details
25	SK-89-09-15	Cover Plate Details
26	SK-89-09-16	Pneumatic Component Layout
27	SK-89-09-17	Pneumatic Schematic
28	SK-89-09-18	Vacant (Elect. Component Layout)
29	SK-89-09-19	Pneumatic Valve Box
30	SK-89-09-20	Control Box
31	11268-10, Rev. 4	Catwalk and Afterburner Elevations
32		High Temperature Gas Cooler Elevation
33		Low Temperature Gas Cooler Elevation

APPENDIX B

EQUIPMENT AND INSTRUMENTATION INFORMATION

APPENDIX B

EQUIPMENT AND INSTRUMENTATION INFORMATION

TABLE OF CONTENTS

APPENDIX C

WASTE CHARACTERIZATION TABLES

APPENDIX C

WASTE CHARACTERIZATION TABLES

APPENDIX C

WASTE CHARACTERIZATION TABLES

TABLE OF CONTENTS

C-1

CHEMICAL COMPOSITIONS OF CLASS C MUNITIONS

TABLE C-1

NOTES: Some munitions have acceptable ranges of some PEP components. The values corresponding to the high end has been used for each munition characterization. Therefore, the sum may exceed 100%.

STE ITEM: 20MM HE-T (MK4) (w/single base propellant)
(primer - 7 grains; data not available)

PEP Weight: 722.5 grains (+7 grain primer)

Item Feed Rate: 900 ctg/hr

Total Btu/hr 422768.0696

Total Ash loading (lb/hr) 0.3646

Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Diphenylamine	0.8581	6.2000	0.7971	140.5276	0.0000	0.0000
Lead Azide	0.5121	3.7000	0.4757	5.8125	0.0039	0.0000
Nitrocellulose	84.9550	613.8000	78.9171	3685.3487	0.0000	0.0000
Tetryl	13.6775	98.8200	12.7054	719.5737	0.0000	0.0000
Total	100.0028	722.5200	92.8954	4551.1365	0.0039	0.0000

STE ITEM: 20MM HEI (M56A3) (w/double base propellant)		Total Btu/hr	552543.7898
PEP Weight:	764 grains	Total Ash loading (lb/hr)	13.9108
Item Feed Rate:	900 ctg/hr	Total Chlorine loading (lb/hr)	0.0049

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Acetylene Black	0.0105	0.0800	0.0103	1.4759	0.0000	0.0000
Aluminum	6.8704	52.4900	6.7487	914.5902	0.1298	0.0000
Antimony Trisulfide	0.0196	0.1500	0.0193	0.3538	0.0002	0.0000
Barium Nitrate	0.1702	1.3000	0.1671	-1.2183	0.0010	0.0000
Calcium Carbonate	0.7906	6.0400	0.7766	-6.2218	0.0044	0.0000
Calcium Resinate	0.0105	0.0800	0.0103	1.5555	.0000	0.0000
Calcium Silicide	0.0602	0.4600	0.0591	3.6126	0.0011	0.0000
Dibutylphthalate	4.3194	33.0000	4.2429	570.5890	0.0000	0.0000
Dinitrotoluene	0.2395	1.8300	0.2353	20.1779	0.0000	0.0000
Diphenylamine	0.7094	5.4200	0.6969	116.1753	0.0000	0.0000
Graphite	0.2696	2.0600	0.2649	38.0048	0.0000	0.0000
Gum Arabic	0.0105	0.0800	0.0103	0.7162	0.0000	0.0000
HMX	0.7696	5.8800	0.7560	32.7248	0.0000	0.0000
Lead Azide	0.1597	1.2200	0.1569	1.8124	0.0012	0.0000
'ead Styphnate	0.1702	1.3000	0.1671	3.5682	0.0012	0.0000
agnesium Aluminum	0.1806	1.3800	0.1774	20.9565	0.0031	0.0000
Nitrocellulose	64.8704	495.6100	63.7213	2814.0788	0.0000	0.0000
Nitroglycerin	7.5602	57.7600	7.4263	515.7575	0.0000	0.0000
Potassium Perchlorate	0.0196	0.1500	0.0193	0.0518	0.0001	0.0001
RDX	12.2304 - 13.000	93.32 - 99.44	12.0137 - 12.7697	536.3800	0.0000	0.0000
Sodium Sulfate	0.0798	0.6100	0.0784	-0.5629	0.0004	0.0000
Trinitroresorcinol	0.0105	0.0800	0.0103	0.3449	0.0000	0.0000
Wax	0.3901	2.9800	0.3831	78.0105	0.0000	0.0000
Zinc Stearate	0.0105	0.0800	0.0103	1.6126	.0000	0.0000
Total	100.7016	769.4800	98.9177	5625.0822	0.1416	.0000

ITEM: 20MM (M96)

PEP Weight:	638.6 grains	Total Btu/Hr	389582.9357
Item Feed Rate:	900 ctg/hr	Total Ash loading (lb/hr)	22.8351
		Total Chlorine loading (lb/hr)	2.8453

Compound	Percentage of PEP (percent)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0400	0.0328	0.7208	0.0003	0.0000
Calcium Resinate	0.5000	0.4105	74.2750	0.0004	0.0000
Diphenylamine	0.5900	0.4844	96.6184	0.0000	0.0000
Lead Sulfocyanate	0.0800	0.0657	1.6776	0.0006	0.0000
Magnesium Aluminum Alloy	12.2300	10.0415	1418.9246	0.2129	0.0000
Nitrocellulose	71.9100	59.0422	3119.4558	0.0000	0.0000
PETN	0.0300	0.0246	1.0593	0.0000	0.0000
Potassium Chlorate	0.1700	0.1396	0.7633	0.0008	0.0005
Potassium Sulfate	0.5500	0.4516	-3.8445	0.0035	0.0000
Potassium Perchlorate	13.3500	10.9611	35.2440	0.0541	0.0342
Tin Dioxide	0.5500	0.4516	0.0000	0.0055	0.0000
Total	100.0000	82.1057	4744.8943	0.2781	0.0347

ITEM: 20MM HEI (M97A2) with DB Propellant

PEP Weight: 639 grains

Item Feed Rate: 900 ctg/hr

Total Btu/Hr 471025.0431

Total Ash loading (lb/hr) 11.4052

Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)		Component Feed Rate (lb/hr)		Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Acetylene Black		0.0100		0.0082	1.4095	0.0000	0.0000
Aluminum		6.5700		5.3977	874.5984	0.1241	0.0000
Antimony Trisulfide		0.0200		0.0164	0.3604	0.0002	0.0000
Barium Nitrate		0.2000		0.1643	-1.4320	0.0012	0.0000
Calcium Carbonate	0.0000 -	0.7900		0.6490	-6.2173	0.0044	0.0000
Calcium Resinate		0.0100		0.0082	1.4855	.0000	0.0000
Calcium Silicide		0.0700		0.0575	4.2000	0.0013	0.0000
Calcium Stearate		0.0100		0.0082	1.6040	.0000	0.0000
Dibutylphthalate	4.3700 -	7.5500	3.5903 -	6.2029	997.3550	0.0000	0.0000
Dinitrotoluene	0.0000 -	0.7900	0.0000 -	0.6490	66.5496	0.0000	0.0000
Diphenylamine	0.5600 -	1.1900	0.4601 -	0.9777	194.8744	0.0000	0.0000
Graphite	0.1900 -	0.5200	0.1561 -	0.4272	73.2940	0.0000	0.0000
Gum Arabic		0.0100		0.0082	0.6840	0.0000	0.0000
HMX	0.0000 -	0.9200	0.0000 -	0.7558	39.1184	0.0000	0.0000
Lead Azide		0.2000		0.1643	2.2700	0.0015	0.0000
Lead Styphnate		0.2000		0.1643	4.5080	0.0010	0.0000
Nitrocellulose	58.5100 -	67.6500	48.0701 -	55.5793	2934.6570	0.0000	0.0000
Nitroglycerin	6.3600 -	8.7400	5.2252 -	7.1805	596.2428	0.0000	0.0000
Potassium Nitrate	0.0800	1.1900	0.0657 -	0.9777	-3.4034	0.0066	0.0000
Potassium Sulfate		0.0000	0.0000 -	0.0000	0.0000	0.0000	0.0000
RDX	11.7200 -	12.6300	9.6288 -	10.3764	521.1138	0.0000	0.0000
Sodium Sulfate	0.0000 -	0.4000		0.3286	-2.8200	0.0023	0.0000
Tin Dioxide	0.4800 -	1.1900	0.3944 -	0.9777	0.0000	0.0119	0.0000
Trinitroresorcinol		0.0100		0.0082	0.3294	0.0000	0.0000
Wax		0.3900		0.3204	78.0000	0.0000	0.0000
Total		111.2600		91.4080	5733.2208	0.1388	0.0000

E ITEM: 20MM HEI (M97A2) with SB Propellant		Total Btu/Hr	435104.1122
EP Weight:	639 grains	Total Ash loading (lb/hr)	11.0322
Item Feed Rate:	900 ctg/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Acetylene Black	0.0100	0.0082	1.4095	0.0000	0.0000
Aluminum	6.5700	5.3977	874.5984	0.1241	0.0000
Antimony Trisulfide	0.0200	0.0164	0.3604	0.0002	0.0000
Barium Nitrate	0.2000	0.1643	-1.4320	0.0012	0.0000
Calcium Carbonate	0.0000	0.0000	0.0000	0.0000	0.0000
Calcium Resinate	0.0100	0.0082	1.4855	.0000	0.0000
Calcium Silicide	0.0700	0.0575	4.2000	0.0013	0.0000
Calcium Stearate	0.0100	0.0082	1.6040	.0000	0.0000
Dibutylphthalate	0.0100	0.0082	1.3210	0.0000	0.0000
Dinitrotoluene	4.3700 - 7.5500	3.5900 - 6.2029	636.0120	0.0000	0.0000
Diphenylamine	0.4000 - 1.0300	0.3300 - 0.8462	168.6728	0.0000	0.0000
Graphite	0.1900 - 0.5200	0.1600 - 0.4272	73.2940	0.0000	0.0000
Gum Arabic	0.0100	0.0082	0.6840	0.0000	0.0000
HMX	0.0000 - 0.9200	0.0000 - 0.7558	39.1184	0.0000	0.0000
ad Azide	0.2000	0.1643	2.2700	0.0015	0.0000
ad Styphnate	0.2000	0.1643	4.5080	0.0010	0.0000
Nitrocellulose	69.0800 - 74.0100	59.7500 - 60.8045	3210.5538	0.0000	0.0000
Nitroglycerin	0.0000	0.0000	0.0000	0.0000	0.0000
Potassium Nitrate	0.0000	0.0000	0.0000	0.0000	0.0000
Potassium Sulfate	0.0800 - 0.7900	0.0700 - 0.6490	-5.5221	0.0051	0.0000
RDX	11.7200 - 12.6300	9.6300 - 10.3764	521.1138	0.0000	0.0000
Sodium Sulfate	0.0000	0.0000	0.0000	0.0000	0.0000
Tin Dioxide	0.3200 - 0.7900	0.2600 - 0.6490	0.0000	0.0079	0.0000
Trinitroresorcinol	0.0100	0.0082	0.3294	0.0000	0.0000
Wax	0.3800	0.3122	76.0000	0.0000	0.0000
Total	105.9400	87.0373	5295.9986	0.1343	0.0000

WASTE ITEM: 20MM HEI (M210) (w/double base propellant)		Total Btu/hr	480948.8096
PEP Weight:	648 grains	Total Ash loading (lb/hr)	13.5332
	900 ctg/hr	Total Chlorine loading (lb/hr)	0.5111

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	5.4198	35.1200	4.5154	721.4775	0.1024	0.0000
Antimony Trisulfide	0.0694	0.4500	0.0579	1.2514	0.0006	0.0000
Barium Nitrate	0.1003	0.6500	0.0836	-0.7182	0.0006	0.0000
Calcium Carbonate	0.7793	5.0500	0.6493	-6.1333	0.0044	0.0000
Calcium Resinate	0.1003 - 0.1204	0.6500 - 0.7800	0.0836 - 0.1003	17.8810	0.0001	0.0000
Dibutylphthalate	4.2901 - 7.3997	27.8000 - 47.9500	3.5743 - 6.1650	977.4992	0.0000	0.0000
Dinitrotoluene	0.7793	5.0500	0.6493	65.6500	0.0000	0.0000
Diphenylamine	1.1698	7.5800	0.9746	191.5588	0.0000	0.0000
Graphite	0.4799	3.1100	0.3999	67.6473	0.0000	0.0000
Gum Arabic	0.0093	0.0600	0.0077	0.6333	0.0000	0.0000
HMX	0.0000 - 0.9105	0.0000 - 5.9000	0.0000 - 0.7586	38.7142	0.0000	0.0000
Lead Azide	0.1898	1.2300	0.1581	2.1544	0.0015	0.0000
Styphnate	0.1296	0.8400	0.1080	2.9219	0.0006	0.0000
gnesium Aluminum	2.3904	15.4900	1.9916	277.3379	0.0416	0.0000
Nitrocellulose	57.3596 - 64.9198	371.6900 - 420.6800	47.7887 - 54.0874	2816.2189	0.0000	0.0000
Nitroglycerin	6.2299 - 8.5694	40.3700 - 55.5300	5.1904 - 7.1396	584.6075	0.0000	0.0000
PETN	0.0201	0.1300	0.0167	0.7084	0.0000	0.0000
Potassium Perchlorate	2.6003	16.8500	2.1664	6.8648	0.0105	0.0067
RDX	9.6404 - 10.5293	62.4700 - 68.2300	8.0319 - 8.7724	434.4398	0.0000	0.0000
Sodium Sulfate	0.3904	2.5300	0.3253	-2.7525	0.0022	0.0000
Tin Dioxide	0.4707 - 1.1698	3.0500 - 7.5800	0.3921 - 0.9746	0.0000	0.0117	0.0000
Wax	0.3102	2.0100	0.2584	62.0370	0.0000	0.0000
Zinc Stearate	0.0093	0.0600	0.0077	1.4259	.0000	0.0000
Total	108.4660	702.8600	90.3677	5772.7052	0.1624	0.0061

WASTE ITEM: 40MM Projectile, AP-T (M81)
PEP Weight: 140.4000 grains
Item Feed Rate: 1780.0000 projectiles/HR

Total Btu/hr 239568.5404
Total Ash loading (lb/hr) 8.1739
Total Chlorine loading (lb/hr) 3.7259

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Strontium Nitrate	45.9444 - 50.0114	64.5060 - 70.2160	16.4030 - 17.8549	-393.0896	0.2449	0.0000
Polyvinyl Chloride	15.6075 - 19.6745	21.9130 - 27.6230	5.5722 - 7.0241	1754.5720	0.0000	0.1116
Oxamid	8.3533 - 10.3319	11.7280 - 14.5060	2.9823 - 3.6887	429.0842	0.0000	0.0000
Polyethylene	23.0819 - 26.9295	32.4070 - 37.8090	8.2406 - 9.6143	5385.8974	0.0000	0.0000
Total	106.9473	150.1540	38.1820	6710.2812	0.2289	0.1044

Revise [illegible]

WASTE ITEM: 40MM Practice Cartridge (M385)
PEP Weight: 69.18 grains
Item Feed Rate: 660 ctg/hr

Total Btu/hr 31286.4785
Total Ash loading (lb/hr) 0.1229
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	0.0463 - 0.0564	0.0320 - 0.0390	0.0030 - 0.0037	7.5046	0.0011	0.0000
Antimony Trisulfide	0.0463 - 0.0564	0.0320 - 0.0390	0.0030 - 0.0037	3.3137	0.0004	0.0000
Barium Nitrate	1.2258 - 1.6826	0.8480 - 1.1640	0.0800 - 0.1097	-12.0472	0.0099	0.0000
Ethyl Centralite	0.0448 - 0.0665	0.0310 - 0.0460	0.0029 - 0.0043	10.0358	0.0000	0.0000
Graphite	0.4467 - 2.0078	0.3090 - 1.3890	0.0291 - 0.1310	283.0002	0.0000	0.0000
Lead Styphnate	0.2616 - 0.2819	0.1810 - 0.1950	0.0171 - 0.0184	6.3534	0.0013	0.0000
Nitrocellulose	74.9523 - 78.9679	51.8520 - 54.6300	4.8889 - 5.1508	3425.6279	0.0000	0.0000
Nitroglycerin	13.8306 - 15.8384	9.5680 - 10.9570	0.9021 - 1.0331	1080.4951	0.0000	0.0000
Potassium Nitrate	0.4467 - 1.1159	0.3090 - 0.7720	0.0291 - 0.0728	-3.1916	0.0062	0.0000
Tetracene	0.0231 - 0.0275	0.0160 - 0.0190	0.0015 - 0.0018	0.3252	0.0000	0.0000
Total	100.1012	69.2500	6.5293	4796.5639	0.0188	0.0000

WASTE ITEM: 40MM Practice Cartridge (M407)

PEP Weight: 88.69 grains

Item Feed Rate: 660 ctg/hr

Total Btu/hr 6871.4882

Total Ash loading (lb/hr) 1.8978

Total Chlorine loading (lb/hr) 0.5104

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	0.0361 - 0.0440	0.0320 - 0.0390	0.0030 - 0.0037	5.8537	0.0008	0.0000
Antimony Trisulfide	0.0755 - 0.0834	0.0670 - 0.0740	0.0063 - 0.0070	1.5035	0.0007	0.0000
Barium Nitrate	0.1387 - 0.1466	0.1230 - 0.1300	0.0116 - 0.0123	-1.0495	0.0009	0.0000
Ethyl Centralite	0.0350 - 0.0519	0.0310 - 0.0460	0.0029 - 0.0043	7.8281	0.0000	0.0000
Graphite	0.0169 - 0.0169	0.0150 - 0.0150	0.0014 - 0.0014	2.3839	0.0000	0.0000
Lead Azide	0.9392 - 0.9392	0.8330 - 0.8330	0.0785 - 0.0785	10.6602	0.0072	0.0000
Lead Styphnate	0.3089 - 0.3247	0.2740 - 0.2880	0.0258 - 0.0272	7.3193	0.0015	0.0000
Nitrocellulose	3.3059 - 3.3927	2.9320 - 3.0090	0.2764 - 0.2837	147.1760	0.0000	0.0000
Nitroglycerin	2.2618 - 2.3667	2.0060 - 2.0990	0.1891 - 0.1979	161.4543	0.0000	0.0000
Potassium Chlorate	20.0101 - 20.0101	17.7470 - 17.7470	1.6733 - 1.6733	89.8456	0.0916	0.0579
Potassium Nitrate	0.0519 - 0.1218	0.0460 - 0.1080	0.0043 - 0.0102	-0.3483	0.0007	0.0000
RDX	0.3304 - 0.3304	0.2930 - 0.2930	0.0276 - 0.0276	13.6308	0.0000	0.0000
'ium Bircarbonate	23.4897 - 23.4897	20.8330 - 20.8330	1.9643 - 1.9643	20.9058	0.1118	0.0000
/ur	7.8295 - 7.8295	6.9440 - 6.9440	0.6547 - 0.6547	311.8497	0.0000	0.0000
Tetracene	0.0304 - 0.0350	0.0270 - 0.0310	0.0025 - 0.0029	0.4138	0.0000	0.0000
Yellow Dye	35.6692 - 35.6692	31.6350 - 31.6350	2.9827 - 2.9827	0.0000	0.0000	0.0000
Total	94.8517	84.1240	7.9317	821.7321	0.2270	0.0610

ASTE ITEM: 76mm Projectile, HVTP-T (M315A1)
PEP Weight: 0.015 grains
Item Feed Rate: 660 ctg/hr

Total Btu/hr 3.1878
Total Ash loading (lb/hr) 0.0007
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Styphnate	100.0000	0.0150	0.0014	2254.0000	0.4766	0.0000

WASTE ITEM: 76mm Projectile, AP-T (M339)
PEP Weight: 0.015 grains
Item Feed Rate: 330 ctg/hr

Total Btu/hr 1.5939
Total Ash loading (lb/hr) 0.0003
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Styphnate	100.0000	0.0150	0.0007	2254.0000	0.4766	0.0000

WASTE ITEM: Fuze, MK27		Total Btu/hr	172555.4086
PEP Weight:	351.82 grains	Total Ash loading (lb/hr)	15.3636
Item Feed Rate:	660 items/hr	Total Chlorine loading (lb/hr)	0.0038

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0398	0.1400	0.0132	0.7171	0.0116	0.0000
Lead Azide	1.3501	4.7500	0.4479	15.3239	0.0003	0.0000
Potassium Chlorate	0.0398	0.1400	0.0132	0.1787	0.4505	0.0001
Tetryl	98.3997	346.1900	32.6408	5176.8108	0.0000	0.0000
Total	99.8295	351.2200	33.1150	5201.9019	0.4632	0.0001

WASTE ITEM: Fuze, Auxiliary Detonating (MK31 Mod 2) (w/booster)
PEP Weight: 54.3 grains
Item Feed Rate: 600 /hr

Total Btu/hr 22734.5477
Total Ash loading (lb/hr) 0.3074
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.3315	0.1800	0.0154	5.9735	0.0028	0.0000
Barium Nitrate	0.5157	0.2800	0.0240	-3.6921	0.0030	0.0000
Lead Azide	7.1639	3.8900	0.3334	81.3103	0.0549	0.0000
Lead Styphnate	1.1050	0.6000	0.0514	24.9061	0.0053	0.0000
Tetracene	0.1289	0.0700	0.0060	1.5263	0.0000	0.0000
Tetryl	90.7551	49.2800	4.2240	4774.6239	0.0000	0.0000
Total	100.0000	54.3000	4.6543	4884.6481	0.0660	0.0000

WASTE ITEM: Fuze, Point Detonating (M48)
PEP Weight: 6.12 grains
Item Feed Rate: 660 ctg/hr

Total Btu/hr 774.0707
Total Ash loading (lb/hr) 0.4519
Total Chlorine loading (lb/hr) 0.0092

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	5.3922 - 6.3725	0.3300 - 0.3900	0.0311 - 0.0368	114.8333	0.0433	0.0000
Barium Chromate	6.7810	0.4150	0.0391	-33.7018	0.0678	0.0000
Barium Nitrate	0.9804	0.0600	0.0057	-7.0196	0.0058	0.0000
Boron Powder	1.3072	0.0800	0.0075	328.6667	0.0421	0.0000
Lead Azide	75.4902 - 76.3072	4.6200 - 4.6700	0.4356 - 0.4403	866.0866	0.5848	0.0000
Lead Styphnate	1.9608	0.1200	0.0113	44.1961	0.0093	0.0000
Potassium Chlorate	4.5752 - 5.5556	0.2800 - 0.3400	0.0264 - 0.0321	24.9444	0.0254	0.0161
Silicon Carbide	0.6536 - 0.9804	0.0400 - 0.0600	0.0038 - 0.0057	0.0000	0.0098	0.0000
Tetracene	0.3268	0.0200	0.0019	3.8693	0.0000	0.0000
Vinyl Alcohol Acetate Resin	0.0817	0.0050	0.0005	8.3701	0.0000	0.0000
:al	100.6536	6.1600	0.5808	1341.4773	0.7832	0.0160

+ 16

WASTE ITEM: Fuze (M66A1/A2)
PEP Weight: 107.4 grains
Item Feed Rate: 660 ctg/hr

Total Btu/hr 47807.2831
Total Ash loading (lb/hr) 2.6953
Total Chlorine loading (lb/hr) 0.3183

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	0.5587	0.6000	0.0566	13.4134	0.0023	0.0000
Lead Azide	3.2495	3.4900	0.3291	36.8822	0.0249	0.0000
Magnesium	9.1155	9.7900	0.9231	971.0696	0.1512	0.0000
Strontium Nitrate	17.9236	19.2500	1.8150	-140.8799	0.0878	0.0000
Tetryl	63.5940	68.3000	6.4397	3345.6825	0.0000	0.0000
PVC	5.5400	5.9500	0.5610	494.0605	0.0000	0.0314
Total	99.9814	107.3800	10.1244	4721.1075	0.2662	0.0314

ᴊᴛE ITEM: Grenade Fuze (M204A2)

PEP Weight: 0.355 grains

Item Feed Rate: 1175 units/hr

Total Btu/hr 160.9265

Total Ash loading (lb/hr) 0.0398

Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	11.2676	0.0400	0.0067	1499.9437	0.2129	0.0000
Antimony Trisulfide	11.2676	0.0400	0.0067	203.0423	0.0967	0.0000
Barium Nitrate	22.5352	0.0800	0.0134	-161.3521	0.1322	0.0000
Lead Styphnate	53.5211	0.1900	0.0319	1206.3662	0.2551	0.0000
Tetracene	5.6338	0.0200	0.0034	66.7042	0.0000	0.0000
Total	104.2254	0.3700	0.0621	2700.5946	0.6686	0.0000

WASTE ITEM: Grenade Fuze (M206)
PEP Weight: 0.355 grains
Item Feed Rate: 1175 units/hr

Total Btu/hr 160.9265
Total Ash loading (lb/hr) 0.0398
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	11.2676	0.0400	0.0067	1499.9437	0.2129	0.0000
Antimony Trisulfide	11.2676	0.0400	0.0067	203.0423	0.0967	0.0000
Barium Nitrate	22.5352	0.0800	0.0134	-161.3521	0.1322	0.0000
Lead Styphnate	53.5211	0.1900	0.0319	1206.3662	0.2551	0.0000
Tetracene	5.6338	0.0200	0.0034	66.7042	0.0000	0.0000
Total	104.2254	0.3700	0.0621	2700.5946	0.6686	0.0000

WASTE ITEM: Grenade Fuze (M213)
PEP Weight: 0.355 grains
Item Feed Rate: 1175 units/hr

Total Btu/hr 160.9265
Total Ash loading (lb/hr) 0.0398
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	11.2676	0.0400	0.0067	1499.9437	0.2129	0.0000
Antimony Trisulfide	11.2676	0.0400	0.0067	203.0423	0.0967	0.0000
Barium Nitrate	22.5352	0.0800	0.0134	-161.3521	0.1322	0.0000
Lead Styphnate	53.5211	0.1900	0.0319	1206.3662	0.2551	0.0000
Tetracene	5.6338	0.0200	0.0034	66.7042	0.0000	0.0000
Total	104.2254	0.3700	0.0621	2700.5946	0.6686	0.0000

TEM: Grenade Fuze (M215)
ght: 0.355 grains
ed Rate: 1175 units/hr

Total Btu/hr 160.9265
Total Ash loading (lb/hr) 0.0398
Total Chlorine loading (lb/hr) 0.0000

ompound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
m	11.2676	0.0400	0.0067	1499.9437	0.2129	0.0000
y Trisulfide	11.2676	0.0400	0.0067	203.0423	0.0967	0.0000
Nitrate	22.5352	0.0800	0.0134	-161.3521	0.1322	0.0000
yphnate	53.5211	0.1900	0.0319	1206.3662	0.2551	0.0000
ne	5.6338	0.0200	0.0034	66.7042	0.0000	0.0000
	104.2254	0.3700	0.0621	2700.5946	0.6686	0.0000

WASTE ITEM: Grenade Fuze (M502)		Total Btu/hr	107887.6849
PEP Weight:	331.9 grains	Total Ash loading (lb/hr)	0.3370
Item Feed Rate:	440 ctg/hr	Total Chlorine loading (lb/hr)	0.0049

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0994	0.3300	0.0207	1.7917	0.0009	0.0000
Barium Nitrate	0.0392	0.1300	0.0082	-0.2804	0.0002	0.0000
Carborundum	0.0090	0.0300	0.0019	0.0000	0.0001	0.0000
Lead Azide	1.8500	6.1400	0.3859	20.9970	0.0142	0.0000
Lead Styphnate	0.0904	0.3000	0.0189	2.0374	0.0004	0.0000
Tetracene	0.0090	0.0300	0.0019	0.1070	0.0000	0.0000
Tetryl	97.8307	324.7000	20.4097	5146.8716	0.0000	0.0000
Potassium Chlorate	0.0813	0.2700	0.0170	0.3653	0.0004	0.0002
Total	100.0090	331.9300	20.8642	5171.4221	0.0162	0.0002

WASTE ITEM: Fuze, Point Detonating (M557) (w/booster)		Total Btu/hr	137557.2094
PEP Weight:	339.76-381.9 grains	Total Ash loading (lb/hr)	0.4357
Item Feed Rate:	440 items/hr	Total Chlorine loading (lb/hr)	0.0060

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0864 - 0.1021	0.3300 - 0.3900	0.0207 - 0.0245	1.8402	0.0009	0.0000
Barium Chromate	0.1087	0.4150	0.0261	-0.5401	0.0011	0.0000
Barium Nitrate	0.0157	0.0600	0.0038	-0.1125	0.0001	0.0000
Barium Stearate	1.9482	< 7.4400	0.4677	269.4297	0.0042	0.0000
Boron Powder	0.0209	0.0800	0.0050	5.2669	0.0007	0.0000
Calcium Stearate	1.9482	< 7.4400	0.4677	312.4839	0.0018	0.0000
Graphite	1.9691	< 7.5200	0.4727	277.5449	0.0000	0.0000
Lead Azide	1.2097 - 1.2228	4.6200 - 4.6700	0.2904 - 0.2935	13.8792	0.0094	0.0000
Lead Styphnate	0.0314	0.1200	0.0075	0.7082	0.0001	0.0000
Potassium Chlorate	0.0733 - 0.0890	0.2800 - 0.3400	0.0176 - 0.0214	0.3997	0.0004	0.0003
Silicon Carbide	0.0105 - 0.0157	0.0400 - 0.0600	0.0025 - 0.0038	0.0000	0.0002	0.0000
scene	0.0052	0.0200	0.0013	0.0620	0.0000	0.0000
ryl	85.6507 - 96.4284	327.1000 - 368.2600	20.5606 - 23.1478	5073.0973	0.0000	0.0000
Vinyl Alcohol Acetate Resin	0.0013	0.0050	0.0003	0.1341	0.0000	0.0000
Total	103.9068	396.8200	24.9430	5730.3225	0.0181	0.0002

WASTE ITEM: Fuze, Point Detonating (M572) (w/booster)		Total Btu/hr	137557.2094
PEP Weight:	339.76-381.9 grains	Total Ash loading (lb/hr)	0.4357
Item Feed Rate:	440 items/hr	Total Chlorine loading (lb/hr)	0.0060

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0864 - 0.1021	0.3300 - 0.3900	0.0207 - 0.0245	1.8402	0.0009	0.0000
Barium Chromate	0.1087	0.4150	0.0261	-0.5401	0.0011	0.0000
Barium Nitrate	0.0157	0.0600	0.0038	-0.1125	0.0001	0.0000
Barium Stearate	1.9482	< 7.4400	0.4677	269.4297	0.0042	0.0000
Boron Powder	0.0209	0.0800	0.0050	5.2669	0.0007	0.0000
Calcium Stearate	1.9482	< 7.4400	0.4677	312.4839	0.0018	0.0000
Graphite	1.9691	< 7.5200	0.4727	277.5449	0.0000	0.0000
Lead Azide	1.2097 - 1.2228	4.6200 - 4.6700	0.2904 - 0.2935	13.8792	0.0094	0.0000
Lead Styphnate	0.0314	0.1200	0.0075	0.7082	0.0001	0.0000
Potassium Chlorate	0.0733 - 0.0890	0.2800 - 0.3400	0.0176 - 0.0214	0.3997	0.0004	0.0003
Silicon Carbide	0.0105 - 0.0157	0.0400 - 0.0600	0.0025 - 0.0038	0.0000	0.0002	0.0000
tracene	0.0052	0.0200	0.0013	0.0620	0.0000	0.0000
,etryl	85.6507 - 96.4284	327.1000 - 368.2600	20.5606 - 23.1478	5073.0973	0.0000	0.0000
Vinyl Alcohol Acetate Resin	0.0013	0.0050	0.0003	0.1341	0.0000	0.0000
Total	103.9068	396.8200	24.9430	5730.3225	0.0181	0.0002

WASTE ITEM: Rocket Motor Igniter (M20A1)		Total Btu/hr	13250.1207
PEP Weight:	51.9-58.1 grains	Total Ash loading (lb/hr)	2.2490
Item Feed Rate:	660 items/hr	Total Chlorine loading (lb/hr)	0.0114

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	87.6076 - 98.2788	50.9000 - 57.1000	4.7991 - 5.3837	2359.6747	0.4036	0.0000
Charcoal	0.2926 - 0.3270	0.1700 0.1900	0.0160 - 0.0179	46.0938	0.0000	0.0000
Egyptian Lacquer	0.1549 - 0.1893	0.0900 0.1100	0.0085 - 0.0104	0.0000	0.0000	0.0000
Lead Thiocyanate	0.5164 - 0.5852	0.3000 0.3400	0.0283 - 0.0321	12.2716	0.0040	0.0000
Potassium Chlorate	0.6540 - 0.7229	0.3800 0.4200	0.0358 - 0.0396	3.2458	0.0033	0.0021
Total	100.1033	58.1600	5.4837	2418.7880	0.4106	0.0021

WASTE ITEM: Rocket Motor Igniter (MK117 & MK118)
PEP Weight: 30 grains
Item Feed Rate: 2280 ctg/hr

Total Btu/hr 23461.2000
Total Ash loading (lb/hr) 4.0131
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	100.0000	30.0000	9.7714	2401.0000	0.4107	0.0000

wASTE ITEM: Rocket Motor Igniter (MK125-5)		Total Btu/hr	22638.0000
PEP Weight:	10 grains	Total Ash loading (lb/hr)	3.8723
Item Feed Rate:	6600 ctg/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	100.0000	10.0000	9.4286	2401.0000	0.4107	0.0000

WASTE ITEM: 3.5-inch Rocket Motor		Total Btu/hr	442016.0928
PEP Weight:	2520 grains	Total Ash loading (lb/hr)	2.7294
Item Feed Rate:	240 motors/hr	Total Chlorine loading (lb/hr)	1.7246

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Carbon Black	1.2000	30.2400	1.0368	169.1400	0.0000	0.0000
Ethyl Centralite	0.9000	22.6800	0.7776	135.8370	0.0000	0.0000
Nitrocellulose	54.6000	1375.9200	47.1744	2368.5480	0.0000	0.0000
Nitroglycerine	35.5000	894.6000	30.6720	2421.8100	0.0000	0.0000
Potassium Perchlorate	7.8000	196.5600	6.7392	20.5920	0.0316	0.0200
Total	100.0000	2520.0000	86.4000	5115.9270	0.0316	0.0200

WASTE ITEM: Bomb Ejection Cartridge (CCU-1/B)		Total Btu/hr	45049.2386
PEP Weight:	8.29 grains	Total Ash loading (lb/hr)	3.2608
Item Feed Rate:	6600 ctgs/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Ethyl Centralite	0.1809 - 0.3739	0.0150 - 0.0310	0.0141 - 0.0292	56.4394	0.0000	0.0000
Nitrocellulose	56.2726 - 59.2159	4.6650 - 4.9090	4.3984 - 4.6285	2568.7867	0.0000	0.0000
Nitroglycerin	12.4729 - 15.3920	1.0340 - 1.2760	0.9749 - 1.2031	1050.0449	0.0000	0.0000
Potassium Sulfate	0.1809 - 0.5549	0.0150 - 0.0460	0.0141 - 0.0434	-3.8786	0.0036	0.0000
Red Phosphorus	18.6128	1.5430	1.4548	1901.2961	0.4265	0.0000
RDX	8.9385	0.7410	0.6987	368.8017	0.0000	0.0000
Total	103.0881	8.5460	8.0577	5763.5097	0.4172	0.0000

WASTE ITEM: Booster (M21A4)		Total Btu/hr	105335.6555
PEP Weight:	321.3 grains	Total Ash loading (lb/hr)	0.1701
Item Feed Rate:	440 /hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Azide	1.0987	3.5300	0.2219	12.4698	0.0084	0.0000
Tetryl	98.9013	317.7700	19.9741	5203.1994	0.0000	0.0000
Total	100.0000	321.3000	20.1960	5215.6692	0.0084	0.0000

WASTE ITEM: Booster (MK39 Mod 0)
PEP Weight: 415.8 grains
Item Feed Rate: 480 /hr

Total Btu/hr 150001.6320
Total Ash loading (lb/hr) 0.0000
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Tetryl	100.0000	415.8000	28.5120	5261.0000	0.0000	0.0000

.ASTE ITEM: Detent		Total Btu/hr	169103.5714
PEP Weight:	10 grains	Total Ash loading (lb/hr)	0.0000
Item Feed Rate:	22500 ctg/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Tetryl	100.0000	10.0000	32.1429	5261.0000	0.0000	0.0000

STE ITEM: Detonator (M17)		Total Btu/hr	29275.2576
PEP Weight:	4.784 grains	Total Ash loading (lb/hr)	7.5855
Item Feed Rate:	19500 units	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Azide	74.2057	3.5500	9.8893	842.2345	0.5687	0.0000
Tetryl	25.7107	1.2300	3.4264	1352.6401	0.0000	0.0000
Total	99.9164	4.7800	13.3157	2196.7113	0.5692	0.0000

..STE ITEM: Detonator (M22)
PEP Weight: 4.17 grains
Item Feed Rate: 5860 units

Total Btu/hr 7650.3891
Total Ash loading (lb/hr) 1.9431
Total Chlorine loading (lb/hr) 0.0630

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	6.2350	0.2600	0.2177	112.3549	0.0535	0.0000
Carborundum	0.9592	0.0400	0.0335	0.0000	0.0096	0.0000
Lead Azide	60.6715	2.5300	2.1180	688.6211	0.4650	0.0000
Potassium Chlorate	6.2350	0.2600	0.2177	27.9952	0.0285	0.0180
Tetryl	25.8993	1.0800	0.9041	1362.5612	0.0000	0.0000
Total	100.0000	4.1700	3.4909	2191.5324	0.5566	0.0180

WASTE ITEM: Detonator (M24)		Total Btu/hr	12154.3500
PEP Weight:	3.9 grains	Total Ash loading (lb/hr)	8.1475
Item Feed Rate:	19500 /hr	Total Chlorine loading (lb/hr)	0.2821

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	8.9744	0.3500	0.9750	161.7179	0.0770	0.0000
Carborundum	1.2821	0.0500	0.1393	0.0000	0.0128	0.0000
Lead Azide	80.7692	3.1500	8.7750	916.7308	0.6190	0.0000
Potassium Chlorate	8.9744	0.3500	0.9750	40.2949	0.0411	0.0260
Total	100.0000	3.9000	10.8643	1118.7436	0.7499	0.0260

ITEM: Detonator (M55)

PEP Weight:	1.312 grains	Total Btu/hr	6667.4434
Item Feed Rate:	19500 /hr	Total Ash loading (lb/hr)	2.0638
		Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	2.2866	0.0300	0.0836	41.2043	0.0196	0.0000
Barium Nitrate	3.8110	0.0500	0.1393	-27.2866	0.0224	0.0000
Lead Azide	63.2622	0.8300	2.3121	718.0259	0.4848	0.0000
Lead Styphnate	6.8598	0.0900	0.2507	154.6189	0.0327	0.0000
RDX	22.1037	0.2900	0.8079	911.9970	0.0000	0.0000
Tetracene	0.7622	0.0100	0.0279	9.0244	0.0000	0.0000
Total	99.0854	1.3000	3.6214	1824.2692	0.5647	0.0000

WASTE ITEM: Impluse Cartridge (MK15 Mod 0)		Total Btu/hr	3895.2643
PEP Weight:	0.26 grains	Total Ash loading (lb/hr)	0.7356
Item Feed Rate:	45000 ctgs/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Potassium Nitrate	40.3846	0.1050	0.6750	-115.5000	0.2241	0.0000
Sulfur	5.7692	0.0150	0.0964	229.7885	0.0000	0.0000
Charcoal	8.4615	0.0220	0.1414	1192.6538	0.0000	0.0000
Lead Styphnate	44.6154	0.1160	0.7457	1005.6308	0.2126	0.0000
Total	99.2308	0.2580	1.6586	2330.5000	0.4401	0.0000

WASTE ITEM: Cutter Cartridge (M21 and M22)		Total Btu/hr	3100.6872
PEP Weight:	2.15 grains	Total Ash loading (lb/hr)	0.1582
Item Feed Rate:	2640 ctgs/hr	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	1.6744 - 2.2326	0.0360 - 0.0480	0.0136 - 0.0181	297.1981	0.0422	0.0000
Antimony Trisulfide	3.6279 - 4.7442	0.0780 - 0.1020	0.0294 - 0.0385	85.4902	0.0407	0.0000
Barium Nitrate	7.5814 - 10.3256	0.1630 - 0.2220	0.0615 - 0.0837	-73.9312	0.0606	0.0000
Calcium Carbonate	0.4651	0.0100	0.0038	-3.6605	0.0026	0.0000
Diphenylamine	0.6512	0.0140	0.0053	106.6344	0.0000	0.0000
Lead Styphnate	8.9767 - 11.7674	0.1930 - 0.2530	0.0728 - 0.0954	265.2381	0.0561	0.0000
Nitrocellulose	64.0930	1.3780	0.5197	2780.3553	0.0000	0.0000
Nitroglycerin	6.4651	0.1390	0.0524	441.0502	0.0000	0.0000
PETN	1.1163 - 1.6744	0.0240 - 0.0360	0.0091 - 0.0136	59.1237	0.0000	0.0000
Sodium Sulfate	0.0930	0.0020	0.0008	-0.6558	0.0005	0.0000
Tetracene	0.8372 - 1.3953	0.0180 - 0.0300	0.0068 - 0.0113	16.5209	0.0000	0.0000
Total	103.9070	2.2340	0.8425	3823.9624	0.1951	0.0000

WASTE ITEM: Fin Assembly w/primer for an 81mm Mortar
PEP Weight: 123.86 grains
Item Feed Rate: 2640 ctgs/hr

Total Btu/hr 249392.5444
Total Ash loading (lb/hr) 0.4958
Total Chlorine loading (lb/hr) 0.0223

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0533	0.0660	0.0249	0.9602	0.0005	0.0000
Charcoal	0.0016	0.0020	0.0008	0.2276	0.0000	0.0000
Diphenylamine	0.7476	0.9260	0.3492	122.4300	0.0000	0.0000
Lead Thiocyanate	0.1558	0.1930	0.0728	3.2676	0.0011	0.0000
Nitrocellulose	57.5618	71.2960	26.8888	2497.0293	0.0000	0.0000
Nitroglycerin	39.8700	49.3830	18.6244	2719.9324	0.0000	0.0000
Potassium Chlorate	0.1655	0.2050	0.0773	0.7431	0.0008	0.0005
Potassium Nitrate	1.5041	1.8630	0.7026	-4.3018	0.0083	0.0000
Sulfur	0.0016	0.0020	0.0008	0.0643	0.0000	0.0000
Trinitrotoluene	0.1494	0.1850	0.0698	9.7324	0.0000	0.0000
Total	100.2107	124.1210	46.8113	5338.8351	0.0106	0.0005

WASTE ITEM: Propellant, M1, MP

Item Feed Rate: 240 lb/hr

Total Btu/Hr 1272228.1188

Total Ash loading (lb/hr) 0.0000

Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)		Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Nitrocellulose	85.0000 +	2.0	199.2 - 208	3687.3000	0.0000	0.0000
Dinitrotoluene	10.0000 +	2.0	19.2 - 28	842.4000	0.0000	0.0000
Dibutylphthalate	5.0000 +	1.0	9.0 - 14	660.5000	0.0000	0.0000
Diphenylamine	1.0000 +	0.2	1.9 - 2	163.7600	0.0000	0.0000
Total	101.0000		254	5300.9505	0.0000	0.0000

WASTE ITEM: Propellant, M7

Item Feed Rate: 125 lb/hr

Total Btu/Hr 639490.8750

Total Ash loading (lb/hr) 3.9488

Total Chlorine loading (lb/hr) 2.4950

Compound	Percentage of PEP (percent)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Nitrocellulose	54.6000	68.2500	2368.5480	0.0000	0.0000
Nitroglycerin	35.5000	44.3750	2421.8100	0.0000	0.0000
Potassium Perchlorate	7.8000	9.7500	20.5920	0.0316	0.0200
Carbon Black	1.2000	1.5000	169.1400	0.0000	0.0000
Ethyl Centralite	0.9000	1.1250	135.8370	0.0000	0.0000
Total	100.0000	125.0000	5115.9270	0.0316	0.0200

Item 6

neric feedrate

WASTE ITEM: Primer, Percussion (M26)
PEP Weight: 1.8 grains
Item Feed Rate: Gener 99000 items/hr (limited by chlorine content)

Total Btu/hr 28723.7186
Total Ash loading (lb/hr) 15.2822
Total Chlorine loading (lb/hr) 3.8870

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	17.2222	0.3100	4.3843	310.3444	0.1478	0.0000
Lead Azide	5.0000	0.0900	1.2729	56.7500	0.0383	0.0000
Lead Thiocyanate	25.0000	0.4500	6.3643	524.2500	0.1726	0.0000
Potassium Chlorate	52.7778	0.9500	13.4357	236.9722	0.2416	0.1527
Total	100.0000	1.8000	25.4571	1128.3167	0.6003	0.1527

revised to 50,000 items/hr

eric feedrate

WASTE ITEM: Primer, Percussion (M47)		Total Btu/hr	123740.2217
PEP Weight:	301 grains	Total Ash loading (lb/hr)	21.2141
Item Feed Rate: Gener	1200 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.0263

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0565	0.1700	0.0291	1.0177	0.0005	0.0000
Charcoal	15.5482	46.8000	8.0229	2191.5150	0.0000	0.0000
Lead Thiocyanate	0.0831	0.2500	0.0429	1.7417	0.0006	0.0000
Potassium Chlorate	0.1761	0.5300	0.0909	0.7906	0.0008	0.0005
Potassium Nitrate	73.7542	222.0000	38.0571	-210.9369	0.4093	0.0000
Sulfur	10.3654	31.2000	5.3486	412.8558	0.0000	0.0000
TNT	0.0166	0.0500	0.0086	1.0824	0.0000	0.0000
Total	100.0000	301.0000	51.6000	2398.0663	0.4111	0.0005

neric feedrate

WASTE ITEM: Primer, Percussion (M68)
PEP Weight: 301 grains
Item Feed Rate: Gener 1200 items/hr (limited by ash content)

Total Btu/hr 123740.2217
Total Ash loading (lb/hr) 21.2141
Total Chlorine loading (lb/hr) 0.0263

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0565	0.1700	0.0291	1.0177	0.0005	0.0000
Charcoal	15.5482	46.8000	8.0229	2191.5150	0.0000	0.0000
Lead Thiocyanate	0.0831	0.2500	0.0429	1.7417	0.0006	0.0000
Potassium Chlorate	0.1761	0.5300	0.0909	0.7906	0.0008	0.0005
Potassium Nitrate	73.7542	222.0000	38.0571	-210.9369	0.4093	0.0000
Sulfur	10.3654	31.2000	5.3486	412.8558	0.0000	0.0000
TNT	0.0166	0.0500	0.0086	1.0824	0.0000	0.0000
Total	100.0000	301.0000	51.6000	2398.0663	0.4111	0.0005

Generic feedrate

WASTE ITEM: Primer, Percussion (M79)		Total Btu/hr	130561.5600
PEP Weight:	381 grains	Total Ash loading (lb/hr)	22.3713
Item Feed Rate: Gener	1000 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.0219

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0446	0.1700	0.0243	0.8040	0.0004	0.0000
Charcoal	15.5591	59.2800	8.4686	2193.0488	0.0000	0.0000
Lead Thiocyanate	0.0656	0.2500	0.0357	1.3760	0.0005	0.0000
Potassium Chlorate	0.1391	0.5300	0.0757	0.6246	0.0006	0.0004
Potassium Nitrate	73.8058	281.2000	40.1714	-211.0845	0.4095	0.0000
Sulfur	10.3727	39.5200	5.6457	413.1448	0.0000	0.0000
TNT	0.0131	0.0500	0.0071	0.8551	0.0000	0.0000
Total	100.0000	381.0000	54.4286	2398.7688	0.4110	0.0004

.ieric feedrate

WASTE ITEM: Primer, Electric (M80A1)		Total Btu/hr	298526.7719
PEP Weight:	876.97 grains	Total Ash loading (lb/hr)	22.7837
Item Feed Rate: Gener	740 items/hr (limited by explosive feedrate)	Total Chlorine loading (lb/hr)	0.0350

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Charcoal	9.1269	80.0400	8.4614	1286.4337	0.0000	0.0000
Ethyl Centralite	0.4960	4.3500	0.4599	74.8652	0.0000	0.0000
Gum Arabic	0.0046	0.0400	0.0042	0.3120	0.0000	0.0000
Lead Thiocyanate	0.1049	0.9200	0.0973	2.1999	0.0007	0.0000
Nitrocellulose	39.6821	348.0000	36.7886	1721.4089	0.0000	0.0000
Potassium Chlorate	0.1300	1.1400	0.1205	0.5837	0.0006	0.0004
Potassium Nitrate	43.8487	384.5400	40.6514	-125.4073	0.2433	0.0000
Sulfur	6.1507	53.9400	5.7022	244.9833	0.0000	0.0000
Total	99.5439	872.9700	92.2854	3220.0667	0.2458	0.0004

neric feedrate

WASTE ITEM: Fuze, Time (M65A1)		Total Btu/hr	132205.9200
PEP Weight:	52.8 grains	Total Ash loading (lb/hr)	22.6143
Item Feed Rate: Gener	7300 items/hr (limited by explosive feedrate)	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/munition)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	11.5341	6.0900	6.3510	276.9335	0.0474	0.0000
Fuze Powder	86.9318	45.9000	47.8671	2087.2330	0.3570	0.0000
Total	98.4659	51.9900	54.2181	2401.0000	0.4107	0.0000

-neric feedrate

WASTE ITEM: Fuze, Point Detonating (M78A1) (w/booster)
PEP Weight: 355.9 grains
Item Feed Rate: Gener 1900 items/hr (limited by explosive feedrate)

Total Btu/hr 497632.6371
Total Ash loading (lb/hr) 2.0482
Total Chlorine loading (lb/hr) 0.0288

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.1158	0.4120	0.1118	2.0860	0.0010	0.0000
Barium Chromate	0.0933	0.3320	0.0901	-0.4636	0.0009	0.0000
Barium Nitrate	0.0169	0.0600	0.0163	-0.1207	0.0001	0.0000
Boron Powder	0.0180	0.0640	0.0174	4.5214	0.0006	0.0000
Carborundum	0.0155	0.0550	0.0149	0.0000	0.0002	0.0000
Lead Azide	2.3240	8.2710	2.2450	26.3770	0.0178	0.0000
Lead Styphnate	0.0337	0.1200	0.0326	0.7600	0.0002	0.0000
Potassium Chlorate	0.1031	0.3670	0.0996	0.4630	0.0005	0.0003
Tetracene	0.0042	0.0150	0.0041	0.0499	0.0000	0.0000
Tetryl	97.2745	346.2000	93.9686	5117.6123	0.0000	0.0000
Vinyl Alcohol Acetate Resin	0.0011	0.0040	0.0011	0.1151	0.0000	0.0000
otal	100.0000	355.9000	96.6014	5151.4004	0.0212	0.0003

.neric feedrate

WASTE ITEM: Fuze, Base Detonating (M91A1) (w/booster)		Total Btu/hr	492718.8608
PEP Weight:	353.4 grains	Total Ash loading (lb/hr)	8.7727
Item Feed Rate: Gener	1900 items/hr (limited by explosive feedrate)	Total Chlorine loading (lb/hr)	0.4219

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	0.1834	0.6480	0.1759	24.4091	0.0035	0.0000
Aluminum Trisulfide	0.1602	0.5660	0.1536	9.4141	0.0011	0.0000
Carborundum	0.0241	0.0850	0.0231	0.0000	0.0002	0.0000
Lead Azide	0.1361	0.4810	0.1306	1.5448	0.0010	0.0000
Magnesium Powder	3.4813	12.3030	3.3394	370.8655	0.0577	0.0000
Potassium Chlorate	0.1607	0.5680	0.1542	0.7217	0.0007	0.0005
PVC	0.6933	2.4500	0.6650	61.8254	0.0000	0.0039
RDX	0.2830	1.0000	0.2714	11.6752	0.0000	0.0000
Strontium Nitrate	5.5461	19.6000	5.3200	-43.5925	0.0272	0.0000
Tetryl	89.3322	315.7000	85.6900	4699.7671	0.0000	0.0000
Total	100.0003	353.4010	95.9231	5136.6158	0.0915	0.0044

Generic feedrate

WASTE ITEM: Fuze, Point Initiating-Base Detonating (M509A1)
PEP Weight: 112.24-125.38 grains
Item Feed Rate: Generi 5500 items/hr (limited by explosive feedrate)

Total Btu/hr 508145.3929
Total Ash loading (lb/hr) 1.1622
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Azide	1.2841 - 1.5393	1.6100 - 1.9300	1.2650 - 1.5164	17.4713	0.0118	0.0000
PETN	1.7786 - 2.2731	2.2300 - 2.8500	1.7521 - 2.2393	80.2628	0.0000	0.0000
Tetryl	86.4572 - 96.1876	108.4000 - 120.6000	85.1714 - 94.7571	5060.4291	0.0000	0.0000
Total	100.0000	125.3800	98.5129	5158.1632	0.0118	0.0000

neric feedrate

WASTE ITEM: Fuze, Proximity (M513A1) (w/booster)
PEP Weight: 388.3 grains
Item Feed Rate: Gener 1800 items/hr (limited by explosive feedrate)

Total Btu/hr 522702.2829
Total Ash loading (lb/hr) 0.4336
Total Chlorine loading (lb/hr) 0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Lead Azide	0.5666	2.2000	0.5657	6.4306	0.0043	0.0000
PETN	0.1545	0.6000	0.1543	5.4561	0.0000	0.0000
Tetryl	99.2789	385.5000	99.1286	5223.0634	0.0000	0.0000
Total	100.0000	388.3000	99.8486	5234.9500	0.0043	0.0000

-eneric feedrate

WASTE ITEM: Fuze, Point Detonating (M521)		Total Btu/hr	70515.4718
PEP Weight:	6.96 - 7.66 grains	Total Ash loading (lb/hr)	22.3502
Item Feed Rate: Gener	34000 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.6534

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	5.1044	0.3910	0.1899	91.9820	0.0438	0.0000
Black Powder	8.4856	0.6500	0.3157	203.7402	0.0349	0.0000
Carborundum	0.7180	0.0550	0.0267	0.0000	0.0072	0.0000
Lead Azide	63.7076	4.8800	2.3703	723.0809	0.4883	0.0000
Lead Thiocyanate	0.7311	0.0560	0.0272	15.3305	0.0050	0.0000
Potassium Chlorate	6.1358	0.4700	0.2283	27.5496	0.0281	0.0178
Tetryl	16.0574	1.2300	0.5974	844.7820	0.0000	0.0000
TNT	0.1436	0.0110	0.0053	9.3572	0.0000	0.0000
Total	101.0836	7.7430	3.7609	1895.2861	0.6007	0.0176

Generic feedrate

WASTE ITEM: Fuze, Point Detonating (M525) (w/booster)
PEP Weight: 270 grains
Item Feed Rate: Gener 2500 items/hr (limited by explosive feedrate)

Total Btu/hr 396174.3750
Total Ash loading (lb/hr) 1.0211
Total Chlorine loading (lb/hr) 0.0310

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.1111	0.3000	0.1071	2.0022	0.0010	0.0000
Lead Azide	1.1667	3.1500	1.1250	13.2417	0.0089	0.0000
Potassium Chlorate	0.1111	0.3000	0.1071	0.4989	0.0005	0.0003
RDX	96.4074	260.3000	92.9643	3977.7696	0.0000	0.0000
Silicon Carbide	0.0185	0.0500	0.0179	0.0000	0.0002	0.0000
Tetryl	2.1852	5.9000	2.1071	114.9626	0.0000	0.0000
Total	100.0000	270.0000	96.4286	4108.4750	0.0106	0.0003

Generic feedrate

WASTE ITEM: Fuze, Point Detonating (M564) (w/booster)
PEP Weight: 361.7 grains
Item Feed Rate: Gener 1900 items/hr (limited by explosive feedrate)

Total Btu/hr 401072.9780
Total Ash loading (lb/hr) 2.7282
Total Chlorine loading (lb/hr) 0.3329

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.3622	1.3100	0.3556	6.5265	0.0031	0.0000
Barium Nitrate	0.0166	0.0600	0.0163	-0.1188	0.0001	0.0000
Lead Azide	1.9795	7.1600	1.9434	22.4678	0.0152	0.0000
Lead Styphnate	0.0332	0.1200	0.0326	0.6957	0.0002	0.0000
Lead Thiocyanate	0.5529	2.0000	0.5429	11.5952	0.0038	0.0000
Potassium Chlorate	1.1722	4.2400	1.1509	5.2634	0.0054	0.0034
RDX	88.5817	320.4000	86.9657	3654.8808	0.0000	0.0000
Tetracene	0.0055	0.0200	0.0054	0.0655	0.0000	0.0000
Tetryl	7.2989	26.4000	7.1657	383.9934	0.0000	0.0000
Total	100.0028	361.7100	98.1784	4085.2565	0.0278	0.0034

Generic feedrate

WASTE ITEM: Projectile Simulator (M74)		Total Btu/hr	135580.4964
PEP Weight:	546.9 grains	Total Ash loading (lb/hr)	21.7072
Item Feed Rate: Generi	500.0 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Aluminum	7.9996 - 10.0000	43.7500 - 54.6900	3.2638 - 4.0799	1331.2000	0.1890	0.0000
Black Powder	90.0000 - 92.0004	492.2100 503.1500	36.7189 - 37.5350	2208.9288	0.3778	0.0000
Total	102.0004	557.8400	41.6149	3470.7020	0.5557	0.0000

Generic feedrate

WASTE ITEM: Illuminating Signal (AN-M37A2)		Total Btu/hr	131621.1129
PEP Weight:	80.86 grains	Total Ash loading (lb/hr)	22.8346
Item Feed Rate: Gener	4700 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.1770

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Asphaltum	0.2869	0.2320	0.1558	50.2102	0.0000	0.0000
Barium Nitrate	0.0495	0.0400	0.0269	-0.3542	0.0003	0.0000
Black Powder	95.4489	77.1800	51.8209	2291.7287	0.3920	0.0000
Hexachlorobenzene	0.0247	0.0200	0.0134	0.7969	0.0000	0.0002
Lead Thiocyanate	0.1855	0.1500	0.1007	3.8901	0.0013	0.0000
Linseed Oil	0.0210	0.0170	0.0114	3.2150	0.0000	0.0000
Magnesium Powder	0.7420	0.6000	0.4029	79.0477	0.0123	0.0000
Potassium Chlorate	0.1855	0.1500	0.1007	0.8329	0.0008	0.0005
Potassium Perchlorate	0.9894	0.8000	0.5371	2.6119	0.0040	0.0025
Strontium Nitrate	1.8303	1.4800	0.9937	-14.3863	0.0090	0.0000
TNT	0.0247	0.0200	0.0134	1.6117	0.0000	0.0000
Total	99.7885	80.6890	54.1769	2424.3315	0.4206	0.0033

Generic feedrate

WASTE ITEM: Illuminating Signal (AN-M43A2)		Total Btu/hr	129739.3893
PEP Weight:	56.03-63.752 grains	Total Ash loading (lb/hr)	22.4040
Item Feed Rate: Generc	5900 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.1928

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Asphaltum	0.1820	0.1160	0.0978	31.8421	0.0000	0.0000
Barium Nitrate	0.0627	0.0400	0.0337	-0.4492	0.0004	0.0000
Black Powder	84.7189 - 96.8283	54.0100 - 61.7300	45.5227 - 52.0296	2324.8483	0.3977	0.0000
Hexachlorobenzene	0.1569	0.1000	0.0843	5.0540	0.0000	0.0012
Lead Thiocyanate	0.2353	0.1500	0.1264	4.9340	0.0016	0.0000
Linseed Oil	0.0125	0.0080	0.0067	1.9189	0.0000	0.0000
Magnesium Powder	0.4690	0.2990	0.2520	49.9631	0.0078	0.0000
Potassium Chlorate	0.6274	0.4000	0.3371	2.8172	0.0029	0.0018
Potassium Perchlorate	0.2353	0.1500	0.1264	0.6212	0.0010	0.0006
[illegible]rontium Nitrate	1.1592	0.7390	0.6229	-9.1111	0.0057	0.0000
[illegible]	0.0314	0.0200	0.0169	2.0442	0.0000	0.0000
Total	100.0000	63.7520	53.7338	2414.4825	0.4169	0.0036

Generic feedrate

WASTE ITEM: Ground Illuminating Signal (red) (M158)
PEP Weight: 570.15-570.95 grains
Item Feed Rate: Generi 475 items/hr (limited by ash content)

Total Btu/hr 116085.4173
Total Ash loading (lb/hr) 22.7682
Total Chlorine loading (lb/hr) 0.0244

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Antimony Trisulfide	0.0298	0.1700	0.0115	1.7502	0.0003	0.0000
Black Powder	8.2154 - 8.3440	46.8400 - 47.6400	3.1784 - 3.2327	200.3392	0.0343	0.0000
Calcium Carbonate	0.6148	3.5100	0.2382	-4.8382	0.0034	0.0000
Charcoal	8.1969	46.8000	3.1757	1155.3481	0.0000	0.0000
Lead Thiocyanate	0.0438	0.2500	0.0170	0.9182	0.0003	0.0000
Magnesium Powder	12.6463	72.2040	4.8996	1347.2094	0.2097	0.0000
Potassium Chlorate	0.0928	0.5300	0.0360	0.4168	0.0004	0.0003
Potassium Nitrate	38.8826	222.0000	15.0643	-111.2041	0.2158	0.0000
PVC	0.0574	0.3280	0.0223	5.1232	0.0000	0.0003
Sulfur	5.4646	31.2000	2.1171	217.6541	0.0000	0.0000
Strontium Nitrate	18.3939	105.0200	7.1264	-144.5761	0.0901	0.0000
IT	0.0088	0.0500	0.0034	0.5706	0.0000	0.0000
Vinyl Alcohol Acetate Resin	1.5329	8.7520	0.5939	157.0439	0.0000	0.0000
Total	94.3084	538.4540	36.5380	2996.2912	0.5877	0.0006

Generic feedrate

WASTE ITEM: 3.5-inch Rocket (M29A2)		Total Btu/hr	502672.7581
PEP Weight:	2571.9-2578.05 grains	Total Ash loading (lb/hr)	3.9914
Item Feed Rate: Generi	270 items/hr (limited by explosive feedrate)	Total Chlorine loading (lb/hr)	1.9447

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Black Powder	1.9744 - 2.2149	50.9000 - 57.1000	1.9633 - 2.2024	53.1786	0.0091	0.0000
Carbon Black	1.1730	30.2400	1.1664	165.3315	0.0000	0.0000
Charcoal	0.0066 - 0.0074	0.1700 - 0.1900	0.0066 - 0.0073	1.0388	0.0000	0.0000
Egyptian Lacquer	0.0035 - 0.0043	0.0900 - 0.1100	0.0035 - 0.0042	0.0000	0.0000	0.0000
Ethyl Centralite	0.8797	22.6800	0.8748	132.7784	0.0000	0.0000
Lead Thiocyanate	0.0116 - 0.0132	0.3000 - 0.3400	0.0116 - 0.0131	0.2766	0.0001	0.0000
Nitrocellulose	53.3706	1375.9200	53.0712	2315.2154	0.0000	0.0000
Nitroglycerin	34.7006	894.6000	34.5060	2367.2781	0.0000	0.0000
Potassium Chlorate	0.0147 - 0.0163	0.3800 - 0.4200	0.0147 - 0.0162	0.0731	0.0001	.0000
Potassium Perchlorate	7.6244	196.5600	7.5816	20.1283	0.0309	0.0195
:al	100.0043	2578.1600	99.4433	5055.0830	0.0401	0.0196

Generic feedrate

WASTE ITEM: Activator, Mine Anti-tank (M-1)
PEP Weight: 46.8-47.184 grains
Item Feed Rate: Generi 14800 items/hr (limited by explosive feedrate)

Total Btu/hr 483197.3179
Total Ash loading (lb/hr) 9.2926
Total Chlorine loading (lb/hr) 0.8196

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Graphite	1.5599	0.7360	1.5561	219.8610	0.0000	0.0000
Lead Azide	8.0112 - 8.3503	3.7800 - 3.9400	7.9920 - 8.3303	94.7758	0.0640	0.0000
Lead Thiocyanate	2.0897 - 2.3398	0.9860 - 1.1040	2.0847 - 2.3342	49.0651	0.0162	0.0000
Potassium Chlorate	2.5644 - 2.8399	1.2100 - 1.3400	2.5583 - 2.8331	12.7514	0.0130	0.0082
Tetryl	84.9101	40.0640	84.7067	4467.1224	0.0000	0.0000
Total	100.0000	47.1840	99.7605	4843.5756	0.0931	0.0082

c feedrate

ITEM: Fuze Booster (M125A1)
ight: 330 - 372 grains
eed Rate: Generi 1800 items/hr (limited by explosive feedrate)

Total Btu/hr	535893.8218
Total Ash loading (lb/hr)	0.4083
Total Chlorine loading (lb/hr)	0.0000

Compound		Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
n Stearate	<	2.0000 <	7.4400 <	1.9131	276.6000	0.0044	0.0000
ite	<	2.0000 <	7.4400 <	1.9131	281.9000	0.0000	0.0000
.		98.0000 - 98.0000	323.4000 - 364.5600	83.1600 - 93.7440	5155.7800	0.0000	0.0000
		102.0000	379.4400	97.5703	5602.2353	0.0043	0.0000

3 3 2

Reprint

Generic feedrate

WASTE ITEM: Ignition Cartridge (M5A2)		Total Btu/hr	531237.1629
PEP Weight:	40 grains	Total Ash loading (lb/hr)	0.8276
Item Feed Rate: Gener	17400 items/hr (limited by explosive feedrate)	Total Chlorine loading (lb/hr)	0.0000

Compound	Percentage of PEP (percent)	Component Concentration (grains/items)	Component Feed Rate (lb/hr)	Heating Value Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Ethyl Centralite	0.7500	0.3000	0.7457	113.1975	0.0000	0.0000
Nitrocellulose	57.7500	23.1000	57.4200	2505.1950	0.0000	0.0000
Nitroglycerin	40.0000	16.0000	39.7714	2728.8000	0.0000	0.0000
Potassium Nitrate	1.5000	0.6000	1.4914	-4.2900	0.0083	0.0000
Total	100.0000	40.0000	99.4286	5342.9025	0.0083	0.0000

Generic feedrate

WASTE ITEM: Delay Plunger, 0.05 sec (M1)		Total Btu/hr	43841.5817
PEP Weight:	1.89-2.17 grains	Total Ash loading (lb/hr)	22.5775
Item Feed Rate: Generi	105000 items/hr (limited by ash content)	Total Chlorine loading (lb/hr)	0.5134

Compound	Percentage of PEP (percent)	Component Concentration (grains/item)	Component Feed Rate (lb/hr)	Heating Value (Btu/lb)	Ash (lb/lb)	Chlorine (lb/lb)
Anitmony Trisulfide	0.9217 - 1.8433	0.0200 - 0.0400	0.4286 - 0.6000	33.2166	0.0158	0.0000
Black Powder	14.7465	0.3200	4.8000	354.0645	0.0606	0.0000
Lead Azide	65.8986 - 76.0369	1.4300 - 1.6500	30.6429 - 24.7500	863.0184	0.5827	0.0000
Lead Thiocyanate	1.3825 - 2.7650	0.0300 - 0.0600	0.6429 - 0.9000	57.9816	0.0191	0.0000
Potassium Chlorate	3.2258 - 5.5300	0.0700 - 0.1200	1.5000 - 1.8000	24.8295	0.0253	0.0160
TNT	0.2765 - 0.5069	0.0060 - 0.0110	0.1286 - 0.1650	33.0304	0.0000	0.0000
Total	101.4286	2.2010	33.0150	1346.8996	0.6936	0.0158

C-2

CHEMICAL COMPOSITIONS OF CLASS C MUNITIONS

COMPOUND	5.56mm Cartridges (lb/hr) Grenade (M195) With Single Base Propellant Only	Blank (M200) With Double Base Propellant Only
Aluminum	0.09	0.09
Antimony Sulfide	0.19	0.19
Barium Nitrate	0.41	0.40 - 0.74
Calcium Carbonate	0	0.07
Diphenylphthalate	0	0.02 - 0.90
Graphite	0.34	0.05 - 0.09
Gum Arabic	<0.01	<0.01
Nitrocellulose	75.77 - 80.71	16.25 - 18.63
PETN	0.06	0.06
Potassium Nitrate	0	0 - 0.11
Potassium Sulfate	0.09 - 0.87	0
Sodium Sulfate	0	0.11
Tetracene	0.05	0.06
Lead Styphnate	0.48	0.48
Dibutylphthalate	0	0 - 0.23
Dinitrotoluene	5.21 - 8.68	0 - 0.23
phenylamine	0.43 - 1.13	0.18 - 0.34
Nitroglycerin	0	2.93 - 4.27
Potassium Chlorate	0	0.02
Total PEP Wt (grains/munition)	27.4	7.4
Munition Feed Rate (ctgs/hr)	22,500	22,500

7.62mm Cartridges
(lb/hr)

COMPOUND	AP (M61) With Double Base Propellant Only	Tracer (M62) With Double Base Propellant Only	Grenade (M64) With Single Base Propellant Only	Blank (M82) With Single Base Propellant	Blank (M82) With Double Base Propellant
Aluminum	0.01	0.12	0.12	0.14	0.14
Antimony Sulfide	0.28	0.25	0.23	0.23 - 0.30	0.23 - 0.30
Barium Nitrate	0.60	0.51	0.51	0.62 - 0.78	0.62 - 0.78
Calcium Carbonate	0.40	0.37	0	0 - .48	0 - 0.48
Calcium Resinate	0	0.23 - 0.26	0	0	0
Ethyl Centralite	0	0	0	0 - 2.41	0 - 2.41
Graphite	0	0	0.52	0 - 0.15	0 - 0.19
Gum Arabic	<0.01	<0.01	<0.01	0	0
Magnesium Aluminum Alloy	0	5.85 - 5.36	0	0	0
Nitrocellulose	103.71 - 113.20	96.84 - 105.71	115.98	44.60 - 47.97	36.30 - 43.96
PETN	0.09	0.07	0.08	0 - 0.10	0 - 0.10
Polyvinyl Chloride	0	3.25	0	0	0
Potassium Nitrate	0	0	0	0	0 - 0.05
Potassium Sulfate	0	0	0	0 - 0.48	0
Sodium Sulfate	0.66	0.62	0	0	0 - 0.24
Strontium Nitrate	0	10.52	0	0	0
Strontium Peroxide	0	2.09 - 2.48	0	0	0
Tetracene	0.08	0.07	0.07	0.08	0.08
Tin Dioxide	0	0	2.58	0	0 - 0.50
Lead Styphnate	0.72	0.62	0.60	0.71 -0.76	0.71 - 0.76
Dibutylphthalate	4.61 - 9.22	4.31 - 8.62	0	0 - 0.72	0 - 0.72
Dinitrotoluene	1.32	1.23	8.75	0 - 2.42	0 - 0.48
Diphenylamine	1.06 - 1.98	0.98 - 1.85	0.77	0.24 - 0.60	0.31 - 0.72
Nitroglycerin	10.54 - 14.49	9.85 - 13.54	0	0	3.85 - 8.66
Total PEP Wt (grains/munition)	41.6	45.6	40.5	15 - 15.6	15.1 - 15.6
Munition Feed Rate (ctgs/hr)	22,500	22,500	22,500	22,500	

50 Caliber Cartridges
(lb/hr)

COMPOUND	AP (M2)	API (M8)	API-T (M20)	Blank (M1)	Tracers
Aluminum	0	0 - 0.43	3.34 - 0.70	0	0
Antimony Sulfide	0.24 - 0.33	0.23 - 0.32	0.22 - 0.31	0.23 - 0.31	0.17 - 0.28
Asphaltum	0	0 - 0.69	0	0	0
Barium Nitrate	1.00 - 1.14	7.67 - 9.72	7.68 - 8.15	.99 - 1.14	0.76 - 1.04
Barium Peroxide	0	0	2.76	0	0 - 9.67
Calcium Carbonate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	2.68	2.68	N/A	0.52	N/A
Calcium Resinate	0	0	1.06	0	1.19 - 6.20
Calcium Silicide	0.19	0 - 0.20	0 - 0.20	0 - 0.20	0 - 0.18
Dichromated					
Aluminum Powder	0 - 0.19	0 - 0.17	0 - 0.20	0 - 0.18	0 - 0.15
Graphite					
S. B. Propel.	1.08	1.07	1.01	N/A	0.31
D. B. Propel.	1.08	1.07	N/A	0.21	N/A
Gum Arabic	<0.03	<0.03	<0.03	0.01	<0.03
Magnesium	0	0 - 8.13	3.60	0	15.44 - 17.65
Magnesium Aluminum Alloy	0	0 - 8.74	8.40 - 8.74	0	0
rocellulose					
S. B. Propel.	234.45 - 248.42	234.45 - 248.44	216.49 - 229.39	N/A	186.16 - 219.12
D. B. Propel.	197.41 - 222.38	197.40 - 222.37	N/A	38.64 - 43.53	N/A
Potassium Nitrate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.27 - 1.36	0.26 - 1.36	N/A	0.06 - 0.26	N/A
Potassium Sulfate					
S. B. Propel.	0.27 - 2.68	0.26 - 2.69	0.25 - 2.48	N/A	0.23 - 2.36
D. B. Propel.	0	0	N/A	0	N/A
Sodium Sulfate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	1.36	1.36	N/A	0.26	N/A
Strontium Nitrate	0	0	3.80	0	18.10 - 28.24
Strontium Oxalate	0	0	0.56	0	0.74 - 3.13
Strontium Peroxide	0	0	3.02	0	3.87 - 25.69
Tetracene	0.05 - 0.11	0.06 - 0.12	0.06 - 0.11	0.01 - 0.06	0.06 - 0.09

50 Caliber Cartridges (continued)
(lb/hr)

COMPOUND	AP (M2)	API (M8)	API-T (M20)	Blank (M1)	Tracers
Tin Dioxide					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.27	0.26	N/A	0.06	N/A
Toludine Red	0	0	0.03	0	0 - 0.06
Zinc Stearate	0	0	0.03	0	0 - 0.12
Lead Styphnate	1.00	0.98	0.98	0.99	0.76 - 0.92
Dibutylphthalate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	16.11 - 26.85	16.12 - 26.84	N/A	3.15 - 5.16	N/A
Dinitrotoluene					
S. B. Propel.	17.47 - 26.85	17.44 - 26.84	16.11 - 24.79	N/A	13.86 - 23.57
D. B. Propel.	2.68	2.68	N/A	0.52	N/A
Diphenylamine					
S. B. Propel.	1.36 - 3.50	1.36 - 3.49	1.23 - 3.21	N/A	1.07 - 3.07
D. B. Propel.	1.87 - 4.04	1.87 - 4.04	N/A	.37 - 0.79	N/A
Nitroglycerin					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel	21.48 - 29.53	21.48 - 29.56	N/A	4.21 - 5.78	N/A
-lon chlorinated Rubber	0	0	0	0	0 - 3.16
Polyvinyl Chloride	0	0	0	0	0 - 7.12
Potassium Perchlorate	0	0 - 0.17	1.03 - 1.37	0	0
Total PEP Wt. (grains/munition)	237.3	252.3	244.3	48.3	293.3 - 318.3
Munition Feed Rate (ctgs/hr)	8000	8000	8000	8000	6750

30 Caliber Cartridges
(lb/hr)

COMPOUNDS	Tracers	AP (M2)	Blank (M1909)
Aluminum	0 - 0.45	0 - 0.14	0.13
Antimony Sulfide	0.05 - 0.94	0.18	0.29
Barium Carbonate	0	0	0 - 0.38
Barium Nitrate	0.17 - 2.01	0.55 - 0.63	1.00 - 2.55
Barium Peroxide	0 - 8.95	0	0
Calcium Carbonate	0 - 1.84	0	0 - 0.38
Calcium Resinate	0.15 - 5.76	0	0
Graphite	0 - 0.73	0.71	0 - 0.15
Gum Arabic	0 - 0.02	0	0
Lead Dioxide	0 - 0.09	0	0
Lead Peroxide	0 - 0.19	0 - 0.18	0
Magnesium	1.83 - 17.23	0	0
Nitrocellulose			
SB Propel	42.83 - 172.88	161.84	34.10 - 37.80
DB Propel	33.63 - 152.27	138.07	31.16 - 35.21
PETN	0.03 - 0.32	0.09	0.10
Potassium Nitrate			
SB Propel	0	0	0.19 - 1.54
DB Propel	0 - 0.92	0.54	0 - 0.04
Potassium Sulfate			
SB Propel	0.05 - 1.84	0	0
DB Propel	0	0.97	0
Sodium Sulfate			
SB Propel	0	0	0
DB Propel	0 - 0.92	0.88	0.19
Strontium Nitrate	3.46 - 19.50	0	0
Strontium Oxalate	0 - 2.93	0	0
Strontium Peroxide	1.43 - 23.78	0	0
Tetracene	0.02 - 0.28	0.05 - 0.07	0.08
Tin Dioxide	0 - 0.19	0 - 0.18	0 - 0.04
Zinc Stearate	0 - 0.11	0	0
Zirconium	0 - 0.19	0 - 0.18	0
Lead Styphnate	0.21 - 2.39	0.70 - 0.71	0.71
Dibutylphthalate			
SB Propel	0	0	0
DB Propel	0.63 - 18.39	14.14	0 - 1.16
Dinitrotoluene			
SB Propel	2.42 - 16.55	12.37	0
DB Propel	0 - 1.84	1.77	0 - 0.38
Diphenylamine	0.25 - 2.76	1.59 - 1.95	0.19 - 0.58
Nitroglycerin			
SB Propel	0	0	0
DB Propel	3.34 - 20.23	16.80	3.09 - 4.63
Parlon Chlorinated Rubber	0 - 1.33	0	0
Polyvinyl Chloride	0 - 3.75	0	0
Total PEP Wt. (grains/munition)	20 - 66.6	55.6	12.6
Munition Feed Rate (ctgs/hr)	22,500	22,500	22,500

20mm Cartridges
(lb/hr)

COMPOUND	HEI With Single Base Propellant	HEI With Double Base Propellant	API (M53) With Double Base Propellant Only	INC (M96) With Single Base Propellant Only
Acetylene Black	<0.01	<0.01	0	<0.01
Aluminum	0 - 6.78	0 - 6.78	0	0
Ammonium Nitrate	0	0	2.19	0
Antimony Sulfide	0 - 0.07	0 - 0.07	0	0.03
Asphaltum	0 - 0.18	0.018	0	0
Barium Nitrate	0.08 - 1.86	0.08 - 1.86	2.32	0
Calcium Carbonate	0	0 - 0.84	0 - 1.05	0
Calcium Resinate	0 - 0.12	0 - 0.12	0.10	0.41
Calcium Silicide	0 - 0.07	0 - 0.07	0.08	0
Calcium Stearate	<0.01	<0.01	0	0
Graphite	0.05 - 0.51	0.05 - 0.51	0 - 0.42	0
Gum Arabic	<0.01	<0.01	<0.01	0
HMX	0 - 0.90	0 - 0.90	0	0
Lead Azide Lead Sulfocyanate	0	0	0	0.07
Magnesium-Aluminum Alloy	0 - 2.34	0 - 2.34	4.76	10.04
Nitrocellulose	56.75 - 77.81	47.13 - 71.12	75.02 - 88.45	59.04
PETN	0 - 0.02	0 - 0.02	0	0.02
Polyvinyl Alcohol	0 - 0.04	0 - 0.04	0	0
Potassium Nitrate	0	0 - 1.25	0.11 - 1.56	0
Potassium Sulfate	0.07 - 0.84	0	0	0.45
RDX	7.92 - 12.47	7.92 - 12.47	0	0
Sodium Sulfate	0	0.07 - 0.41	0 - 0.52	0
Tetracene	0 - 0.01	0 - 0.01	0	0
Tetryl	0 - 10.85	0 - 10.85	0	0

20mm Cartridges (continued)
(lb/hr)

COMPOUND	HEI With Single Base Propellant	HEI With Double Base Propellant	API (M53) With Double Base Propellant Only	INC (M96) With Single Base Propellant Only
Tin Dioxide	0.26 - 0.34	0 - 10.85	0	0
Trinitroresorcinol	<0.01	<0.01	<0.01	0
Wax	0 - 0.38	0 - 0.38	0	0
Zinc Stearate	<0.01	<0.01	<0.01	0
Lead Styphnate	0 - 0.20	0 - 0.20	0.20	0
Dibutylphthalate	0	3.52 - 7.94	5.73 - 9.88	0
Dinitrotoluene	3.59 - 7.94	0 - 0.84	0 - 1.05	0
Diphenylamine	0.33 - 1.09	0.45 - 1.25	0.78 - 1.56	0.48
Nitroglycerin	0	5.12 - 9.19	8.33 - 11.44	0
Potassium Perchlorate	0 - 2.57	0 - 2.57	2.82	10.96
Potassium Chlorate	0	0	0	0.17
Total PEP Wt (grains/munition)	639 - 767.71	639 - 767.71	693	638.6
Munition Feed Rate (ctgs/hr)	900	900	1200	900

PRIMERS
(lb/hr)

COMPOUND	(M28B2)	(M34)	(40A2)	(M57)	(M71)	(M82)
Aluminum	0	0.13	0	0	0	0
Antimony Sulfide	0.07	0.29	0.03	0.02	0.23	0.01
Barium Nitrate	0	0.61	0	0	0	0
Charcoal	18.05	0	8.12	0.96	1.57	0.31
Lead Styphnate	0	0.71	0	0	0	0
Lead Thiocyanate	0.09	0	0.05	0.02	0.32	0.01
PETN	0	0.10	0	0	0	0
Potassium Nitrate	85.62	0	38.53	4.54	7.43	1.46
Sulfur	12.02	0	5.41	0.64	1.03	0.20
Tetracene	0	0.06	0	0	0	0
Trinitroresorcinol	0.02	0	0.01	0.01	0.06	<0.01
Potassium Chlorate	0.21	0	0.10	0.05	0.68	0.03
Total PEP Wt (grains/primer)	301.00	0.59	271.00	66.00	3.52	0.63
Primer Feed Rate (primers/hr)	2700	22,500	1350	660	22,500	22,500

*Assumed primer mix to be NOL 70.

FUZES
(lb/hr)

COMPOUND	M86A1/A2	MK27*	M557	M501	M502	M564	M605
Acetate Resin	0	0	<0.01	0	0	0	0
Aluminum	0	0	0	0	0	0	<0.01
Antimony Sulfide	0	0.26	0.03	0.03	0.47	0.09	<0.01
Barium Chromate	0	0	0.02	0	0	0	0.02
Barium Nitrate	0	0	<0.01	0.01	0.01	<0.01	<0.01
Boron Powder	0	0	<0.01	0	0	0	0
Black Powder	0.06	0	0	0	0	0	0.05
Carborundum	0	0	0	<0.01	<0.01	0	0
Lead Azide	0.34	0.30	0.51	0.38	0.39	0.45	0
Lead Thiocyanate	0	0	0	0	0	0.13	0
Magnesium	0.94	0	0	0	0	0	0
RDX	0	0	0	0	0	20.15	0
Strontium Nitrate	1.86	0	0	0	0	0	0
Tetracene	0	0	<0.01	<0.01	<0.01	<0.01	<0.01
Tetryl	6.59	21.76	21.76	0.10	20.87	1.65	0
Lead Styphnate	0	0	0.01	0.03	0.02	0.01	<0.01
Polyvinyl Chloride	0.57	0	0	0	0	0	0
Potassium Perchlorate	0	0	0	0	0	0	<0.01
Potassium Chlorate	0	0.01	0.02	0.03	0.02	0.27	0
Total PEP Wt (grains/fuze)	107.4	351.82	355.80	6.2	331.9	361.7	17.7
Fuze Feed Rate (fuzes/hr)	675	440	440	660	450	440	32

Miscellaneous
(lb/hr)

COMPOUND	Booster (M21A4)	Detent	Rocket Motor (MK117, MK118)	Rocket Motor (MK125-5)
Black Powder				
Lead Azide	0	0	9.77	9.43
Tetryl	0.22	0	0	0
	19.97	32.14	0	0
Total PEP Wt	321.3	10	30	10
(grains/item)	440	22,500	2280	6600
Feed Rate (itmes/hr)				

5.56mm Cartridges
(Percentage of total PEP weight)

COMPOUND	Grenade (M195) With Single Base Propellant Only	Blank (M200) With Double Base Propellant Only
Aluminum	0.10	0.37
Antimony Sulfide	0.22	0.80
Barium Nitrate	0.46	1.70 - 3.12
Calcium Carbonate	0	0.28
Diphenylphthalate	0	0.09 - 3.78
Graphite	0.39	0.19 - 0.38
Gum Arabic	< 0.01	0.01
Nitrocellulose	86.03 - 91.64	68.30 - 78.32
PETN	0.07	0.26
Potassium Nitrate	0	0 - 0.47
Potassium Sulfate	0.10 - 0.99	0
Sodium Sulfate	0	0.47
Tetracene	0.06	0.24
Lead Styphnate	0.55	2.02
Dibutylphthalate	0	0 - 0.95
Dinitrotoluene	5.91 - 9.85	0 - 0.95
Diphenylamine	0.49 - 1.28	0.76 - 1.42
Nitroglycerin	0	12.30 -17.97
Potassium Chlorate	0	0.09
Total PEP Wt (grains/munition)	27.4	7.4
Munition Feed Rate (ctgs/hr)	22,500	22,500

7.62mm Cartridges
(Percentage of total PEP Weight)

COMPOUND	AP (M61) With Double Base Propellant Only	Tracer (M62) With Double Base Propellant Only	Grenade (M64) With Single Base Propellant Only	Blank (M82) With Single Base Propellant	Blank (M82) With Double Base Propellant
Aluminum	0.01	0.08	0.09	0.27 - 0.28	0.27 - 0.28
Antimony Sulfide	0.21	0.17	0.18	0.46 - 0.60	0.46 - 0.60
Barium Nitrate	0.45	0.35	0.39	1.23 - 1.55	1.23 - 1.55
Calcium Carbonate	0.30	0.25	0	0	0 - 0.96
Calcium Resinate	0	0.16 - 0.18	0	0	0
Ethyl Centralite	0	0	0	0	0 - 4.80
Graphite	0	0	0.40	0 - 0.29	0 - 0.38
Gum Arabic	< 0.01	< 0.01	< 0.01	0	0
Magnesium Aluminum Alloy	0	3.99 - 3.66	0	0	0
Nitrocellulose	7.56 -84.66	66.07 -72.12	89.09	88.94 -95.67	72.40 -87.67
PETN	0.07	0.05	0.06	0 - 0.20	0 - 0.20
Polyvinyl Chloride	0	2.22	0	0	0
Potassium Nitrate	0	0	0	0	0 - 0.10
Potassium Sulfate	0	0	0	0 - 0.96	0
[illegible]ium Sulfate	0.49	0.42	0	0	0 - 0.48
Strontium Nitrate	0	7.18	0	0	0
Strontium Peroxide	0	1.43 - 1.69	0	0	0
Tetracene	0.06	0.05	0.05	0.15 - 0.16	0.15 - 0.16
Tin Dioxide	0	0	1.98	0	0 - 0.10
Lead Styphnate	0.54	0.42	0.46	1.42 - 1.51	1.42 - 1.51
Dibutylphthalate	3.45 - 6.90	2.94 - 5.88	0	0	0 - 1.44
Dinitrotoluene	0.99	0.84	6.72	0 - 4.81	0 - 0.96
Diphenylamine	0.79 - 1.48	0.67 - 1.26	0.59	0.48 - 1.20	0.62 - 1.44
Nitroglycerin	7.88 -10.84	6.72 - 9.24	0	0	7.68 -17.28
Total PEP Wt (grains/munition)	41.6	45.6	40.5	15.1 - 15.6	15.1 -15.6
Munition Feed Rate (ctgs/hr)	22,500	22,500	22,500	22,500	22,500

50 Caliber Cartridges
(Percentage of total PEP weight)

COMPOUND	AP (M2)	API (M8)	API-T (M20)	Blank (M1)	Tracers
Aluminum	0	0 - 0.15	0.12 - 0.25	0	0
Antimony Sulfide	0.09 - 0.12	0.08 - 0.11	0.08 - 0.11	0.42 - 0.57	0.06 - 0.09
Asphaltum	0	0 - 0.24	0	0	0
Barium Nitrate	0.37 - 0.42	2.66 - 3.37	2.75 - 2.92	1.80 - 2.06	0.27 - 0.34
Barium Peroxide	0	0	0.99	0	0 - 3.15
Calcium Carbonate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.99	0.93	N/A	0.95	N/A
Calcium Resinate	0	0	0.38	0	0.42 - 2.02
Calcium Silicide	0.07	0 - 0.07	0 - 0.07	0 - 0.36	0 - 0.06
Dichromated					
Aluminum Powder	0 - 0.07	0 - 0.06	0 - 0.07	0 - 0.33	0 - 0.05
Graphite					
S. B. Propel.	0.40	0.37	0.36	N/A	0.31
D. B. Propel.	0.40	0.37	N/A	0.38	N/A
Gum Arabic	< 0.01	< 0.01	< 0.01	0.02	< 0.01
Magnesium	0	0 - 2.82	1.29	0	5.46 - 5.75
Magnesium Aluminum					
Alloy	0	0 - 3.03	0.01 - 3.13	0	0
Nitrocellulose					
S. B. Propel.	86.45 -91.60	81.31 -86.16	77.54 -82.16	N/A	65.82 -71.39
D. B. Propel.	72.79 -82.00	68.46 -77.12	N/A	70.00 -78.86	N/A
Potassium Nitrate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.10 - 0.50	0.09 - 0.47	N/A	0.10 - 0.48	N/A
Potassium Sulfate					
S. B. Propel.	0.1 - 0.99	0.09 - 0.93	0.09 - 0.89	N/A	0.08 - 0.77
D. B. Propel.	0	0	N/A	0	N/A
Sodium Sulfate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.50	0.47	N/A	0.48	N/A
Strontium Nitrate	0	0	1.36	0	6.40 - 9.20
Strontium Oxalate	0	0	0.20	0	0.26 - 1.02
Strontium Peroxide	0	0	1.08	0	1.37 - 8.37
Tetracene	0.02 - 0.04	0.02 - 0.04	0.02 - 0.04	0.20 - 0.11	0.02 - 0.03
Tin Dioxide					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	0.10	0.09	N/A	0.10	N/A
Toludine Red	0	0	0.01	0	0 - 0.02
Zinc Stearate	0	0	0.01	0	0 - 0.04
Lead Styphnate	0.37	0.34	0.35	1.80	0.27 - 0.30
Dibutylphthalate					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel.	5.94 - 9.90	5.59 - 9.31	N/A	5.71 - 9.52	N/A
Dinitrotoluene					
S. B. Propel.	6.44 - 9.90	6.05 - 9.31	5.77 - 8.88	N/A	4.90 - 7.68
D. B. Propel.	0.99	0.93	N/A	0.95	N/A

50 Caliber Cartridges (continued)
(Percentage of total PEP weight)

COMPOUND	AP (M2)	API (M8)	API-T (M20)	Blank (M1)	Tracers
Diphenylamine					
S. B. Propel.	0.50 - 1.29	0.47 - 1.21	0.44 - 1.15	N/A	0.38 - 1.00
D. B. Propel.	0.69 - 1.49	0.65 - 1.40	N/A	0.67 - 1.43	N/A
Nitroglycerin					
S. B. Propel.	0	0	0	N/A	0
D. B. Propel	7.92 -10.89	7.45 -10.25	N/A	7.62 -10.48	N/A
Parlon chlorinated Rubber	0	0	0	0	0 - 1.03
Polyvinyl Chloride	0	0	0	0	0 - 2.32
Potassium Perchlorate	0	0 - 0.06	0.37 - 0.49	0	0
Total PEP Wt. (grains/munition)	237.3	252.3	244.3	48.3	293.3 -318.3
Munition Feed Rate (ctgs/hr)	8000	8000	8000	8000	6750

30 Caliber Cartridges
(Percentage of total PEP weight)

COMPOUNDS	Tracers	AP (M2)	Blank (M1909)
Aluminum	0 - 0.21	0 - 0.08	0.31
Antimony Sulfide	0.08 - 0.44	0.10	0.71
Barium Carbonate	0	0	0 - 0.95
Barium Nitrate	0.26 - 0.94	0.31 - 0.35	2.48 - 6.29
Barium Peroxide	0 - 4.18	0	0
Calcium Carbonate	0 - 0.86	0	0 - 0.95
Calcium Resinate	0.23 - 2.69	0	0
Graphite	0 - 0.34	0.40	0 - 0.38
Gum Arabic	0 - 0.01	0	0
Lead Dioxide	0 - 0.04	0	0
Lead Peroxide	0 - 0.09	0 - 0.10	0
Magnesium	2.84 - 8.05	0	
Nitrocellulose			
SB Propel	66.29 -80.76	90.56	84.19 -93.33
DB Propel	52.06 -71.13	77.26	76.95 -86.95
PETN	0.05 - 0.15	0.05	0.24
Potassium Nitrate			
SB Propel	0	0	0.48 - 3.81
DB Propel	0 - 0.43	0.30	0 - 0.10
Potassium Sulfate			
SB Propel	0.08 - 0.86	0	0
DB Propel	0	0.54	0
Sodium Sulfate			
SB Propel	0	0	0
DB Propel	0 - 0.43	0.49	0.48
Strontium Nitrate	5.36 - 9.11	0	0
Strontium Oxalate	0 - 1.37	0	0
Strontium Peroxide	2.22 -11.11	0	0
Tetracene	0.03 - 0.13	0.03 - 0.04	0.19
Tin Dioxide	0 - 0.09	0 - 0.10	0 - 0.10
Zinc Stearate	0 - 0.05	0	0
Zirconium	0 - 0.09	0 - 0.10	0
Lead Styphnate	0.32 - 1.12	0.39 - 0.40	1.76
Dibutylphthalate			
SB Propel	0	0	0
DB Propel	0.97 - 8.59	7.91	0 - 2.86
Dinitrotoluene			
SB Propel	3.75 - 7.73	6.92	0
DB Propel	0 - 0.86	0.99	0 - 0.95
Diphenylamine	0.38 - 1.29	0.89 - 1.09	0.48 - 1.43
Nitroglycerin			
SB Propel	0	0	0
DB Propel	5.17 - 9.45	9.40	7.62 -11.43
Parlon CHlorinated Rubber	0 - 0.62	0	0
Polyvinyl Chloride	0 - 1.75	0	0
Total PEP Wt. (grains/munition)	20.1 - 66.6	55.6	12.6
Munition Feed Rate (ctgs/hr)	22,500	22,500	22,500

20mm Cartridges
(Percentage of total PEP weight)

COMPOUND	HEI With Single Base Propellant	HEI With Double Base Propellant	API (M53) With Double Base Propellant Only	INC (M96) With Single Base Propellant Only
Acetylene Black	< 0.01	< 0.01	< 0.01	0
Aluminum	0 - 6.87	0 - 6.87	0	0
Ammonium Nitrate	0	0	1.84	0
Antimony Sulfide	0 - 0.07	0 - 0.07	0	0.04
Asphaltum	0 - 0.18	0 - 0.18	0	0
Barium Nitrate	0.10 - 1.88	0.10 - 1.86	1.95	0
Calcium Carbonate	0	0 - 0.85	0 - 0.88	0
Calcium Resinate	0 - 0.12	0 - 0.12	0.08	0.50
Calcium Silicide	0 - 0.07	0 - 0.07	0.07	0
Calcium Stearate	< 0.01	< 0.01	0	0
Graphite	0.06 - 0.52	0.06 - 0.52	0 - 0.35	0
Gum Arabic	< 0.01	< 0.01	< 0.01	0
HMX	0 - 0.91	0 - 0.91	0	0
Lead Azide	0 - 0.20	0 - 0.20	0	0
Lead Sulfocyanate	0	0	0	0.08
agnesium-Aluminum Alloy	0 - 2.39	0 - 2.39	4.01	12.23
Nitrocellulose	69.08 -78.83	57.36 -72.05	63.15 -74.45	71.91
PETN	0 - 0.02	0 - 0.02	0	0.03
Polyvinyl Alcohol	0 - 0.04	0 - 0.04	0	0
Potassium Nitrate	0	0 - 1.27	0.09 - 1.31	0
Potassium Sulfate	0.08 - 0.85	0	0	0.55
RDX	9.64 -12.63	9.64 -12 63	0	0
Sodium Sulfate	0	0.08 - 0.42	0.08 - 0.42	0
Tetracene	0 - 0.01	0 - 0.01	0	0
Tetryl	0 - 10.99	0 -10.99	0	0
Tin Dioxide	0.32 - 0.34	0 - 1.27	0.53 - 1.31	0.55
Trinitroresorcinol	< 0.01	< 0.01	< 0.01	0
Wax	0 - 0.39	0 - 0.39	0	0
Zinc Stearate	< 0.01	< 0.01	< 0.01	0
Lead Styphnate	0 - 0.20	0 - 0.20	0.17	0
Dibutylphthalate	0	4.29 - 8.04	4.82 - 8.32	0
Dinitrotoluene	4.37 - 8.04	0 - 0.85	0 - 0.88	0
Diphenylamine	0.40 - 1.10	0.55 - 1.27	0.66 - 1.31	0.59
Nitroglycerin	0	6.23 - 9.31	7.01 - 9.63	0
Potassium Perchlorate	0 - 2.60	0 - 2.60	2.37	13.35
Potassium Chlorate	0	0	0	0.17
Total PEP Wt (grains/munition)	639 - 767.71	639 - 767.71	693	638.6
Munition Feed Rate (ctgs/hr)	900	900	1200	900

PRIMERS
(Percentage of total PEP weight)

COMPOUND	(M28B2)	(M34)	(40A2)	(M57)	(M71)	(M82)*
Aluminum	0	6.78	0	0	0	0
Antimony Sulfide	0.06	15.25	0.06	0.26	1.99	0.45
Barium Nitrate	0	32.20	0	0	0	0
Charcoal	15.55	0	15.54	15.36	13.92	15.19
Lead Styphnate	0	37.29	0	0	0	0
Lead Thiocyanate	0.08	0	0.09	0.38	2.84	0.66
PETN	0	5.08	0	0	0	0
Potassium Nitrate	73.75	0	73.73	72.88	65.63	72.04
Sulfur	10.35	0	10.36	10.24	9.09	10.12
Tetracene	0	3.39	0	0	0	0
Trinitroresorcinol	0.02	0	0.02	0.08	0.57	0.13
Potassium Chlorate	0.18	0	0.20	0.81	5.97	1.41
Total PEP Wt (grains/primer)	301.00	0.59	271.00	66.00	3.52	0.63
Primer Feed Rate (primers/hr)	2700	22,500	1350	660	22,500	22,500

*Assumed primer mix to be NOL 70.

FUZES
(Percentages of total PEP weight)

COMPOUND	M66A1/A2	MK27*	M557	M501	M502	M564	M605
Acetate Resin	0	0	<0.01	0	0	0	0
Aluminum	0	0	0	0	0	0	0.23
Antimony Sulfide	0	0.04	0.12	5.10	0.10	0.39	0.23
Barium Chromate	0	0	0.09	0	0	0	24.75
Barium Nitrate	0	0	0.02	2.02	0.04	0.02	0.50
Boron Powder	0	0	0.02	0	0	0	0
Black Powder	0.56	0	0	0	0	0	56.50
Carborundum	0	0	0	0.65	0.01	0	0
Lead Azide	3.26	1.35	2.30	64.94	1.85	1.98	0
Lead Thiocyanate	0	0	0	0	0	0.55	0
Magnesium	9.12	0	0	0	0	0	0
RDX	0	0	0	0	0	88.61	0
Strontium Nitrate	17.92	0	0	0	0	0	0
Tetracene	0	0	<0.01	0.40	0.01	<0.01	0.11
Tetryl	63.59	98.40	97.30	17.74	97.83	7.24	0
Lead Styphnate	0	0	0.03	4.84	0.09	0.03	1.20
Polyvinyl Chloride	5.54	0	0	0	0	0	0
Potassium Perchlorate	0	0	0	0	0	0	5.77
Potassium Chlorate	0	0.04	0.10	4.31	0.08	1.17	0
Total PEP Wt (grains/fuze)	107.4	351.82	355.80	6.2	331.9	361.7	17.7
Fuze Feed Rate (fuzes/hr)	675	440	440	660	450	440	32

Miscellaneous
(Percentage of total PEP weight)

COMPOUND	Booster (M21A4)	Detent	Rocket Motor (MK117, MK118)	Rocket Motor (MK125-5)
Black Powder	0	0	100	100
Lead Azide	1.10	0	0	0
Tetryl	98.90	100	0	0
Total PEP Wt (grains/item)	321.3	10	30	10
Feed Rate (itmes/hr)	440	22,500	2280	6600

C-3

CHLORINE, ASH AND BTU RATES FOR CLASS C MUNITIONS

ITEM 65
5.56 MM CARTRIDGES
GRENADE
M195

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.09	0.10		0.00	1.8895	0.17	13,312	1,198
Antimony Trisulfide	0.19	0.22		0.00	0.8582	0.16	1,802	342
Barium Nitrate	0.41	0.46		0.00	0.5867	0.24	-716	-294
Calcium Carbonate	0	0		0.00	0.5603	0.00	-787	0
Diphenylphthalate	0	0		0.00		0.00	unknown	0
Graphite	0.34	0.39		0.00		0.00	14,095	4,792
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
Nitrocellulose	80.76	91.64		0.00		0.00	4,338	350,337
PETN	0	0.07		0.00		0.00	3,531	0
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulfate	0.87	0.99		0.00	0.6439	0.56	-699	-608
Sodium Sulfate	0	0		0.00	0.5632	0.00	-705	0
Tetracene	0.05	0.06		0.00		0.00	1,184	59
Lead Styphnate	0.48	0.55		0.00	0.7766	0.37	2,254	1,082

ITEM 65
5.56 MM CARTRIDGES
GRENADE - M195
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate	0	0		0.00		0.00	13,210	0
Dinitrotoluene	8.68	9.85		0.00		0.00	8,424	73,120
Diphenylamine	1.13	1.28		0.00		0.00	16,376	18,505
Nitroglycerin	0	0		0.00		0.00	6,882	0
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (Grains/Munition)	27.4
Munition feed rate (items/hr)	22,500
Total Chlorine lb/hr	0.00
Total Ash lb/hr	1.50
Total HV Btu/hr	448,601

ITEM 66

BLANK
M200

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.09	0.37		0.00	1.8895	0.17	13,312	1,198
Antimony Trisulfide	0.19	0.80		0.00	0.8582	0.16	1,802	342
Barium Nitrate	0.74	3.12		0.00	0.5867	0.43	-716	-530
Calcium Carbonate	0.07	0.28		0.00	0.5603	0.04	-787	-55
Diphenylamine	0.90	3.78		0.00		0.00	unknown	0
Graphite	0.09	0.38		0.00		0.00	14,095	1,269
Gum Arabic	<0.01	0.01		0.00		0.00	6,840	68
Nitrocellulose	18.63	78.32		0.00		0.00	4,338	80,817
PETN	0.06	0.26		0.00		0.00	3,531	212
Potassium Nitrate	0.11	0.47		0.00	0.5549	0.06	-286	-31
Potassium Sulfate	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate	0.11	0.47		0.00	0.5632	0.06	-705	-78
Tetracene	0.06	0.24		0.00		0.00	1,184	71
Lead Styphnate	0.48	2.02		0.00	0.7766	0.37	2,254	1,082

ITEM 66
BLANK - M200
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate	0.23	0.95		0.00		0.00	13,210	3,038
Dinitrotoluene	0.23	0.95		0.00		0.00	8,424	1,938
Diphenylamine	0.34	1.42		0.00		0.00	16,376	5,568
Nitroglycerin	4.27	17.97		0.00		0.00	6,822	29,130
Potassium Chlorate	0.02	0.09	0.2893	0.01	0.4578	0.01	449	9

Total PEP Wt. (grains/munition)	7.4
Munition feed rate (ctgs/hr)	22,500
Total Chlorine lb/hr	0.01
Total Ash lb/hr	1.30
Total HV BTU/hr	124,048

ITEM 67

AP
M61

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.01	0.01		0.00	1.8895	0.02	13,312	133
Antimony Trisulfide	0.28	0.21		0.00	0.8582	0.24	1,802	505
Barium Nitrate	0.60	0.45		0.00	0.5867	0.35	-716	-430
Calcium Carbonate	0.40	0.30		0.00	0.5603	0.22	-787	-315
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Ethyl Centralite	0	0		0.00		0.00	15,093	0
Graphite	0	0		0.00		0.00	14,095	0
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose	113.20	84.66		0.00		0.00	4,338	491,062
PETN	0.09	0.07		0.00		0.00	3,531	318
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulphate	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulphate	0.66	0.49		0.00	0.5632	0.37	-705	-465
Strontium Nitrate	0	0		0.00	0.4846	0.00	-786	0

ITEM 67
AP - M61
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.08	0.06		0.00		0.00	1,184	95
Tin Dioxide	0	0		0.00	1.000	0.00		0
Lead Styphnate	0.72	0.54		0.00	0.4766	0.34	2,254	1,623
Dibutylphthalate	9.22	6.90		0.00		0.00	13,210	121,796
Dinitrotoluene	1.32	0.99		0.00		0.00	8,424	11,120
Diphenylamine	1.98	0.79		0.00		0.00	16,376	32,424
Nitroglycerin	14.49	10.84		0.00		0.00	6,822	98,851

Total PEP Wt. (grains/munition)	41.6
Munition feed rate (ctgs/hr)	22,500
Total Chlorine lb/hr	0.00
Total Ash lb/hr	1.54
Total HV Btu/hr	756,785

ITEM 68

TRACER
M62

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/hr	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.12	0.08		0.00	1.8895	0.23	13,312	1,597
Antimony Trisulfide	0.25	0.17		0.00	0.8582	0.21	1,802	451
Barium Nitrate	0.51	0.35		0.00	0.5867	0.30	-716	-365
Calcium Carbonate	0.37	0.25		0.00	0.5603	0.21	-787	-291
Calcium Resinate	0.26	0.18		0.00	0.0872	0.02	14,855	3,862
Ethyl Centralite	0	0		0.00		0.00	15,093	0
Graphite	0	0		0.00		0.00	14,095	0
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
Magnesium Aluminum Alloy	5.85	3.66		0.00	1.7408	10.18	11,602	67,872
Nitrocellulose	105.71	72.12		0.00		0.00	4,338	458,570
PETN	0.07	0.05		0.00		0.00	3,531	247
Polyvinyl Chloride	3.25	2.22	0.5673	1.84		0.00	8,918	28,984
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulphate	0	0		0.00	0.6739	0.00	-699	0
Sodium Sulphate	0.62	0.42		0.00	0.5632	0.35	-705	-437
Strontium Nitrate	10.52	7.18		0.00	0.4846	5.10	-786	-8,269
Strontium Peroxide	2.48	1.69		0.00	unknown	0.00	unknown	0

ITEM 68
TRACER - M62
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/hr	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Tetracene	0.07	0.05		0.00		0.00	1,184	83
Tin Dioxide	0	0		0.00	1.000	0.00		0
Lead Styphnate	0.62	0.42		0.00	0.4766	0.30	2,254	1,397
Dibutylphthalate	8.62	5.88		0.00		0.00	13,210	113,870
Dinitrotoluene	1.23	0.84		0.00		0.00	8,424	10,362
Diphenylamine	1.85	1.26		0.00		0.00	16,376	30,296
Nitroglycerin	13.54	9.24		0.00		0.00	6,822	92,370

Total PEP Wt. (grains/munition)	45.6
Munition feed rate (ctgs/hr)	22,500
Total chlorine (lb/hr)	1.84
Total ash (lb/hr)	16.90
Total HV (Btu/hr)	800,667

ITEM 69

GRENADE
M64

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.12	0.09		0.00	1.8895	0.23	13,312	1,597
Antimony Trisulfide	0.23	0.18		0.00	0.8582	0.20	1,802	414
Barium Nitrate	0.51	0.39		0.00	0.5867	0.30	-716	-365
Calcium Carbonate	0	0		0.00	0.5603	0.00	1,787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Ethyl Centralite	0	0		0.00		0.00	15,093	0
Graphite	0.52	0.40		0.00		0.00	14,095	7,329
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose	115.98	89.09		0.00		0.00	4,338	503,121
PETN	0.08	0.06		0.00		0.00	3,531	282
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulphate	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulphate	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4846	0.00	-786	0

ITEM 69
GRENADE - M64
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.07	0.05		0.00		0.00	1,184	83
Tin Dioxide	2.58	1.98		0.00	1.0000	2.58		0
Lead Styphnate	0.60	0.46		0.00	0.4766	0.29	2,254	1,352
Dibutylphthalate	0	0		0.00		0.00	13,210	0
Dinitrotoluene	8.75	6.72		0.00		0.00	8,424	73,710
Diphenylamine	0.77	0.59		0.00		0.00	16,376	12,610
Nitroglycerin	0	0		0.00		0.00	6,822	0

Total PEP Wt. (grains/munition)	40.5
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.60
Total HV (Btu/hr)	600,201

ITEM 70
BLANK - M82
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.14	0.28		0.00	1.8895	0.26	13,312	1,864
Antimony Trisulfide	0.30	0.60		0.00	0.8582	0.26	1,802	541
Barium Nitrate	0.78	1.55		0.00	0.5867	0.46	-716	-558
Calcium Carbonate	0.48	0		0.00	0.5603	0.27	-787	-378
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Ethyl Centralite	0-2.41	0		0.00		0.00	15,093	-36,374
Graphite	0.15	0.29		0.00		0.00	14,095	2,114
Gum Arabic	0	0		0.00		0.00	6,840	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose	47.97	95.67		0.00		0.00	4,338	208,094
PETN	0.10	0.20		0.00		0.00	3,531	353
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulphate	0.48	0.96		0.00	0.6439	0.31	-699	-336
Sodium Sulphate	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4846	0.00	-786	0

ITEM 70
BLANK - M82
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.08	0.16		0.00		0.00	1,184	95
Tin Dioxide	0	0		0.00	1.0000	0.00		0
Lead Styphnate	0.76	1.51		0.00	0.4766	0.36	2,254	1,713
Dibutylphthalate	0.72	0		0.00		0.00	13,210	9,511
Dinitrotoluene	2.42	4.81		0.00		0.00	8,424	20,386
Diphenylamine	.60	1.20		0.00		0.00	16,376	9,826
Nitroglycerin	0	0		0.00		0.00	6,822	0

Total PEP Wt. (grains/munition)	15.6
Munition Feed Rate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	1.92
Total HV (Btu/hr)	216,851

ITEM 70
BLANK
M82
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.14	0.28		0.00	1.8895	0.26	13,312	1,864
Antimony Trisulfide	0.30	0.60		0.00	0.8582	0.26	1,802	541
Barium Nitrate	0.78	1.55		0.00	0.5867	0.46	-716	-558
Calcium Carbonate	0.48	0.96		0.00	0.5603	0.27	-787	-378
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Ethyl Centralite	2.41	4.80		0.00		0.00	15,093	36,374
Graphite	0.19	0.38		0.00		0.00	14,095	2,678
Gum Arabic	0	0		0.00		0.00	6,840	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose	43.96	87.67		0.00		0.00	4,338	190,698
PETN	0.10	0.20		0.00		0.00	3,531	353
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Nitrate	0.05	0.10		0.00	0.5549	0.03	-286	-14
Potassium Sulphate	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulphate	0.24	0.48		0.00	0.5632	0.14	-705	-169

ITEM 70
BLANK - M82
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Strontium Nitrate	0	0		0.00	0.4846	0.00	-786	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.08	0.16		0.00		0.00	1,184	95
Tin Dioxide	0.50	0.10		0.00	1.0000	0.50		0
Lead Styphnate	0.76	1.51		0.00	0.4766	0.36	2,254	1,713
Dibutylphthalate	0.72	1.44		0.00		0.00	13,210	9,511
Dinitrotoluene	0.48	0.96		0.00		0.00	8,424	4,044
Diphenylamine	0.72	1.44		0.00		0.00	16,376	11,791
Nitroglycerin	8.66	17.28		0.00		0.00	6,822	59,079

Total PEP Wt. (grains/munition)	15.6
Munition Feed Rae (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	2.28
Total HV (Btu/hr)	317,622

ITEM 71

AP - M2
With Singe Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.33	0.12		0.00	0.8582	0.28	1,802	595
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.14	0.42		0.00	0.5867	0.67	-716	-816
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (SB Propellant)	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.19	0.07		0.00	1.8311	0.35	6,000	1,140
Dichromated Aluminum Powder	0.19	0.07		0.00	unknown	0.00	unknown	0
Graphite (SB Propellant)	1.08	0.40		0.00		0.00	14,095	15,223
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose (SB Propellant)	248.42	91.60		0.00		0.00	4,338	1,077,646
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0

ITEM 71
AP - M2
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (SB Propellant)	2.68	0.99		0.00	0.6439	1.73	-699	-1,873
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.11	0.04		0.00		0.00	1,184	130
Tin Dioxide (SB Propellant)	0	0		0.00	1.0000	0.00		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	1.00	0.37		0.00	0.4766	0.48	2,254	2,254
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	26.85	9.90		0.00		0.00	8,424	226,184
Diphenylamine (SB Propellant)	3.50	0.50-1.29		0.00		0.00	16,376	57,316
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0

ITEM 71
AP - M2
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	236.3
Munition feedrate (ctga/hr)	8000
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.51
Total HV (Btu/hr)	1,378,004

ITEM 71

AP - M2
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.33	0.12		0.00	0.8582	0.28	1,802	595
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.14	0.42		0.00	0.5867	0.67	-716	-816
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (DB Propellant)	2.68	0.99		0.00	0.5603	1.50	-787	-2,109
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.19	0.07		0.00	1.8311	0.35	6,000	1,140
Dichromated Aluminum Powder	0.19	0.07		0.00	unknown	0.00	unknown	0
Graphite (DB Propellant)	1.08	0.40		0.00		0.00	14,095	15,223
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose (DB Propellant)	222.38	82.00		0.00		0.00	4,338	964,684
Potassium Nitrate (DB Propellant)	1.36	0.50		0.00	0.5549	0.75	-286	-389

ITEM 71
AP - M2
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	1.36	0.50		0.00	0.5632	0.77	-705	-959
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.11	0.04		0.00		0.00	1,184	130
Tin Dioxide (DB Propellant)	0.27	0.10		0.00	1.0000	0.27		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	1.00	0.37		0.00	0.4766	0.48	2,254	2,254
Dibutylphthalate (DB Propellant)	26.85	9.90		0.00		0.00	13,210	354,689
Dinitrotoluene (DB Propellant)	2.68	0.99		0.00		0.00	8,424	22,576
Diphenylamine (DB Propellant)	4.04	1.49		0.00		0.00	16,376	66,159
Nitroglycerin (DB Propellant)	29.53	10.89		0.00		0.00	6,822	201,454

ITEM 71
AP - M2
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	236.3
Munition feedrate (ctga/hr)	8000
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	5.07
Total HV (Btu/hr)	1,624,836

ITEM 72

API - M8
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.43	0.15		0.00	1.8895	0.81	13,312	5,724
Antimony Trisulfide	0.32	0.11		0.00	0.8582	0.27	1,802	577
Asphaltum	0.69	0.24		0.00		0.00	17,500	12,075
Barium Nitrate	9.72	3.37		0.00	0.5867	5.70	-716	-6,960
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (SB Propellant)	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.20	0.07		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.17	0.06		0.00	unknown	0.00	unknown	0
Graphite (SB Propellant)	1.07	0.37		0.00		0.00	14,095	15,082
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	8.13	2.82		0.00	1.6583	13.48	10,653	86,609
Magnesium Aluminum Alloy	8.74	3.03		0.00	1.7408	15.21	11,602	101,401
Nitrocellulose (SB Propellant)	248.44	86.16		0.00		0.00	4,338	1,077,733
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0

ITEM 72
API - M8
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (SB Propellant)	2.69	0.93		0.00	0.6439	1.73	-699	-1,880
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.12	0.04		0.00		0.00	1,184	142
Tin Dioxide (SB Propellant)	0	0		0.00	1.0000	0.00		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	0.98	0.34		0.00	0.4766	0.47	2,254	2,209
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	26.84	9.31		0.00		0.00	8,424	226,100
Diphenylamine (SB Propellant)	3.49	1.21		0.00		0.00	16,376	57,152
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0

ITEM 72
API - M8
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0.17	0.06	0.2559	0.04	0.4050	0.07	264	45

Total PEP Wt. (grains/munition)	252.3
Munition feedrate (ctgs/hr)	8,000
Total Chlorine (lb/hr)	0.04
Total Ash (lb/hr)	38.11
Total HV (Btu/hr)	1,577,414

ITEM 72

API - M8
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.43	0.15		0.00	1.8895	0.81	13,312	5,724
Antimony Trisulfide	0.32	0.11		0.00	0.8582	0.27	1,802	577
Asphaltum	0.69	0.24		0.00		0.00	17,500	12,075
Barium Nitrate	9.72	3.37		0.00	0.5867	5.70	-716	-6,960
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (DB Propellant)	2.68	0.93		0.00	0.5603	1.50	-787	-2,109
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.20	0.07		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.17	0.06		0.00	unknown	0.00	unknown	0
Graphite (DB Propellant)	1.07	0.37		0.00		0.00	14,095	15,082
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	8.13	2.82		0.00	1.6583	13.48	10,653	86,609
Magnesium Aluminum Alloy	8.74	3.03		0.00	1.7408	15.21	11,602	101,401
Nitrocellulose (SB Propellant)	248.44	86.16		0.00		0.00	4,338	1,077,733
Nitrocellulose (DB Propellant)	222.37	77.12		0.00		0.00	4,338	964,641

ITEM 72
API - M8
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (DB Propellant)	1.36	0.47		0.00	0.5549	0.75	-286	-389
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	1.36	0.47		0.00	0.5632	0.77	-705	-959
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.12	0.04		0.00		0.00	1,184	142
Tin Dioxide (DB Propellant)	0.26	0.09		0.00	1.0000	0.26		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	0.98	0.34		0.00	0.4766	0.47	2,254	2,209
Dibutylphthalate (DB Propellant)	26.84	9.31		0.00		0.00	13,210	354,556
Dinitrotoluene (DB Propellant)	2.68	0.93		0.00		0.00	8,424	22,576
Diphenylamine (DB Propellant)	4.04	1.40		0.00		0.00	16,376	66,159

ITEM 72
API - M8
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Nitroglycerin (DB Propellant)	29.56	10.25		0.00		0.00	6,822	201,658
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0.17	0.06	0.2559	0.04	0.4050	0.07	264	45

Total PEP Wt. (grains/munition)	252.3
Munition feedrate (ctgs/hr)	8,000
Total Chlorine (lb/hr)	0.04
Total Ash (lb/hr)	39.66
Total HV (Btu/hr)	2,902,175

ITEM 73

API-T-20

WITH SINGLE BASE PROPELLANT

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.70	0.25		0.00	1.8895	1.32	13,312	9,318
Antimony Trisulfide	0.33	0.11		0.00	0.8582	0.28	1,802	595
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	8.15	2.92		0.00	0.5867	4.78	-716	-5,835
Barium Peroxide	2.76	0.99		0.00	unknown	0.00	unknown	0
Calcium Carbonate (SB Propellant)	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	1.06	0.38		0.00	0.0872	0.09	14,855	15,746
Calcium Silicide	0.20	0.07		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.20	0.07		0.00	unknown	0.00	unknown	0
Graphite (SB Propellant)	1.01	0.36		0.00		0.00	14,095	14,236
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	3.60	1.29		0.00	1.6583	5.97	10,653	38,351
Magnesium Aluminum Alloy	8.74	3.13		0.00	1.7408	15.21	11,602	101,401
Nitrocellulose (SB Propellant)	229.39	82.16		0.00		0.00	4,338	995,094

ITEM 73
API-T - M20
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulfate (SB Propellant)	2.48	0.89		0.00	0.6439	1.60	-699	-1,734
Sodium Sulfate (SB Propellant)	0	1.08		0.00	0.5632	0.00	-705	0
Strontium Nitrate	3.80	1.36		0.00	0.4896	1.86	-786	-2,987
Strontium Oxalate	0.56	0.20		0.00	unknown	0.00	unknown	0
Strontium Peroxide	3.02	1.08		0.00	unknown	0.00	unknown	0
Tetracene	0.11	0.04		0.00		0.00	1,184	130
Tin Dioxide (SB Propellant)	0	0		0.00	1.0000	0.00		0
Toludine Red	0.03	0.01		0.00	unknown	0.00	unknown	0
Zinc Stearate	0.03	0.01		0.00	0.1287	0.00	15,400	462
Lead Styphnate	0.98	0.35		0.00	0.4766	0.47	2,254	2,209
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	24.79	8.88		0.00		0.00	8,424	208,831
Diphenylamine (SB Propellant)	3.21	1.15		0.00		0.00	16,376	52,567

ITEM 73
API-T - M20
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	1.37	0.49	0.2559	0.35	0.4050	0.55	264	362

Total PEP Wt. (grains/munition)	244.3
Munition feedrate (ctgs/hr)	8,000
Total chlorine (lb/hr)	0.35
Total ash (lb/hr)	32.50
Total HV (Btu/hr)	1,430,151

ITEM 73

API-T - M20
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.70	0.25		0.00	1.8895	1.32	13,312	9,318
Antimony Trisulfide	0.33	0.11		0.00	0.8582	0.28	1,802	595
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	8.15	2.92		0.00	0.5867	4.78	-716	-5,835
Barium Peroxide	2.76	0.99		0.00	unknown	0.00	unknown	0
Calcium Carbonate (DB Propellant)	N/A	N/A		0.00	0.5603	0.00	-787	0
Calcium Resinate	1.06	0.38		0.00	0.0872	0.09	14,855	15,746
Calcium Silicide	0.20	0.07		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.20	0.07		0.00	unknown	0.00	unknown	0
Graphite (DB Propellant)	N/A	N/A		0.00		0.00	14,095	0
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	3.60	1.29		0.00	1.6583	5.97	10,653	38,351
Magnesium Aluminum Alloy	8.74	3.13		0.00	1.7408	15.21	11,602	101,401
Nitrocellulose (DB Propellant)	N/A	N/A		0.00		0.00	4,338	0
Potassium Nitrate (DB Propellant)	N/A	N/A		0.00	0.5549	0.00	-286	0

ITEM 73
API-T - M20
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (DB Propellant)	N/A	N/A		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	N/A	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	3.80	1.36		0.00	0.4896	1.86	-786	-2,987
Strontium Oxalate	0.56	0.20		0.00	unknown	0.00	unknown	0
Strontium Peroxide	3.02	1.08		0.00	unknown	0.00	unknown	0
Tetracene	0.11	0.04		0.00		0.00	1,184	130
Tin Dioxide (DB Propellant)	N/A	N/A		0.00	1.0000	0.00		0
Toludine Red	0.03	0.01		0.00	unknown	0.00	unknown	0
Zinc Stearate	0.03	0.01		0.00	0.1287	0.00	15,400	462
Lead Styphnate	0.98	0.35		0.00	0.4766	0.47	2,254	2,209
Dibutylphthalate (DB Propellant)	N/A	N/A		0.00		0.00	13,210	0
Dinitrotoluene (DB Propellant)	N/A	N/A		0.00		0.00	8,424	0
Diphenylamine (DB Propellant)	N/A	N/A		0.00		0.00	16,376	0
Nitroglycerin (DB Propellant)	N/A	N/A		0.00		0.00	6,822	0

ITEM 73
API-T - M20
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	1.37	0.49	0.2559	0.35	0.4050	0.55	264	362

Total PEP Wt. (grains/munition)	244.3
Munition feedrate (ctgs/hr)	8,000
Total chlorine (lb/hr)	0.35
Total ash (lb/hr)	30.90
Total HV (Btu/hr)	161,157

ITEM 74

BLANK - M1
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.31	0.57		0.00	0.8582	0.27	1,802	559
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.14	2.06		0.00	0.5867	0.67	-716	-816
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (SB Propellant)	N/A	N/A		0.00	0.5603	0.00	-787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.20	0.36		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.18	0.33		0.00	unknown	0.00	unknown	0
Graphite (SB Propellant)	N/A	N/A		0.00		0.00	14,095	0
Gum Arabic	0.01	0.02		0.00		0.00	6,840	68
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose (SB Propellant)	N/A	N/A		0.00		0.00	4,338	0
Potassium Nitrate (SB Propellant)	N/A	N/A		0.00	0.5549	0.00	-286	0

ITEM 74
BLANK - M1
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (SB Propellant)	N/A	N/A		0.00	0.6439	0.00	-699	0
Sodium Sulfate (SB Propellant)	N/A	N/A		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.06	0.11		0.00		0.00	1,184	71
Tin Dioxide (SB Propellant)	N/A	N/A		0.00	1.0000	0.00		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	0.99	1.80		0.00	0.4766	0.47	2,254	2,231
Dibutylphthalate (SB Propellant)	N/A	N/A		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	N/A	N/A		0.00		0.00	8,424	0
Diphenylamine (SB Propellant)	N/A	N/A		0.00		0.00	16,376	0
Nitroglycerin (SB Propellant)	N/A	N/A		0.00		0.00	6,822	0

ITEM 74
BLANK - M1
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	48.3
Munition feedrate (ctgs/hr)	8,000
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	1.78
Total HV (Btu/hr)	3,313

ITEM 74

BLANK - M1
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.31	0.57		0.00	0.8582	0.27	1,802	559
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.14	2.06		0.00	0.5867	0.67	-716	-816
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate (DB Propellant)	0.52	0.95		0.00	0.5603	0.29	-787	-409
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Calcium Silicide	0.20	0.36		0.00	1.8311	0.37	6,000	1,200
Dichromated Aluminum Powder	0.18	0.33		0.00	unknown	0.00	unknown	0
Graphite (DB Propellant)	0.21	0.38		0.00		0.00	14,095	2,960
Gum Arabic	0.01	0.02		0.00		0.00	6,840	68
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0

ITEM 74
BLANK - M1
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Nitrocellulose (DB Propellant)	43.53	78.86		0.00		0.00	4,338	188,833
Potassium Nitrate (DB Propellant)	0.26	0.48		0.00	0.5549	0.14	-286	-74
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	0.26	0.48		0.00	0.5632	0.15	-705	-183
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.06	0.11		0.00		0.00	1,184	71
Tin Dioxide (DB Propellant)	0.06	0.10		0.00	1.0000	0.06		0
Toludine Red	0	0		0.00	unknown	0.00	unknown	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	0.99	1.80		0.00	0.4766	0.47	2,254	2,231

ITEM 74
BLANK - M1
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate (DB Propellant)	5.16	9.52		0.00		0.00	13,210	68,164
Dinitrotoluene (DB Propellant)	0.52	0.95		0.00		0.00	8,424	4,380
Diphenylamine (DB Propellant)	0.79	1.43		0.00		0.00	16,376	12,937
Nitroglycerin (DB Propellant)	5.78	10.48		0.00		0.00	6,822	39,431
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	48.3
Munition feedrate (ctgs/hr)	8,000
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	2.42
Total HV (Btu/hr)	319,352

ITEM 75

TRACERS
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.28	0.09		0.00	0.8582	0.24	1,802	505
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.04	0.34		0.00	0.5867	0.61	-716	-745
Barium Peroxide	0.67	3.15		0.00	unknown	0.00	unknown	0
Calcium Carbonate (SB Propellant)	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	6.20	2.02		0.00	0.0872	0.54	14,855	92,101
Calcium Silicide	0.18	0.06		0.00	1.8311	0.33	6,000	1,080
Dichromated Aluminum Powder	0.15	0.05		0.00	unknown	0.00	unknown	0
Graphite (SB Propellant)	0.31	0.31		0.00		0.00	14,095	4,369
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	17.65	5.75		0.00	1.6583	29.27	10,653	188,025
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose (SB Propellant)	219.12	71.39		0.00		0.00	4,338	950,543
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulfate (SB Propellant)	2.36	0.77		0.00	0.6439	1.52	-699	-1,650

ITEM 75
TRACERS
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	28.24	9.20		0.00	0.4896	13.83	-786	-22,197
Strontium Oxalate	3.13	1.02		0.00	unknown	0.00	unknown	0
Strontium Peroxide	25.69	8.37		0.00	unknown	0.00	unknown	0
Tetracene	0.09	0.03		0.00		0.00	1,184	107
Tin Dioxide (SB Propellant)	0	0		0.00	1.0000	0.00		0
Toludine Red	0.06	0.02		0.00	unknown	0.00	unknown	0
Zinc Stearate	0.12	0.04		0.00	0.1287	0.02	15,400	1,848
Lead Styphnate	0.92	0.30		0.00	0.4766	0.44	2,254	2,074
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	23.57	7.68		0.00		0.00	8,424	198,554
Diphenylamine (SB Propellant)	3.07	1.00		0.00		0.00	16,376	50,274
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0
Parlon Chlorinated Rubber	3.16	1.03	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	7.12	2.32	0.5673	4.04		0.00	8,918	63,496

ITEM 75
TRACERS
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	318.3
Munition feedrate (ctga/hr)	6750
Total chlorine (lb/hr)	4.04
Total ash (lb/hr)	46.80
Total HV (Btu/hr)	1,528,589

ITEM 75

TRACERS
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.28	0.09		0.00	0.8582	0.24	1,802	505
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	1.04	0.34		0.00	0.5867	0.61	-716	-745
Barium Peroxide	0.67	3.15		0.00	unknown	0.00	unknown	0
Calcium Carbonate (DB Propellant)	N/A	N/A		0.00	0.5603	0.00	-787	0
Calcium Resinate	6.20	2.02		0.00	0.0872	0.54	14,855	92,101
Calcium Silicide	0.18	0.06		0.00	1.8311	0.33	6,000	1,080
Dichromated Aluminum Powder	0.15	0.05		0.00	unknown	0.00	unknown	0
Graphite (DB Propellant)	N/A	N/A		0.00		0.00	14,095	0
Gum Arabic	<0.03	<0.01		0.00		0.00	6,840	205
Magnesium	17.65	5.75		0.00	1.6583	29.27	10,653	188,025
Magnesium Aluminum Alloy	0	0		0.00	1.7408	0.00	11,602	0
Nitrocellulose (DB Propellant)	N/A	N/A		0.00		0.00	4,338	0

ITEM 75
TRACERS
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (DB Propellant)	N/A	N/A		0.00	0.5549	0.00	-286	0
Potassium Sulfate (DB Propellant)	N/A	N/A		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	N/A	N/A		0.00	0.5632	0.00	-705	0
Strontium Nitrate	28.24	9.20		0.00	0.4896	13.83	-786	-22,197
Strontium Oxalate	3.13	1.02		0.00	unknown	0.00	unknown	0
Strontium Peroxide	25.69	8.37		0.00	unknown	0.00	unknown	0
Tetracene	0.09	0.03		0.00		0.00	1,184	107
Tin Dioxide (DB Propellant)	N/A	N/A		0.00	1.0000	0.00		0
Toludine Red	0.06	0.02		0.00	unknown	0.00	unknown	0
Zinc Stearate	0.12	0.04		0.00	0.1287	0.02	15,400	1,848
Lead Styphnate	0.92	0.30		0.00	0.4766	0.44	2,254	2,074
Dibutylphthalate (DB Propellant)	N/A	N/A		0.00		0.00	13,210	0
Dinitrotoluene (DB Propellant)	N/A	N/A		0.00		0.00	8,424	0
Diphenylamine (DB Propellant)	N/A	N/A		0.00		0.00	16,376	0

ITEM 75
TRACERS
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Nitroglycerin (DB Propellant)	N/A	N/A		0.00		0.00	6,822	0
Parlon Chlorinated Rubber	3.16	1.03	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	7.12	2.32	0.5673	4.04		0.00	8,918	63,496
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0

Total PEP Wt. (grains/munition)	318.3
Munition feedrate (ctga/hr)	6750
Total chlorine (lb/hr)	4.04
Total ash (lb/hr)	45.28
Total HV (Btu/hr)	326,499

ITEM 76
TRACERS
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.45	0.21		0.00	1.8895	0.85	13,312	5,990
Antimony Trisulfide	0.94	0.44		0.00	0.8552	0.80	1,802	1,694
Barium Carbonate	0	0		0.00	unknown	0.00	unknown	0
Barium Nitrate	2.01	0.94		0.00	0.5867	1.18	-715	-1,437
Barium Peroxide	8.95	4.18		0.00	unknown	0.00	unknown	0
Calcium Carbonate	1.84	0.86		0.00	0.7603	1.40	-787	-1,448
Calcium Resinate	5.76	2.69		0.00	0.0872	0.50	14,855	85,565
Graphite	0.73	0.34		0.00		0.00	14,095	10,289
Gum Arabic	0.02	0.01		0.00		0.00	6,840	137
Lead Dioxide	0.09	0.04		0.00	unknown	0.00	unknown	0
Lead Peroxide	0.19	0.09		0.00	unknown	0.00	unknown	0
Magnesium	17.23	8.05		0.00	1.6583	28.57	10,653	183,551
Nitrocellulose (SB Propellant)	172.88	80.76		0.00		0.00	4,338	749,953
Nitrocellulose (DB Propellant)	152.27	71.13		0.00		0.00	4,338	660,547
PETN	0.32	0.15		0.00		0.00	3,531	1,130
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0

ITEM 76
TRACERS
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (DB Propellant)	0.92	0.43		0.00	0.5549	0.51	-286	-263
Potassium Sulfate (SB Propellant)	1.84	0.86		0.00	0.6439	1.18	-699	-1,286
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Sodium Sulfate (DB Propellant)	0.92	0.43		0.00	0.5632	0.52	-705	-649
Strontium Nitrate	19.50	9.11		0.00	0.4896	9.55	-786	-15,327
Strontium Oxalate	2.93	1.37		0.00	unknown	0.00	unknown	0
Strontium Peroxide	23.78	11.11		0.00	unknown	0.00	unknown	0
Tetracene	0.28	0.13		0.00		0.00	1,184	332
Tin Dioxide	0.19	0.09		0.00	1.000	0.19		0
Zinc Stearate	0.11	0.05		0.00	0.1287	0.01	15,400	1,694
Zirconium	0.19	0.09		0.00	unknown	0.00	unknown	0
Lead Styphnate	2.39	1.12		0.00	0.4766	1.14	2,254	5,387
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0

ITEM 76
TRACERS
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate (DB Propellant)	18.39	8.59		0.00		0.00	13,210	242,932
Dinitrotoluene (SB Propellant)	16.55	7.73		0.00		0.00	8,424	139,417
Dinitrotoluene (DB Propellant)	1.84	0.86		0.00		0.00	8,424	15,500
Dephenylamine	2.76	1.29		0.00		0.00	16,376	45,198
Nitroglycerin (SB Propellant)	0			0.00		0.00	6,822	0
Nitroglycerin (DB Propellant)	20.23	9.45		0.00		0.00	6,822	138,009
Parlon Chlorinated Rubber	1.33	0-0.62	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	3.75	1.75	0.5673	2.13		0.00	8,918	33,443

Total PEP Wt. (grains/munition)	66.6
Munition feedrate (ctga/hr)	22,500
Total chlorine (lb/hr)	2.13
Total ash (lb/hr)	46.40
Total HV (Btu/hr)	2,300,358

ITEM 76
TRACERS
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.45	0.21		0.00	1.8895	0.85	13,312	5,990
Antimony Trisulfide	0.94	0.44		0.00	0.8552	0.80	1,802	1,694
Barium Carbonate	0	0		0.00	unknown	0.00	unknown	0
Barium Nitrate	2.01	0.94		0.00	0.5867	1.18	-715	-1,437
Barium Peroxide	8.95	4.18		0.00	unknown	0.00	unknown	0
Calcium Carbonate	1.84	0.86		0.00	0.7603	1.40	-787	-1,448
Calcium Resinate	5.76	2.69		0.00	0.0872	0.50	14,855	85,565
Graphite	0.73	0.34		0.00		0.00	14,095	10,289
Gum Arabic	0.02	0.01		0.00		0.00	6,840	137
Lead Dioxide	0.09	0.04		0.00	unknown	0.00	unknown	0
Lead Peroxide	0.19	0.09		0.00	unknown	0.00	unknown	0
Magnesium	17.23	8.05		0.00	1.6583	28.57	10,653	183,551
Nitrocellulose (SB Propellant)	172.88	80.76		0.00		0.00	4,338	749,953
Nitrocellulose (DB Propellant)	152.27	71.13		0.00		0.00	4,338	660,547
PETN	0.32	0.15		0.00		0.00	3,531	1,130
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0

ITEM 76
TRACERS
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (DB Propellant)	0.92	0.43		0.00	0.5549	0.51	-286	-263
Potassium Sulfate (SB Propellant)	1.84	0.86		0.00	0.6439	1.18	-699	-1,286
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Sodium Sulfate (DB Propellant)	0.92	0.43		0.00	0.5632	0.52	-705	-649
Strontium Nitrate	19.50	9.11		0.00	0.4896	9.55	-786	-15,327
Strontium Oxalate	2.93	1.37		0.00	unknown	0.00	unknown	0
Strontium Peroxide	23.78	11.11		0.00	unknown	0.00	unknown	0
Tetracene	0.28	0.13		0.00		0.00	1,184	332
Tin Dioxide	0.19	0.09		0.00	1.000	0.19		0
Zinc Stearate	0.11	0.05		0.00	0.1287	0.01	15,400	1,694
Zirconium	0.19	0.09		0.00	unknown	0.00	unknown	0
Lead Styphnate	2.39	1.12		0.00	0.4766	1.14	2,254	5,387
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0

ITEM 76
TRACERS
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate (DB Propellant)	18.39	8.59		0.00		0.00	13,210	242,932
Dinitrotoluene (SB Propellant)	16.55	7.73		0.00		0.00	8,424	139,417
Dinitrotoluene (DB Propellant)	1.84	0.86		0.00		0.00	8,424	15,500
Dephenylamine	2.76	1.29		0.00		0.00	16,376	45,198
Nitroglycerin (SB Propellant)	0			0.00		0.00	6,822	0
Nitroglycerin (DB Propellant)	20.23	9.45		0.00		0.00	6,822	138,009
Parlon Chlorinated Rubber	1.33	0.62	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	3.75	1.75	0.5673	2.13		0.00	8,918	33,443

Total PEP Wt. (grains/munition)	66.6
Munition feedrate (ctga/hr)	22,500
Total chlorine (lb/hr)	2.13
Total ash (lb/hr)	46.40
Total HV (Btu/hr)	2,300,358

ITEM 77
AP - M2
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.14	0.08		0.00	l.8895	0.12	13,312	1,864
Antimony Trisulfide	0.18	0.10		0.00	0.8552	0.15	1,802	324
Barium Carbonate	0	0		0.00	unknown	0.00	unknown	0
Barium Nitrate	0.63	0.35		0.00	0.5867	0.37	-715	-450
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Graphite	0.71	0.40		0.00		0.00	14,095	10,007
Gum Arabic	0	0		0.00		0.00	6,840	0
Lead Dioxide	0	0		0.00	unknown	0.00	unknown	0
Lead Peroxide	0.18	0.10		0.00	unknown	0.00	unknown	0
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Nitrocellulose (SB Propellant)	161.84	90.56		0.00		0.00	4,338	702,062
PETN	0.09	0.05		0.00		0.00	3,531	318
Potassium Nitrate (SB Propellant)	0	0		0.00	0.5549	0.00	-286	0

ITEM 77
AP - M2
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (SB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.07	0.04		0.00		0.00	1,184	83
Tin Dioxide	0.18	0.10		0.00	1.000	0.18		0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Zirconium	0.18	0.10		0.00	unknown	0.00	unknown	0
Lead Styphnate	0.71	0.40		0.00	0.4766	0.34	2,254	1,600
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	12.37	6.92		0.00		0.00	8,424	104,205
Dephenylamine	1.95	1.09		0.00		0.00	16,376	31,933
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0

ITEM 77
AP - M2
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0

Total PEP wt. (grains/munition)	55.6
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	1.16
Total HV (Btu/hr)	851,946

ITEM 77
AP - M2
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/hr	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.14	0.08		0.00	1.8895	0.12	13,312	1,864
Antimony Trisulfide	0.18	0.10		0.00	0.8552	0.15	1,802	324
Barium Carbonate	0	0		0.00	unknown	0.00	unknown	0
Barium Nitrate	0.63	0.35		0.00	0.5867	0.37	-715	-450
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Graphite	0.71	0.40		0.00		0.00	14,095	10,007
Gum Arabic	0	0		0.00		0.00	6,840	0
Lead Dioxide	0	0		0.00	unknown	0.00	unknown	0
Lead Peroxide	0.18	0.10		0.00	unknown	0.00	unknown	0
Magnesium	0	0		0.00	1.6583	0.00	10,653	0
Nitrocellulose (DB Propellant)	138.07	77.27		0.00		0.00	4,338	598,948
PETN	0.09	0.05		0.00		0.00	3,531	318
Potassium Nitrate (DB Propellant)	0.54	0.30		0.00	0.5549	0.30	-286	-154
Potassium Sulfate (DB Propellant)	0.97	0.54		0.00	0.6439	0.62	-699	-678

ITEM 77
AP - M2
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/hr	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Sodium Sulfate (DB Propellant)	0.88	0.49		0.00	0.5632	0.50	-705	-620
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.07	0.04		0.00		0.00	1,184	83
Tin Dioxide	0.18	0.10		0.00	1.000	0.18		0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Zirconium	0.18	0.10		0.00	unknown	0.00	unknown	0
Lead Styphnate	0.71	0.40		0.00	0.4766	0.34	2,254	1,600
Dibutylphthalate (DB Propellant)	14.14	7.91		0.00		0.00	13,210	186,789
Dinitrotoluene (DB Propellant)	1.77	0.99		0.00		0.00	8,424	14,910
Dephenylamine	1.95	1.09		0.00		0.00	16,376	31,933
Nitroglycerin (DB Propellant)	16.80	9.40		0.00		0.00	6,822	114,610
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0

ITEM 77
AP - M2
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/hr	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Total PEP Wt. (grains/munition)	55.6							
Munition feedrate (ctgs/hr)	22,500							
Total chlorine (lb/hr)	0.00							
Total ash (lb/hr)	2.58							
Total HV (Btu/hr)	959,484							

ITEM 78

BLANKS - M1909
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.13	0.31		0.00	1.8895	0.25	13,312	1,731
Antimony Trisulfide	0.29	0.71		0.00	0.8552	0.25	1,802	523
Barium Carbonate	0.38	0.95		0.00	unknown	0.00	unknown	0
Barium Nitrate	2.55	6.29		0.00	0.5867	1.50	-715	-1,823
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate	0.38	0.95		0.00	0.5603	0.21	-787	-299
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Graphite	0.15	0.38		0.00		0.00	14,095	2,114
Gum Arabic	0	0		0.00		0.00	6,840	0
Lead Dioxide	0	0		0.00	unknown	0.00	unknown	0
Lead Peroxide	0	0		0.00	unknown	0.00	unknown	0
Magnesium	0			0.00	1.6583	0.00	10,653	0
Nitrocellulose (SB Propellant)	37.80	93.33		0.00		0.00	4,338	163,976
PETN	1.10	0.24		0.00		0.00	3,531	3,884
Potassium Nitrate (SB Propellant)	1.54	3.81		0.00	0.5549	0.85	-286	-440

ITEM 78
BLANKS - M1909
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Sulfate (SB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (SB Propellant)	0	0		0.00	0.5632	0.00	-705	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.08	0.19		0.00		0.00	1,184	95
Tin Dioxide	0.04	0.10		0.00	1.000	0.04		0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Zirconium	0	0		0.00	unknown	0.00	unknown	0
Lead Styphnate	0.71	1.76		0.00	0.4766	0.34	2,254	1,600
Dibutylphthalate (SB Propellant)	0	0		0.00		0.00	13,210	0
Dinitrotoluene (SB Propellant)	0	0		0.00		0.00	8,424	0
Dephenylamine	0.58	1.43		0.00		0.00	16,376	9,498
Nitroglycerin (SB Propellant)	0	0		0.00		0.00	6,822	0

ITEM 78
BLANKS - M1909
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0

Total PEP Wt. (grains/munition)	12.6
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.44
Total HV (Btu/hr)	180,859

ITEM 78

BLANKS - M1909
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.13	0.31		0.00	1.8895	0.25	13,312	1,731
Antimony Trisulfide	0.29	0.71		0.00	0.8552	0.25	1,802	523
Barium Carbonate	0.38	0.95		0.00	unknown	0.00	unknown	0
Barium Nitrate	2.55	6.29		0.00	0.5867	1.50	-715	-1,823
Barium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Calcium Carbonate	0.38	0.95		0.00	0.5603	0.21	-787	-299
Calcium Resinate	0	0		0.00	0.0872	0.00	14,855	0
Graphite	0.15	0.38		0.00		0.00	14,095	2,114
Gum Arabic	0	0		0.00		0.00	6,840	0
Lead Dioxide	0	0		0.00	unknown	0.00	unknown	0
Lead Peroxide	0	0		0.00	unknown	0.00	unknown	0
Magnesium	0			0.00	1.6583	0.00	10,653	0
Nitrocellulose (DB Propellant)	35.21	86.95		0.00		0.00	4,338	152,741
PETN	1.10	0.24		0.00		0.00	3,531	3,884
Potassium Nitrate (SB Propellant)	1.54	3.81		0.00	0.5549	0.85	-286	-440

ITEM 78
BLANKS - M1909
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Potassium Nitrate (DB Propellant)	0.04	0.10		0.00	0.5549	0.02	-286	-11
Potassium Sulfate (DB Propellant)	0	0		0.00	0.6439	0.00	-699	0
Sodium Sulfate (DB Propellant)	0.19	0.48		0.00	0.5632	0.11	-705	-134
Strontium Nitrate	0	0		0.00	0.4896	0.00	-786	0
Strontium Oxalate	0	0		0.00	unknown	0.00	unknown	0
Strontium Peroxide	0	0		0.00	unknown	0.00	unknown	0
Tetracene	0.08	0.19		0.00		0.00	1,184	95
Tin Dioxide	0.04	0.10		0.00	1.000	0.04		0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Zirconium	0	0		0.00	unknown	0.00	unknown	0
Lead Styphnate	0.71	1.76		0.00	0.4766	0.34	2,254	1,600
Dibutylphthalate (DB Propellant)	0.16	2.86		0.00		0.00	13,210	2,114
Dinitrotoluene (DB Propellant)	0.38	0.95		0.00		0.00	8,424	3,201
Dephenylamine	0.58	1.43		0.00		0.00	16,376	9,498

ITEM 78
BLANKS - M1909
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Nitroglycerin (DB Propellant)	4.63	11.43		0.00		0.00	6,822	31,586
Parlon Chlorinated Rubber	0	0	unknown	0.00	unknown	0.00	unknown	0
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0

Total PEP Wt. (grains/munition)	12.6
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.57
Total HV (Btu/hr)	206,380

ITEM 79

HEI
With Single Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetylene Black	<0.01	<0.01		0.00		0.00	14,095	141
Aluminum	6.78	6.87		0.00	1.8895	12.81	13,312	90,255
Ammonium Nitrate	0	0		0.00	unknown	0.00	unknown	0
Antimony Trisulfide	0.07	0.07		0.00	0.8582	0.06	1,802	126
Asphaltum	0.18	0.18		0.00		0.00	17,500	3,150
Barium Nitrate	1.86	1.88		0.00	0.5867	1.09	-716	-1,332
Calcium Carbonate	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0.12	0.12		0.00	0.6872	0.08	14,855	1,783
Calcium Silicide	0.07	0.07		0.00	1.811	0.13	6,000	420
Calcium Stearate	<0.01	<0.01		0.00	0.0924	0.00	16,040	160
Graphite	0.51	0.52		0.00		0.00	14,095	7,188
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
HMX	0.90	0.91		0.00		0.00	4,252	3,827
Lead Azide		0.20		0.00	0.7664	0.00	1,135	0

ITEM 79
HEI
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Lead Sulfocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium Aluminum Alloy	2.34	2.39		0.00	1.7408	4.07	11,602	27,149
Nitrocellulose	77.81	78.83		0.00		0.00	4,338	337,540
PETN	0.02	0.02		0.00		0.00	3,531	71
Polyvinyl Alcohol	0.04	0.04		0.00	unknown	0.00	unknown	0
Potassium Nitrate	0.00	0.00		0.00	0.5549	0.00	-286	0
Potassium Sulfate	0.84	0.85		0.00	0.6439	0.54	-699	-587
RDX	12.47	12.63		0.00		0.00	4,126	51,451
Sodium Sulfate	0	0		0.00	0.5632	0.00	-705	0
Tetracen	0.01	0.01		0.00		0.00	1,184	12
Tetryl	10.85	10.99		0.00		0.00	5,261	57,082
Tin Dioxide	0.34	0.34		0.00	1.0000	0.34		0
Trinitroresorcinol	<0.01	<0.01		0.00		0.00	3,294	33
Wax	0.38	0.39		0.00		0.00	20,000	7,600

ITEM 79
HEI
With Single Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Zinc Stearate	<0.01	<0.01		0.00	0.1287	0.00	15,400	154
Lead Styphnate	0.20	0.20		0.00	0.4766	0.10	2,254	452
Dibutylphthalate	0	0		0.00		0.00	13,210	0
Dinitrotoluene	7.94	8.04		0.00		0.00	8,424	66,887
Diphenylamine	1.09	1.10		0.00		0.00	16,376	17,850
Nitroglycerin	0	0		0.00		0.00	6,822	0
Potassium Perchlorate	2.57	2.60	0.2559	0.00	0.4050	1.04	264	678
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (grains/munition)	767.71
Munition feedrate (ctgs/hr)	900
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	20.26
Total HV (Btu/hr)	672,158

ITEM 79

HEI
With Double Base Propellant

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetylene Black	<0.01	<0.01		0.00		0.00	14,095	141
Aluminum	6.78	6.87		0.00	1.8895	12.81	13,312	90,255
Ammonium Nitrate	0	0		0.00	unknown	0.00	unknown	0
Antimony Trisulfide	0.07	0.07		0.00	0.8582	0.06	1,802	126
Asphaltum	0.18	0.18		0.00		0.00	17,500	3,150
Barium Nitrate	1.86	1.86		0.00	0.5867	1.09	-716	-1,332
Calcium Carbonate	0.84	0.85		0.00	0.5603	0.47	-787	-661
Calcium Resinate	0.12	0.12		0.00	0.6872	0.08	14,855	1,783
Calcium Silicide	0.07	0.07		0.00	1.811	0.13	6,000	420
Calcium Stearate	<0.01	<0.01		0.00	0.0924	0.00	16,040	160
Graphite	0.51	0.52		0.00		0.00	14,095	7,188
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
HMX	0.90	0.91		0.00		0.00	4,252	3,827
Lead Azide		0.20		0.00	0.7664	0.00	1,135	0

ITEM 79
HEI
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Lead Sulfocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium Aluminum Alloy	2.34	2.39		0.00	1.7408	4.07	11,602	27,149
Nitrocellulose	71.12	72.05		0.00		0.00	4,338	308,519
PETN	0.02	0.02		0.00		0.00	3,531	71
Polyvinyl Alcohol	0.04	0.04		0.00	unknown	0.00	unknown	0
Potassium Nitrate	1.25	1.27		0.00	0.5549	0.69	-286	-358
Potassium Sulfate	0	0		0.00	0.6439	0.00	-699	0
RDX	12.47	12.63		0.00		0.00	4,126	51,451
Sodium Sulfate	0.41	0.42		0.00	0.5632	0.23	-705	-289
Tetracen	0.01	0.01		0.00		0.00	1,184	12
Tetryl	10.85	10.99		0.00		0.00	5,261	57,082
Tin Dioxide	10.85	1.27		0.00	1.0000	10.85		0
Trinitroresorcinol	<0.01	<0.01		0.00		0.00	3,294	33
Wax	0.38	0.39		0.00		0.00	20,000	7,600

ITEM 79
HEI
With Double Base Propellant
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Zinc Stearate	<0.01	<0.01		0.00	0.1287	0.00	15,400	154
Lead Styphnate	0.20	0.20		0.00	0.4766	0.10	2,254	451
Dibutylphthalate	7.94	8.04		0.00		0.00	13,210	104,887
Dinitrotoluene	0.84	0.85		0.00		0.00	8,424	7,076
Diphenylamine	1.25	1.27		0.00		0.00	16,376	20,470
Nitroglycerin	9.19	9.31		0.00		0.00	6,822	62,694
Potassium Perchlorate	2.57	2.60	0.2559	0.66	0.4050	1.04	264	678
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (grains/munition)	767.71
Munition feedrate (ctgs/hr)	900
Chlorine (lb/hr)	0.66
Total ash (lb/hr)	31.62
Total HV (Btu/hr)	752,805.00

ITEM 80

API
M53

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetylene Black	0	<0.01		0.00		0.00	14,095	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Ammonium Nitrate	2.19	1.84		0.00	unknown	0.00	unknown	0
Antimony Trisulfide	0	0		0.00	0.8582	0.00	1,802	0
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	2.32	1.95		0.00	0.5867	1.36	-716	-1,661
Calcium Carbonate	1.05	0.88		0.00	0.5603	0.59	-787	-826
Calcium Resinate	0.10	0.08		0.00	0.6872	0.07	14,855	1,486
Calcium Silicide	0.08	0.07		0.00	1.811	0.14	6,000	480
Calcium Stearate	0	0		0.00	0.0924	0.00	16,040	0
Graphite	0.42	0.35		0.00		0.00	14,095	5,920
Gum Arabic	<0.01	<0.01		0.00		0.00	6,840	68
HMX	0	0		0.00		0.00	4,252	0
Lead Azide		0		0.00	0.7664	0.00	1,135	0
Lead Sulfocyanate	0	0		0.00	0.6903	0.00	2,097	0

ITEM 80
API - M53
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Magnesium Aluminum Alloy	4.76	4.01		0.00	1.7408	8.29	11,602	55,226
Nitrocellulose	88.45	74.45		0.00		0.00	4,338	383,696
PETN	0	0		0.00		0.00	3,531	0
Polyvinyl Alcohol	0	0		0.00	unknown	0.00	unknown	0
Potassium Nitrate	1.56	1.31		0.00	0.5549	0.87	-286	-446
Potassium Sulfate	0	0		0.00	0.6439	0.00	-699	0
RDX	0	0		0.00		0.00	4,126	0
Sodium Sulfate	0.52	0.42		0.00	0.5632	0.29	-705	-367
Tetracen	0	0		0.00		0.00	1,184	0
Tetryl	0	0		0.00		0.00	5,261	0
Tin Dioxide	0	1.31		0.00	1.0000	0.00		0
Trinitroresorcinol	<0.01	<0.01		0.00		0.00	3,294	33
Wax	0	0		0.00		0.00	20,000	0
Zinc Stearate	<0.01	<0.01		0.00	0.1287	0.00	15,400	154
Lead Styphnate	0.20	0.17		0.00	0.4766	0.10	2,254	451

ITEM 80
API - M53
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate	9.88	8.32		0.00		0.00	13,210	130,515
Dinitrotoluene	1.05	0.88		0.00		0.00	8,424	8,845
Diphenylamine	1.56	1.31		0.00		0.00	16,376	25,547
Nitroglycerin	11.44	9.63		0.00		0.00	6,822	78,044
Potassium Perchlorate	2.82	2.37	0.2559	0.72	0.4050	1.14	264	744
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0
				0.72		12.85		687,909

Total PEP Wt. (grains/munition)	639
Munition feedrate (ctgs/hr)	1200
Total chlorine (lb/hr)	0.72
Total ash (lb/hr)	12.85
Total HV (Btu/hr)	687,909

ITEM 81

INC
M96

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetylene Black	<0.01	0		0.00		0.00	14,095	141
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Ammonium Nitrate	0	0		0.00	unknown	0.00	unknown	0
Antimony Trisulfide	0.03	0.04		0.00	0.8582	0.03	1,802	54
Asphaltum	0	0		0.00		0.00	17,500	0
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Calcium Carbonate	0	0		0.00	0.5603	0.00	-787	0
Calcium Resinate	0.41	0.50		0.00	0.6872	0.28	14,855	6,091
Calcium Silicide	0	0		0.00	1.811	0.00	6,000	0
Calcium Stearate	0	0		0.00	0.0924	0.00	16,040	0
Graphite	0	0		0.00		0.00	14,095	0
Gum Arabic	0	0		0.00		0.00	6,840	0
HMX	0	0		0.00		0.00	4,252	0
Lead Azide		0		0.00	0.7664	0.00	1,135	0
Lead Sulfocyanate	0.07	0.08		0.00	0.6903	0.05	2,097	147

ITEM 81
INC - M96
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Magnesium Aluminum Alloy	10.04	12.23		0.00	1.7408	17.48	11,602	116,484
Nitrocellulose	59.04	71.91		0.00		0.00	4,338	256,116
PETN	0.02	0.03		0.00		0.00	3,531	71
Polyvinyl Alcohol	0	0		0.00	unknown	0.00	unknown	0
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Potassium Sulfate	0.45	0.55		0.00	0.6439	0.29	-699	-315
RDX	0	0		0.00		0.00	4,126	0
Sodium Sulfate	0	0		0.00	0.5632	0.00	-705	0
Tetracen	0	0		0.00		0.00	1,184	0
Tetryl	0	0		0.00		0.00	5,261	0
Tin Dioxide	0	0.55		0.00	1.0000	0.00		0
Trinitroresorcinol	0	0		0.00		0.00	3,294	0
Wax	0	0		0.00		0.00	20,000	0
Zinc Stearate	0	0		0.00	0.1287	0.00	15,400	0
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0

ITEM 81
INC - M96
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Dibutylphthalate	0	0		0.00		0.00	13,210	0
Dinitrotoluene	0	0		0.00		0.00	8,424	0
Diphenylamine	0.48	0.59		0.00		0.00	16,376	7,860
Nitroglycerin	0	0		0.00		0.00	6,822	0
Potassium Perchlorate	10.96	13.35	0.2559	2.80	0.4050	4.44	264	2,893
Potassium Chlorate	0.17	0.17	0.2893	0.05	0.4578	0.08	449	76

Total PEP Wt. (grains/munition)	638.6
Munition feedrate (ctgs/hr)	900
Total chlorine (lb/hr)	2.85
Total ash (lb/hr)	22.65
Total HV (Btu/hr)	389,618

ITEM 82

M28B2

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.07	0.06		0.00	0.8582	0.06	1,802	126
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Charcoal	18.05	15.55		0.00		0.00	14,095	254,415
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0
Lead Thiocyanate	0.09	0.08		0.00	0.6903	0.06	2,097	189
PETN	0	0		0.00		0.00	3,531	0
Potassium Nitrate	85.62	73.75		0.00	0.5549	47.51	-286	-24,487
Sulfur	12.02	10.35		0.00		0.00	3,983	47,876
Tetracene	0	0		0.00		0.00	1,184	0
Trinitroresorcinol	0.02	0.02		0.00		0.00	3,294	66
Potassium Chlorate	0.21	0.18	0.2893	0.06	0.4578	0.10	449	94

Total PEP Wt. (grains/munition)	301.00
Munition feedrate (ctgs/hr)	2700
Total chlorine (lb/hr)	0.06
Total ash (lb/hr)	47.73
Total HV (Btu/hr)	278,279

ITEM 83

M34

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0.13	6.78		0.00	1.8895	0.25	13,312	1,731
Antimony Trisulfide	0.29	15.25		0.00	0.8582	0.25	1,802	523
Barium Nitrate	0.61	32.20		0.00	0.5867	0.36	-716	-437
Charcoal	0	0		0.00		0.00	14,095	0
Lead Styphnate	0.71	37.29		0.00	0.4766	0.34	2,254	1,600
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
PETN	0.10	5.08		0.00		0.00	3,531	353
Potassium Nitrate	0	0		0.00	0.5549	0.00	-286	0
Sulfur	0	0		0.00		0.00	3,983	0
Tetracene	0.06	3.39		0.00		0.00	1,184	71
Trinitroresorcinol	0	0		0.00		0.00	3,294	0
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (grains/munition)	0.59
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Toal ash (lb/hr)	1.20
Total HV (Btu/hr)	3,841

ITEM 84

40A2

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.03	0.05		0.00	0.8582	0.03	1,802	54
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Charcoal	8.12	15.54		0.00		0.00	14,095	114,451
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0
Lead Thiocyanate	0.05	0.09		0.00	0.6903	0.03	2,097	105
PETN	0	0		0.00		0.00	3,531	0
Potassium Nitrate	38.53	73.73		0.00	0.5549	21.38	-286	-11,020
Sulfur	5.41	10.36		0.00		0.00	3,983	21,548
Tetracene	0	0		0.00		0.00	1,184	0
Trinitroresorcinol	0.01	0.02		0.00		0.00	3,294	33
Potassium Chlorate	0.10	0.20	0.2893	0.03	0.4578	0.05	449	45

Total PEP Wt. (grains/munition)	271.00
Munition feedrate(ctgs/hr)	1350
Total chlorine (lb/hr)	0.03
Total ash (lb/hr)	21.49
Total HV (Btu/hr)	125,216

ITEM 85

M57

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.02	0.26		0.00	0.8582	0.02	1,802	36
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Charcoal	0.96	15.36		0.00		0.00	14,095	13,531
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0
Lead Thiocyanate	0.02	0.38		0.00	0.6903	0.01	2,097	42
PETN	0	0		0.00		0.00	3,531	0
Potassium Nitrate	4.54	72.88		0.00	0.5549	2.52	-286	-1,298
Sulfur	0.64	10.24		0.00		0.00	3,983	2,549
Tetracene	0	0		0.00		0.00	1,184	0
Trinitroresorcinol	0.01	0.08		0.00		0.00	3,294	33
Potassium Chlorate	0.05	0.81	0.2893	0.01	0.4578	0.02	449	22

Total PEP Wt. (grains/munition)	66.00
Munition feedrate (ctgs/hr)	660
Total chlorine (lb/hr)	0.01
Total ash (lb/hr)	2.57
Total HV (Btu/hr)	14,915

ITEM 86

M71

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.23	0.45		0.00	0.8582	0.20	1,802	414
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Charcoal	1.57	15.19		0.00		0.00	14,095	22,129
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0
Lead Thiocyanate	0.32	0.66		0.00	0.6903	0.22	2,097	671
PETN	0	0		0.00		0.00	3,531	0
Potassium Nitrate	7.43	72.04		0.00	0.5549	4.12	-286	-2,125
Sulfur	1.03	10.12		0.00		0.00	3,983	4
Tetracene	0	0		0.00		0.00	1,184	0
Trinitroresorcinol	0.06	0.13		0.00		0.00	3,294	198
Potassium Chlorate	0.68	1.41	0.2893	0.20	0.4578	0.31	449	305

Total PEP Wt. (grains/munition)	3.52
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.20
Total ash (lb/hr)	4.85
Total HV (Btu/hr)	21,596

ITEM 87

M82

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.01	0.45		0.00	0.8582	0.01	1,802	18
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Charcoal	0.31	15.19		0.00		0.00	14,095	4,369
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0
Lead Thiocyanate	0.01	0.66		0.00	0.6903	0.01	2,097	21
PETN	0	0		0.00		0.00	3,531	0
Potassium Nitrate	1.6	72.04		0.00	0.5549	0.89	-286	-458
Sulfur	0.20	10.12		0.00		0.00	3,983	797
Tetracene	0	0		0.00		0.00	1,184	0
Trinitroresorcinol	<0.01	0.13		0.00		0.00	3,294	33
Potassium Chlorate	0.03	1.41	0.2893	0.01	0.4578	0.01	449	13

Total PEP Wt. (grains/munition)	0.63
Munition feedrate (ctgs/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	0.92
Total HV (Btu/hr)	4,793

ITEM 88

M66A1/A2

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0	0		0.00	0.8582	0.00	1,802	0
Barium Chromate	0	0		0.00	1.0000	0.00	-497	0
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0.06	0.56		0.00	0.4107	0.02	2,401	144
Carborundum	0	0		0.00	1.0000	0.00		0
Lead Azide	0.34	3.26		0.00	0.7664	0.26	1,135	386
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0.94	9.12		0.00	1.6983	1.60	10,653	10,014
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	1.86	17.92		0.00	0.4896	0.91	-796	-1,481
Tetracene	0	0		0.00		0.00	1,184	0
Tetryl	6.59	63.59		0.00		0.00	5,261	34,670
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0

ITEM 88
M66A1/A2
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0.57	5.54	0.5763	0.33		0.00	8,918	5,083
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (grains/fuze)	107.4
Fuze feedrate (fuzes/hr)	675
Total chlorine (lb/hr)	0.33
Total ash (lb/hr)	2.79
Total HV (Btu/hr)	48,816

ITEM 89

MK27*

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.26	0.04		0.00	0.8582	0.22	1,802	469
Barium Chromate	0	0		0.00	1.0000	0.00	-497	0
Barium Nitrate	0	0		0.00	0.5867	0.00	-716	0
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0	0		0.00	0.4107	0.00	2,401	0
Carborundum	0	0		0.00	1.0000	0.00		0
Lead Azide	0.30	1.35		0.00	0.7664	0.23	1,135	341
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	0	0		0.00		0.00	1,184	0
Tetryl	21.76	98.40		0.00		0.00	5,261	114,479
Lead Styphnate	0	0		0.00	0.4766	0.00	2,254	0

ITEM 89
MK27*
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0.01	0.04	0.2893	0.00	0.4578	0.00	449	4

Total PEP Wt. (grains/fuze)	351.82
Fuze feedrate (fuzes/hr)	440
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	0.45
Total HV (Btu/hr)	115,293

*Assumed primer mix to be NOL 70.

ITEM 90

M557

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	<0.01	<0.01		0.00		0.00	10,245	102
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.03	0.12		0.00	0.8582	0.03	1,802	54
Barium Chromate	0.02	0.09		0.00	1.0000	0.02	-497	-10
Barium Nitrate	<0.01	0.02		0.00	0.5867	0.01	-716	-7
Boron Powder	<0.01	0.02		0.00	3.2201	0.03	25,143	251
Black Powder	0	0		0.00	0.4107	0.00	2,401	0
Carborundum	0	0		0.00	1.0000	0.00		0
Lead Azide	0.51	2.30		0.00	0.7664	0.39	1,135	579
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	<0.01	<0.01		0.00		0.00	1,184	12
Tetryl	21.76	97.30		0.00		0.00	5,261	114,479
Lead Styphnate	0.01	0.03		0.00	0.4766	0.00	2,254	23

ITEM 90
M557
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5763	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0.02	0.10	0.2893	0.01	0.4578	0.01	449	9

Total PEP Wt. (grains/fuze)	355.80
Fuze feedrate	440
Total chlorine (lr/hr)	0.01
Total Ash (lb/hr)	0.49
Total HV (Btu/hr)	115,492

ITEM 91

M501

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.03	5.10		0.00	0.8582	0.03	1,802	54
Barium Chromate	0	0		0.00	1.0000	0.00	-497	0
Barium Nitrate	0.01	2.02		0.00	0.5867	0.01	-716	-7
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0	0		0.00	0.4107	0.00	2,401	0
Carborundum	<0.01	0.65		0.00	1.0000	0.01		0
Lead Azide	0.38	64.94		0.00	0.7664	0.29	1,135	431
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	<0.01	0.40		0.00		0.00	1,184	12
Tetryl	0.10	17.74		0.00		0.00	5,261	526
Lead Styphnate	0.03	4.84		0.00	0.4766	0.01	2,254	68

ITEM 91
M501
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0.03	4.31	0.2893	0.01	0.4578	0.01	449	13

Total PEP Wt. (grains/fuze)	6.2
Fuze feedrate (fuze/hr)	660
Total chlorine (lb/hr)	0.01
Total ash (lb/hr)	0.36
Total HV (Btu/hr)	1,097

ITEM 92

M502

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.47	0.10		0.00	0.8582	0.40	1,802	847
Barium Chromate	0	0		0.00	1.0000	0.00	-497	0
Barium Nitrate	0.01	0.04		0.00	0.5867	0.01	-716	-7
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0	0		0.00	0.4107	0.00	2,401	0
Carborundum	<0.01	0.01		0.00	1.0000	0.01		0
Lead Azide	0.39	1.85		0.00	0.7664	0.30	1,135	443
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	<0.01	0.01		0.00		0.00	1,184	12
Tetryl	20.87	97.83		0.00		0.00	5,261	109,797
Lead Styphnate	0.02	0.09		0.00	0.4766	0.01	2,254	45

ITEM 92
M502
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0.02	0.08	0.2893	0.01	0.4578	0.01	449	9

Total PEP Wt. (grains/fuze)	331.9
Fuze feedrate (fuzes/hr)	450
Total chlorine (lb/hr)	0.01
Total ash (lb/hr)	0.74
Total HV (Btu/hr)	111,146

ITEM 93

M564

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	0	0		0.00	1.8895	0.00	13,312	0
Antimony Trisulfide	0.09	0.39		0.00	0.8582	0.08	1,802	162
Barium Chromate	0	0		0.00	1.0000	0.00	-497	0
Barium Nitrate	<0.01	0.02		0.00	0.5867	0.01	-716	-7
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0	0		0.00	0.4107	0.00	2,401	0
Carborundum	0	0		0.00	1.0000	0.00		0
Lead Azide	0.45	1.98		0.00	0.7664	0.34	1,135	511
Lead Thiocyanate	0.13	0.55		0.00	0.6903	0.09	2,097	273
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	20.15	88.61		0.00		0.00	4,126	83,139
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	<0.01	<0.01		0.00		0.00	1,184	12
Tetryl	1.65	7.24		0.00		0.00	5,261	8,681
Lead Styphnate	0.01	0.03		0.00	0.4766	0.00	2,254	23

ITEM 93
M564
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	0	0	0.2559	0.00	0.4050	0.00	264	0
Potassium Chlorate	0.27	1.17	0.2893	0.08	0.4578	0.12	449	121

Total PEP Wt. (grains/fuze)	361.7
Fuze feedrate (fuzes/hr)	440
Total chlorine (lb/hr)	0.08
Total ash (lb/hr)	0.64
Total HV (Btu/hr)	92,915

ITEM 94

M605

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Acetate Resin	0	0		0.00		0.00	10,245	0
Aluminum	<0.01	0.23		0.00	1.8895	0.02	13,312	133
Antimony Trisulfide	<0.01	0.23		0.00	0.8582	0.01	1,802	18
Barium Chromate	0.02	24.75		0.00	1.0000	0.02	-497	-10
Barium Nitrate	<0.01	0.50		0.00	0.5867	0.01	-716	-7
Boron Powder	0	0		0.00	3.2201	0.00	25,143	0
Black Powder	0.05	56.50		0.00	0.4107	0.02	2,401	120
Carborundum	0	0		0.00	1.0000	0.00		0
Lead Azide	0	0		0.00	0.7664	0.00	1,135	0
Lead Thiocyanate	0	0		0.00	0.6903	0.00	2,097	0
Magnesium	0	0		0.00	1.6983	0.00	10,653	0
RDX	0	0		0.00		0.00	4,126	0
Strontium Nitrate	0	0		0.00	0.4896	0.00	-796	0
Tetracene	<0.01	0.11		0.00		0.00	1,184	12
Tetryl	0	0		0.00		0.00	5,261	0
Lead Styphnate	<0.01	1.20		0.00	0.4766	0.00	2,254	23

ITEM 94
M605
(Cont'd)

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Polyvinyl Chloride	0	0	0.5673	0.00		0.00	8,918	0
Potassium Perchlorate	<0.01	5.77	0.2559	0.00	0.4050	0.00	264	3
Potassium Chlorate	0	0	0.2893	0.00	0.4578	0.00	449	0

Total PEP Wt. (grains/fuze)	17.7
Fuze feedrate (fuzes/hr)	32
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	0.08
Total HV (Btu/hr)	292

ITEM 95

BOOSTER
M21A4

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Black Powder	0	0		0.00	0.4017	0.00	2,401	0
Lead Azide	0.22	1.10		0.00	0.7664	0.17	1,135	250
Tetryl	19.97	98.90		0.00		0.00	5,261	105,062

Total PEP Wt. (grains/item)	321.3
Feedrate (items/hr)	440
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	0.17
Total HV (Btu/hr)	105,312

ITEM 96

DETENT

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Black Powder	0	0		0.00	0.4017	0.00	2,401	0
Lead Azide	0	0		0.00	0.7664	0.00	1,135	0
Tetryl	32.14	100		0.00		0.00	5,261	169,089

Total PEP Wt. (grains/item)	10
Feedrate (items/hr)	22,500
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	0.00
Total HV	169,089

ITEM 97

ROCKET MOTOR
MK117, MK118

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Black Powder	9.77	100		0.00	0.4017	3.92	2,401	23,458
Lead Azide	0	0		0.00	0.7664	0.00	1,135	0
Tetryl	0	0		0.00		0.00	5,261	0

Total PEP Wt. (grains/item)	30
Feedrate (items/hr)	2280
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.92
Total HV (Btu/hr)	23,458

ITEM 98

ROCKET MOTOR
MK125-5

Component	MAX lb/hr	MAX % PEP	MAX cl lb/lb	MAX cl lb/hr	MAX Ash lb/lb	MAX Ash lb/hr	MAX HV Btu/lb	MAX HV Btu/hr
Black Powder	9.43	100		0.00	0.4017	3.79	2,401	22,641
Lead Azide	0	0		0.00	0.7664	0.00	1,135	0
Tetryl	0	0		0.00		0.00	5,261	0

Total PEP Wt. (grains/item)	10
Feedrate (items/hr)	6600
Total chlorine (lb/hr)	0.00
Total ash (lb/hr)	3.79
Total HV (Btu/hr)	22,641

C-4

HEATING, VALUE, ASH, AND CHLORINE DATA
FOR MUNITIONS COMPONENTS

TABLE C.2 - Heating Value, Ash, and Chlorine Content Data For Munitions Components

COMPOUND	CHEMICAL FORMULA	MW [a]	ΔH_f, Kcal /mol [a]	COMBUSTION PRODUCTS	MW [a]	ΔH_f, Kcal /mol [a]	Cl lb/lb	ASH lb/lb	HHV Btu/lb
ACETYLENE BLACK	C	12.01100	0.00	C O2	44.0098	-94.0520	0.0000	0.0000	14095
ALUMINUM	Al	26.98154	0.00	AL2 O3	101.9613	-399.0900	0.0000	1.8895	13312
ALUMINUM TRISULFIDE	AL2 S3	150.14308	-121.60	AL2 O3	101.9613	-399.0900			
				S O2	64.0588	-70.9400	0.0000	0.6791	5878
ANTIMONY TRISULFIDE	Sb2 S3	339.68000	-38.20	Sb2 O3	291.4982	-165.4000			
				SO2	64.0588	-70.9400	0.0000	0.8582	1802
ASPHALTUM							0.0000	0.0000	17500
BARIUM CHROMATE	Ba Cr O4	253.33360	-342.20	Ba O	153.3394	-133.0000			
				Cr O3	99.9942	-139.3000	0.0000	1.0000	-497
BARIUM NITRATE	Ba (N O3)2	261.34980	-236.99	Ba O	153.3394	-133.0000	0.0000	0.5867	-716
				(+N2, O2)					
BARIUM STEARATE	Ba(C18 H35 O2)2	704.28660		Ba O	153.3394		0.0000	0.2177	13830 [e]
				C O2					
				H2 O					
BLACK POWDER	74% - K N O3						0.0000	0.4107	2401
	10.4% - S								
	15.6% - C								
BORON POWDER	B	10.81000	0.00	B2 O3	69.6182	-302.0000	0.0000	3.2201	25143
CALCIUM CARBONATE	Ca C O3	100.08920	-289.50	Ca O	56.0794	-151.7000			
				C O2	44.0098	-94.0520	0.0000	0.5603	-787

TABLE C.2 (cont.) - Heating Value, Ash, and Chlorine Content Data For Munitions Components

COMPOUND	CHEMICAL FORMULA	M W [a]	^H f ,Kcal /mol [a]	COMBUSTION PRODUCTS	MW [a]	^H f ,Kcal /mol [a]	Cl lb/lb	ASH lb/lb	HHV Btu/lb
CALCIUM RESINATE	Ca C40 H58 O4 [b]	642.97580	-580.55 [b]	Ca O	56.0794	-151.7000			
				C O2	44.0098	-94.0520			
				H2 O	18.0152	-68.3174 (L)	0.0000	0.0872	14855
CALCIUM SILICIDE	Ca Si2	96.25200		Ca O	56.0794	-151.7000			
				Si O2	60.0848	-202.6200	0.0000	1.8311	6000 [d]
CALCIUM STEARATE	Ca(C18 H35 O2)2	607.02660		Ca O	56.0794	-151.7000			
				C O2	44.0098	-94.0520			
				H2 O	18.0152	-68.3174 (L)	0.0000	0.0924	16040 [e]
CARBON BLACK	C	12.01100	0.00	C O2	44.0098	-94.0520	0.0000	0.0000	14095
CARBORUNDUM	Si C + FUSED ALUMINA						0.0000	1.0000	0
CHARCOAL	C	12.01100	0.00	C O2	44.0098	-94.0520	0.0000	0.0000	14095
DIBUTYLPHTHALATE	C6 H4 (COOC4 H9)2						0.0000	0.0000	13210
DINITROTOLUENE	C7 H6 N2 O4						0.0000	0.0000	8424
DIPHENYLAMINE	C12 H11 N						0.0000	0.0000	16376
ETHYL CENTRALITE	C17 H20 N2 O [b]	268.35780	-31.90 [b]	C O2	44.0098	-94.0520			
				H2 O	18.0152	-68.3174 (L)	0.0000	0.0000	15093
				(+N2)					
GRAPHITE	C	12.01100	0.00	C O2	44.0098	-94.0520	0.0000	0.0000	14095
GUM ARABIC	Complex Carbohydrates						0.0000	0.0000	6840 [d]
HEXACHLOROBENZENE	C6 CL6	284.78400					0.7469	0.0000	3222 [c]

TABLE C.2 (cont.) - Heating Value, Ash, and Chlorine Content Data For Munitions Components

COMPOUND	CHEMICAL FORMULA	MW[a]	^H_f, Kcal/mol[a]	COMBUSTION PRODUCTS	MW[a]	^H_f, Kcal/mol[a]	Cl lb/lb	ASH lb/lb	HHV Btu/lb
H M X	C4 H8 N8 O8						0.0000	0.0000	4252
LACQUER	Nitrocellulose & Solvent						0.0000	0.0000	UNKNOWN
LEAD AZIDE	Pb N6						0.0000	0.7664	1135
LEAD SULFOCYANATE	Pb (S C N)2	323.35540	-5.00[b]	Pb O S O2 C O2 (+N2)	223.1994 64.0588 44.0098	-51.7200 -70.9400 -94.0520	0.0000	0.6903	2097
LEAD STYPHNATE	Pb C6 H3 N3 O9						0.0000	0.4766	2254
LINSEED OIL	Glycerides of Fatty Acids C21 H38 O4 TYP	354.52880					0.0000	0.0000	15292[e]
MAGNESIUM	Mg	24.30500	0.00	Mg O	40.3044	-143.8400	0.0000	1.6583	10653
MAGNESIUM/ALUMINUM ALLOY	Mg2 AL[b]	75.59154	0.00	Mg O AL2 O3	40.3044 101.9613	-143.8400 -399.0900	0.0000	1.7408	11602
NITROCELLULOSE	C6 H7 O5 (NO2)3						0.0000	0.0000	4338
NITROGLYCERIN	C3 H5 N3 O9						0.0000	0.0000	6822
OXAMIDE	N H2 C O C O N H2	88.06580					0.0000	0.0000	4153[f]
P E T N	C5 H8 N4 O12						0.0000	0.0000	3531

TABLE C.2 (cont.) - Heating Value, Ash, and Chlorine Content Data For Munitions Components

COMPOUND	CHEMICAL FORMULA	MW [a]	^H f ,Kcal /mol [a]	COMBUSTION PRODUCTS	MW [a]	^H f ,Kcal /mol [a]	Cl lb/lb	ASH lb/lb	HHV Btu/lb
PHOSPHORUS (RED)	P	30.97376	-4.22	P2 O5	141.9445	-360.0000	0.0000	2.2914	10215
POLYETHYLENE	(C H2)n	n 14.02680					0.0000	0.0000	20000 [a]
POLYVINYL CHLORIDE	(C2 H3 CL)n						0.5673	0.0000	8918
POTASSIUM CHLORATE	K Cl O3	122.54920	-93.50	K O H	56.1053	-102.0200			
				H Cl (g)	36.4609	-22.0630	0.2893	0.4578	449
POTASSIUM NITRATE	K N O3	101.10290	-118.08	K O H	56.1053	-102.0200	0.0000	0.5549	-286
				(+N2, O2)					
POTASSIUM PERCHLORATE	K Cl O4	138.54860	-103.80	K O H	56.1053	-102.0200			
				H Cl (g)	36.4609	-22.0630	0.2559	0.4050	264
POTASSIUM SULFATE	K2 S O4	174.25360	-342.65	K O H	56.1053	-102.0200			
				S O2	64.0588	-70.9400	0.0000	0.6439	-699
R D X	C3 H6 N6 O6						0.0000	0.0000	4126
SILICON CARBIDE	Si C			Si C			0.0000	1.0000	0
SODIUM BICARBONATE	Na H C O3	84.00687	-226.00	Na O H	39.9971	-101.9600			
				C O2	44.0098	-94.0520			
				H2 O	18.0152	-68.3174 (L)	0.0000	0.4761	89
SODIUM SULFATE	Na2 SO4	142.03714	-330.50	Na O H	39.9971	-101.9600			
				S O2	64.0588	-70.9400	0.0000	0.5632	-705
STRONTIUM NITRATE	Sr (NO3)2	211.62980	-233.20	Sr O	103.6194	-140.8000	0.0000	0.4896	-786
				(+N2, O2)					
SULFUR	S	32.06000	0.00	S O2	64.0588	-70.9400	0.0000	0.0000	3983
TETRACENE	C2 H8 N10 O						0.0000	0.0000	1184

TABLE C.2 (cont.) - Heating Value, Ash, and Chlorine Content Data For Munitions Components

COMPOUND	CHEMICAL FORMULA	M W[a]	^H ,Kcal /mol f[a]	COMBUSTION PRODUCTS	MW[a]	^H ,Kcal /mol f[a]	Cl lb/lb	ASH lb/lb	HHV Btu/lb
TETRYL	C7 H5 N5 O8						0.0000	0.0000	5261
TIN DIOXIDE	Sn O2						0.0000	1.0000	0
TRINITRORESORCINOL	C6 H(OH)2 (NO2)3	245.10500					0.0000	0.0000	3294[d]
TRINITROTOLUENE	CH3 C6 H2(NO2)3						0.0000	0.0000	6516[d]
VINYL ALCOHOL ACETATE RESIN (POLYVINYL ACETATE)	(C4 H6 O2)n	n 86.09020					0.0000	0.0000	10245[e]
WAX							0.0000	0.0000	20000
ZINC STEARATE	Zn(C18 H35 O2)2	632.32660		Zn O C O2 H2 O	81.3794		0.0000	0.1287	15400[e]

a = Robert H. Perry, Don Green, 1984, Perry's Chemical Engineers' Handbook, 6th Ed.

b = Private Communication from the Tooele Army Depot to the U. S. Corps of Engineers.

c = U.S. Dept. of Commerce, Guidance Manual for Hazardous Waste Incinerator Permits, PB84-100577.

d = Crane Ammunition Activity List

e = Rex M. Robbins, 1987, Using a Computerized Spreadsheet: Pollution Engineering, p.58.

f = CRC Handbook of Chemistry and Physics, 1988, 68th Ed.

C-5

COMPONENTS MISSING FROM C-4

TABLE C-5

COMPONENT MISSING FROM TABLE C-4

Component	Chemical Formula
Ammonium Nitrate	NH_4N0_3
Barium Carbonate	$Ba(CO_3)2$
Barium Peroxide	BaO_2
Diphenylphthalate	$C_6H_4(COOC_6H_5)_2$
Dichromated Aluminum Powder	$Al(Cr0_7)_3$
Egyptian Lacquer	Unknown
Fuze Powder	Unknown
Laquer	Nitrocellose and solvent (HV-Unknown)
Lead Dioxide	PbO_2
Lead Peroxide	Does not exist
Parlon Chlorinated Rubber	Unknown
Polyvinyl Alcohol	
Strontium Oxalate	$SrC_204 \cdot H_{20}$
Strontium Peroxide	SrO_2
Toludine Red	$CH_3C_6H_3NO_2N_2C_{10}H_5OHCON_7C_6H_4NO_2$ (typ)
Zirconium	Zr

APPENDIX D

CALCULATIONS

APPENDIX D

CALCULATIONS

TABLE OF CONTENTS

D-1 GENERIC FEEDRATE CALCULATIONS

Appendix C lists the 98 identified munitions that will potentially be incinerated in the deactivation furnace. The 98 items are divided into three categories - Group I and II, and Class C.

Group 1 munitions include those items for which chemical composition data are available and feedrates have been established through controlled experimentation by Army personnel. Group II and Class C munitions, however have not had feedrates established experimentally.

This calculation shows generically how the feedrates were determined for group II and Class C munitions. Potential limiting factors include ash content, chlorine content, POHC content, and PEP content.

The following is the step by step procedure for calculating the feed rate.

STEP 1

Calculate the PEP feed rate based on the ash production rate. The ash production rate cannot exceed 22.8 lb/hr.

STEP 2

Calculate the PEP feedrate based on C1 content. The C1 feedrate cannot exceed 2 lb/hr.

STEP 3

Calculate the PEP feedrate based on POHC content. The POHC feedrate cannot exceed 39.8 lb/hr.

STEP 4

Select the lowest feedrate from Steps 1 through 3 and compare it to a PEP feedrate of 100 lb/hr. The lowest of these two values will be the PEP feed/rate.

STEP 5

From the allowable PEP feedrate determined in Step 4. Determine the item feedrate.

Items/Hr = (PEP lb/hr) x (items/PEP-lb)

D-2 MATERIAL & ENERGY BALANCE ASSUMPTIONS AND CALCULATIONS

D-2.1 Assumptions

- Waste compositions are based on the data in Appendix C.
- Fuel composition is typical for No. 2 fuel oil.
- Waste and fuel enter the incinerator at 60°F.
- Air enters at standard conditions of 60°F, 14.696 psia with 70% relative humidity.
- Waste feed rates are based on standard operating procedures (see Section 3).
- Kiln infiltration air flowrate and kiln shell heat loss are based on previous operating experience (Private Communication with J. Clayson, El Dorado Engineering).
- Kiln temperature is minimized by (1) minimizing kiln burner fuel feedrate within the turndown capabilities of the burner, and (2) maximizing kiln burner air flowrate within the same constraints.
- Afterburner temperature is maintained at 1200°F to represent worst case conditions for POHC destruction.
- Afterburner fuel and air feedrates are both maximized (within the constraints of the burner) to achieve maximum combustion gas flowrate for the 1200°F operating temperature.
- Maximum air flowrate to the afterburner is based on burner manufacturer specifications of 1430 scfm with 24 psig air.
- Afterburner heat loss includes heat lost from the kiln-to-afterburner transition duct as well as heat lost through the afterburner shell.
- Heat transfer area for the duct is 350 square feet, based on 55 feet of 24-inch duct.
- Heat transfer area for the afterburner shell is 400 square feet.
- Heat loss is by radiation and natural convection into 60°F still air.
- Duct and afterburner shell emissivities are 0.8, based on oxidized carbon steel.
- Afterburner skin temperature is approximated at 150°F.
- Duct skin temperature is iteratively determined from gas heat loss through the duct, assuming negligible inside gas film resistance to heat transfer.

- Temperatures and pressures downstream from the afterburner are based on typical operating conditions.
- Ash partitioning between gas and bottom ash in the kiln is a rough estimate, as is the particulate loading in the baghouse exit gas. Actual values will be measured during the trial burns.
- Cyclone particulate collection efficiency is unknown. For material balance purposes, all particulate collection is assumed to occur in the baghouse.
- All chlorine in the waste is assumed to be converted to HCl (although much of the Cl may be converted to KCl, in fact).

D-2.2 Calculations

- The calculations for Tests 1 through 10 can be found on the following pages.

Note these calculations will be submitted at a later date.

D-3 TOULENE FEEDRATE CALCULATION

Toulene will be used as a POHC for the final burn. It does not normally occur in any of the waste items, but will be introduced as part of the feed during one of the trial burn tests. This calculation will determine the required feedrate of toluene.

Assumptions:

Desired Toluene sample size:	10 ng/L
Minimum Detectable Sample Size:	0.1 ng/L
Maxiumum Detectable Sample Size:	100 ng
Stack Gas Flow Rate	4000 scfm
Moisture Content	7%
Gas Sample Rate	1 L/min
Gas Sample Volume	20 L
Sample Duration	20 min
Sample Procedure	VOST (Method 0030)

STEP 1 - Calculate POHC concentration in GAS

$$10\frac{ng}{L} \; x \; 10^{-9}\frac{g}{ng} \; x \; \frac{lb}{454g} \; x \; \frac{28.32L}{scf} = 6.24 \; x \; 10^{-10} \; lb/dscf$$

STEP 2 - Correct for 7% moisture

$$= 6.23 \; x \; 10^{-10}\frac{lb}{dscf} \; x \; \frac{(1-0.07dscf}{scf} = 5.80 \; x \; 10^{-10} \; lb/SCF$$

STEP 3 - Calculate emission rate

$$5.8 \; x \; 10^{-10}\frac{lb}{scf} \; x \; \frac{4000scf}{min} \; x \; \frac{60min}{hr} = 1.39 \; x \; 10^{-4} \; lb/hr$$

STEP 4 - Calculate POHC feedrate

$$= 1.39x10^{-4}\ lb/hr\ x\ \frac{1}{1-0.9999} = 1.39\ lb/hr$$

Therefore, Use a nominal feedrate of 1.5 lb/hr.

D-4 SAMPLING DURATION CALCULATIONS

D.4.1 DNT Sample Duration Calculation

Assumptions
Feed item - item 41
DNT Feedrate - 28.80 lb/hr
Sample method - AEHA MM5
DRE - 99.99%
Stack Gas Flow Rate: 4000 scf/min..
Moisture: 7%.
Sample rate: 30 dscf/hr.
Minimum Sample Needed for Detection: 15 ug.
Desired Sample: 50 ug.

Sample Duration - 1hr

STEP 1 Calculate POHC Emission Rate (lb/hr):

POHC Emissions (w/DRE of 99.99%), lb/hr = [POHC Feed Rate, lb/hr X (1 - 0.9999)]

DNT Emissions = 28.80 lb/hr X (1 - 0.9999) = 0.00280 lb/hr.

STEP 2 Calculate POHC Concentration in Stack Gas (lb/scf):

POHC concentration (lb/scf) = [POHC Emission Rate (lb/hr)] / [stack gas flow rate (scf/min) X 60 min/hr].

DNT Conc. = [0.00280 lb/hr] / [4000 scf/min X 60 min/hr] = 1.20 X 10^{-8} lb/scf.

STEP 3 Calculate POHC Concentration corrected for 7% Moisture (lb/dscf):

POHC concentration (lb/dscf) = [POHC Conc. (lb/scf)] X [(1 scf) / (1 - 0.07) dscf]

DNT Conc. (lb/dscf) = [120 X 10^{-8} lb/scf] X [(1 scf) / (1 - 0.07) dscf] = 1.25 X 10^{-8} lb/dscf

STEP 4 Calculate POHC Collection Rate (ug/hr):

POHC Collection Rate (ug/hr) = [POHC Conc. (lb/dscf)] X [Sampling Rate (dscf/hr)] X [453,592,370 (ug/lb)]

DNT Collection Rate (ug/hr) = 0.86 X 10^{-8} lb/dscf X 30 dscf/hr X 453,592,370 ug/lb = 170.7 ug/hr.

Test length requires a minimum of 50 ug sample available in one hour.

Test length needed for DNT = 50 ug/170.7 ug/hr = 0.29 hr.

Therefore, one hour test run will be sufficient.

D-4.2 NG Sample Duration Calculation

Assumptions:

Feed Item - Item 63
NG Feed Rate - 39.7 lb/hr

Other Assumptions - See D.4.1 above

STEP 1 - Calculate POHC Emission Rate (lb/hr):

NG Emissions = 39.7 lb/hr x (1-0.9999)

NG Emissions = .00397 lb/ hr

STEP 2 - Calculate POHC Concentration in Stack Gas (lb/scf):

NG Concentration = [.00397 lb/hr] / [4000 scf/min X 60 min/hr] = 1.65 X 10^{-8} lb/scf

STEP 3 - Calculate POHC Concentration corrected for 7% Moisture (lb/dscf):

NG concentration (lb/dscf) = [1.65 X 10^{-8} (lb/scf)] X [(1 scf) / (1 - 0.07)dscf] =
1.78 X 10^{-8} lb/dscf

STEP 4 - Calculate POHC Collection Rate(ug/hr):

NG Collection Rate (ug/hr) = 1.78 X 10^{-8} lb/dscf X 30 dscf/hr X 453,592,370 ug/lb = 242.0 ug/hr

Test length requires minimum of 50 ug sample available.
Test length needed for NG = 50 ug/242.0 ug/hr = 0.21 hr.

Therefore, a one hour test run will be sufficient

APPENDIX E

SAMPLING TRAINS

APPENDIX E

SAMPLING TRAINS

The sampling trains used for testing of particulate matter, and POHC's are shown in Figures E-1 and E-2. A detailed discussion of each sampling train follows:

E-1 PARTICULATE MATTER SAMPLING TRAIN

The sampling train (see Figure E-1) to be used for sampling of particulate matter is standard EPA Reference Method 5 (RM5) sampling train (40 CFR Part 60). The components of the RM5 sampling train, from inlet to outlet, are as follows:

- Nozzle
- Pyrex[R]-lined probe
- 90-degree connector
- Four-inch filter with glass housing
- 90-degree elbow
- Impinger #1, 100mL of distilled/deionized water
- 180-degree connector
- Impinger #2, 100mL of distilled/deionized water
- 180-degree connector
- Impinger #3, dry
- 180-degree connector
- Impinger #4, silica gel

E-2 AEHA MM5 SAMPLING

The sampling train to be utilized during NG and DNT testing is another modification of the RM5 discussed above and is referred to as an AEHA MM5 sampling train (Figure E-2). The AEHA MM5 sampling train is the same as the RM5 sampling train from the sampling nozzle to the third impinger except that in the AEHA MM5, the first impinger initially contains 50mL of distilled/deionized water to be used as a spiking medium, while impingers two and three are initially dry. Following the third impinger, there is a vertically oriented resin tube, a 180-degree connector, and a vertically oriented return flow tube which directs the gas

[R] Pyrex is a registered trademark of Corning Glass Works, Houghton Park, Corning NY.

flow to the fourth impinger. The resin resin tube is packed with 20 grams of XAD-2 resin in four 5-gram sections each separated by glass wool. Each end of the resin tube is plugged with glass wool to hold the resin in place. The resin tube and the return flow tube will be housed in a dry compartment to avoid potential water migration through glassware connections. The fourth impinger is also initially dry while a fifth impinger contains silica gel. Components are listed below.

- Nozzle
- Pyrex-lined probe
- 90-degree connector
- Four-inch glass-fiber filter
- 90-degree connector
- Impinger #1, dry (50mL of d/d water for spiking medium)
- 180-degree connector
- Impinger #2, dry
- 180-degree connector
- Impinger #3, dry
- 180-degree connector
- XAD-2 resin tube (vertical orientation)
- 180-degree connector
- Straight glass tube
- 180-degree connector
- Impinger #4, dry
- 180-degree connector
- Impinger #5, silica gel

E-3 SPIKING PROCEDURES

A solution for a field surrogate spike of the sampling train will be prepared by the analytical laboratory. In the event of multiple POHC's, the sampling train will be spiked with a surrogate for each of the specified POHC's. The project engineer will determine the level of this spike and supply that value to the laboratory. To calculate the spike level, the project engineer must determine the quantity of the target compound captured by the sampling train in the sampling period for the case of the lowest quantity captured (e.g., highest DRE legitimately possible for the incinerator). The spike level will be at least four times this quantity. For example, assume for the case of an incinerator, the quantity of the target compound captured in a one-hour period at 99.99 percent DRE is 50 ug. The minimum spike level will be 200 ug, 4 times the 50 ug level. When the sampling train is assembled, 50 ml of deionized water will be added to the first impinger to support a field spike. Half of the calculated spike level should be on the first resin section, placed there by direct injection, while the other half of the spike level will be in the 50 ml of water in the first impinger. The spike level for the entire train will not exceed 1000 ug.

E-4 SAMPLING PROCEDURES

The actual sampling operations for all sampling trains will be conducted using [R] Chem-Solv the standard RM5 sampling procedure as described in 40 CFR Part 60. The RM5 procedures will be utilized for pretest and post-test leak checks, isokinetic sampling rate, and filter changes.

E-5 SPECIAL CONSIDERATIONS

In the sampling trains discussed above, the probe and filter housing will be assembled in a normal RM5 sampling box to allow heating of both the probe and the filter to 248°F +/- 25°F. The impingers will be packed in an ice bath to provide the necessary cooling of the gas sample. The resin tube and the return flow tube of the AEHA MM5 will be housed in a dry compartment to avoid potential water migration through glassware connections.

E-6 CLEANUP REQUIREMENTS

E-6.1 Reference Method 5 Sampling Train

The glass ware for the RM5 sampling train will be cleaned using soapy tap water and brush, when necessary, to remove any visible residue. The glassware will then be rinsed thoroughly with tap water before being placed in a sonic bath containing distilled/deionized water and Chem-Solv[R]. Following sonication, the glassware will be rinsed with distilled/deionized water and is allowed to air dry before being used.

E-6.2 AEHA Modified Method 5

(a) Glassware Cleanup. Cleanup of the AEHA MM5 glassware will be as follows: All glassware prior to the resin module will be rinsed with acetone to remove any contaminants from previous runs which may adhere to the glassware. The glassware will then be placed in a sonic bath containing distilled water and Chem-Solv[R]. Following sonication, the glassware will be rinsed with distilled water and is allowed to air dry.

(b) Resin Cleanup. XAD-2 resin will be purchased in a purified form (previously cleaned by Soxhlet extraction). If the need for cleaning resin arises, the procedures recommended in method 0010 of US Environmental Protection Agency Publication No. SW-846 Appendix A will be utilized. (This guidance lists two acceptable methods 1 and 2, which method is actually used will be determined by the selected laboratory.)

[R]Chem-Solv is a registered trademark of Mallinckrodt

APPENDIX F

ANALYTICAL PROCEDURES

APPENDIX F

ANALYTICAL PROCEDURES

TABLE OF CONTENTS

APPENDIX F

ANALYTICAL PROCEDURES

F-1 SAMPLE RECOVERIES AND ANALYTICAL PROCEDURES

F-1.1 Reference Method 5 Sampling Train

Particulate Matter Recovery and Analysis. The RM5 sampling train was described in Appendix E. Particulate matter will be collected from two sections of the RM5 sampling train as follows.

a. The first section to be recovered will be the sampling nozzle, the sampling probe, 90-degree elbow and front half of the filter housing. The probe and nozzle are rinsed three times with acetone with the rinses collected in a glass sample container. Following each rinse, the inside of the probe will be swabbed with a probe brush. The probe brush will be flushed with acetone (which will also be collected) following the final rinse. The probe wash will then be transported to the laboratory where the 90-degree elbow and the front half of the filter housing will be rinsed with acetone. These rinses will be added to the probe wash and the total sample volume will be measured. The sample will then be placed in a pre-weighed beaker and the acetone will be evaporated. The beaker will then be desiccated and weighed to a constant weight.

b. The second section to be recovered will be the glass fiber filter. The filter will be removed from the filter housing and will be placed in a petri dish. The glass fiber filter (which was desiccated and weighed prior to use) will then be desiccated and weighed to a constant weight.

c. The total particulate collected will be calculated by subtracting an acetone blank weight from the weight gained by the tared beaker and summing this adjusted weight with the weight increase of the filter for an individual test.

d. The impingers will be weighed before and after each run to determine the amount of moisture collected.

F-1.2 AEHA Modified Method 5 Sampling Trains

DNT and NG Recovery and Analysis. Recovery of the AEHA MM5 sampling train is summarized in Table F-1 and is discussed in the following paragraphs.

a. The AEHA MM5 sampling train was described in detail in Appendix E and for sample recovery procedures has three major sections. The first section is the filter and all components preceding it. The second major section starts with the back half of the filter housing and includes everything following it (three impingers and connecting glassware) up to the resin tube. While there is a return flow tube and two impingers following the resin tube, their sole function is to direct the gas flow and to remove moisture, respectively, and will not be analyzed for POHC. The third major section is the resin tube itself.

b. The initial sample recovery starts outside the field laboratory as the train is partially disassembled. The filter housing and the 90-degree elbow are removed intact and are capped off on each end before transporting them to the field laboratory. The remainder of the sampling train (impingers and resin tube) are disassembled and capped off before being transported intact to the field laboratory. The probe liner is rinsed with solvent (toluene) which is collected in a sample container. The sample container is sealed and returned to the field laboratory.

c. In the field laboratory, each of the impingers are weighed prior to further organic recovery steps in order to determine the exhaust gas moisture content. Once weighing is completed, the condensate is collected and each of the first three impingers and their associated connecting glassware are rinsed with distilled/deionized water. The rinse and condensate are combined and extracted three times (by separator funnel shakeout) with solvent. Solvent volumes are based on the total water volume to be extracted (4:1 water:solvent), but will not exceed 75mL. The first two extractions are completed at neutral conditions while the water is slightly acidic for the third extraction (acidified by addition of sulfuric acid).

d. The resin module is recovered in sections with each section generating three samples. Each section has 30 mL of toluene added to it and then receives mechanical shakeout procedures. After 30 minutes of shakeout, 10 ml of toluene is removed and becomes the first sample extract. Another 10 mL of toluene is added to the original sample containing the resin and receives another 30-minute mechanical shakeout. Another 10 mL of toluene is removed and becomes the second sample extract. Again, 10 mL of toluene is added back the original sample and receives another 30-minute shakeout. Following the third shakeout, the resin and solvent are left combined and become the third extract.

e. The last recovery procedure involves the filter and all preceding train components (front half of the filter housing, 90-degree elbow, and probe wash). The front half of the filter housing and the 90-degree elbow are rinsed with toluene. This rinse is combined with the previously collected toluene probe rinse. The glass fiber filter is recovered and immersed in the toluene rinse. Following some shaking, this sample is allowed to stand for a minimum of 24 hours before analysis.

F-1.3 Ash Samples

a. To determine a mass balance of POHC, all ash residue will be collected from the incinerator, gas coolers, cyclone and baghouse. Each unit will be cleaned as much as possible and the total quantity of ash will be determined for each unit. Ash samples will be extracted by shakeout extraction techniques and the resultant solutions will be analyzed by either GC-ECD or GC/MC, depending on POHC concentration in the sample. This analysis will yield POHC concentrations and, subsequently, the total mass of POHC in the ash.

b. TCLP tests will also be performed on the ash samples.

c. If adequate ash samples are available, two sources of ash will be subject to the required tests: kiln ash and APCS ash. If the quantity of ash is limited, then a composite sample will be prepared by combining all ash collected for the same feed item.

TABLE F-1

AEHA MM5 SAMPLE RECOVERY

Train Component	Recovery Procedure	Analysis Parameters
	STEP A	
Nozzle, probe and front half of filter housing	1. Rinse with toluene and then with acetone; 2. Retain for use in Step B; 3. Analyze acetone rinse by GC for NG or DNT;	NG/DNT
	STEP B	
Filter	1. Remove the filter from the filter housing; 2. Place the filter in the toluene from STEP 1; 3. Analyze by GC for NG or DNT;	NG/DNT
	STEP C	
Impingers 1, 2 and 3	1. Weigh for moisture gain; 2. Collect impinger solutions as one sample; 3. Rinse all impingers and all connections, starting with the back half of the filter housing, with distilled/deionized water; 4. Combine rinses from 3 with the solution from 2 and extract three times with toluene; 5. Analyze by GC for NG or DNT; 6. Rinse all glassware again with acetone and analyze the rinse by GC for NG or DNT;	Moisture DNT/NG
	STEP D	
XAD-2 resin tube	1. Weigh for moisture gain; 2. Remove resin from tube (in separate sections and rinse tube with toluene into the fourth resin section sample; 3. Extract each section three times with toluene; 4. Analyze by GC for NG or DNT;	Moisture NG/DNT

TABLE F-1
(Cont.)

Train Component	Recovery Procedure	Analysis Parameters
Impingers 4 and 5	STEP E 1. Weigh for moisture gain; 2. Discard solutions and reclaim silica gel.	Moisture

F-2 MEMORANDUM OF EPA ACCEPTANCE OF AEHA MM5

Attached is a memorandum of EPA acceptance of thw AEHA MM5 Procedure.

APPENDIX G

QA/QC PROCEDURES

APPENDIX G

QA/QC PROCEDURES

Appendix G, QA/QC Procedures, will be revised in its entirety.

APPENDIX H

AMMUNITION TERMINOLOGY

APPENDIX H

AMMUNITION TERMINOLOGY

1. API — Designation of an armor-piercing incendiary munition which is designed to penetrate armor and destroy the target by fire.

2. AP-T — Designation for armor-piercing munition designed to penetrate armor which has a tracer added to aid the gunner in following the projectile path to the target.

3. Booster — A component of an explosive train which, by exploding, amplifies the action of the detonator providing the initiating force necessary for the explosion of the burster or main charge.

4. Cartridge (CTG) — Complete small arms munition containing a propellant, primer, and projectile, and in some cases, an incendiary or tracer component.

5. Detonator — A component of an explosive train which amplifies the action of the primer and provides the initiating force necessary to explode the booster.

6. Explosive Train — A sequence of components in a munition which are designed to generate an explosion and/or flight of a projectile. For example, in the cartridges listed previously, the primer is activated by percussion and/or an electrical charge. The combustion of primer ignites the propellant which, by its action, propels the projectile toward the target. The projectile may also contain incendiary and tracer components. In larger munitions, the explosive train is started by the activation of a fuze containing a primer. The primer combustion causes the detonator to explode. The explosion of the detonator amplifies the force of the primer combustion and causes the booster charge to explode. The booster charge explosion activates the burster and/or the main charge.

7. Fuze — Component of ammunition which, when activated, initiates the explosive train reaction.

   TYPES
   PD Fuze: Point-detonating fuze, located on front of the projectile, and is activated by impact and/or time.

   BD Fuze: Base-detonating fuze, located at the rear of the projectile and is activated after impact with the target.

   MTSQ Fuze: Mechanical time-super quick fuze, fuze has a mechanical linkage and various time setting for detonation

8. HEI — Designation for a high explosive incendiary munition designed to destroy a target by fire and explosion.

9. HEI-T — Designation for a high explosive incendiary munition with a tracer added to aid the gunner in following the projectile path to the target.

10. HV-TP-T	Designation for a high velocity, target practice munition with a tracer added to aid the gunner in following the projectile path to the target.
11. Igniter	Portion of the rocket motor which causes the ignition of the propellant.
12. INC	Designation for an incendiary munition designed to destroy a target by fire.
13. Incendiary	Mixture of chemical compounds contained in a projectile designed to burn and destroy a target by fire.
14. Primer	Component of a munition containing a small amount of sensitive high explosive which starts the explosive chain reaction by rapid combustion.
15. Propellant	A chemical mixture designed for rapid combustion with a large evolution of gas which used to propel a projectile out of the weapon.
16. Rocket Motor	The propellant portion of a rocket munition.
17. TP-T	Designation for a target practice munition with a tracer added to aid the gunner in following the projectile path to the target.
18. Tracer	Mixture of chemical compounds contained in a projectile designed to burn and produce color and light.

APPENDIX I

RESPONSE TO *DEC* COMMENTS

SENECA ARMY DEPOT (SEAD)
EPA ID# NY0213820830
TRIAL BURN PLAN
COMMENT RESPONSES

1.0 INTRODUCTION

Comment #1 Page 1-1, second paragraph: Please include the HC1 emission standard as part of the performance requirements described on page 1-1.

Response #1 *Page 1-1 has been modified to include the HC1 emission standard.*

Comment #2 The regulations and EPA and NYSDEC guidance require that the trial bum also demonstrate that emissions of metals and products of incomplete combustion (PICS) do not exceed acceptable limits. These must be added to the trial burn and should also be listed in this paragraph.

Response #2 *PICs will be addressed by the installation of a THC analyzer, which will measure and record hydrocarbon emissions during the trial burn.*

MAIN has revised Tables 3-1 through 3-4 to include the feed rates of metals and metal compounds to the deactivation furnace. These rates do not include rates associated with projectiles and casings.

MAIN recommends that metals emissions be reviewed based on volume IV of the hazardous waste incineration guidance series entitled "Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators", dated August 1989 and other applicable documents. ***This is currently outside MAIN's scope of work.***

Comment #3 In addition, the slow passage of combustion gases through relatively low temperatures that might occur in the low temperature gas cooler (350°F) might be conductive to the formation of dioxins and furans. If materials containing significant hydrocarbon and chlorine is ever expected to be incinerated, it would also be necessary to test for dioxins and furans in the emissions and discharges.

Response #3 *MAIN recommends that dioxins and furans be tested as part of the trial burn. Section 4, 5 and 6 have been revised to include dioxin and furan testing. This will also require the establishment of testing and analytical protocols, potential equipment modifications and a QA/QC plan.* ***This is currently outside MAIN's scope of work.***

2.0 ENGINEERING DESCRIPTION

2.2 Description of Major Components

Comment #4 2.2.1 Throughout the application, SEAD has maintained that fugitive emissions will be controlled by keeping the kiln pressure below atmospheric. This does not appear to be the case. The model 1236 APE Rotary Kiln Incinerator is commonly referred to as a "popping furnace" namely because of the popping sound that occurs periodically due to sudden explosions of munitions within the kiln. This in turn causes a sudden increase in pressure inside the kiln above atmospheric pressure. Fugitive emissions from the combustion zone must be controlled by keeping the combustion zone totally sealed against fugitive emissions (which is virtually impossible), maintaining a combustion zone pressure lower than that of atmospheric, or by some equivalent alternate means of control. If SEAD still maintains that fugitive emissions will be controlled through negative pressure, describe how, where, and with what instrument that this pressure will be measured. Operation of the kiln above-0.08 in. wc (below atmosphere) with munitions in the combustion chamber will not be permitted. In addition, please provide information on how the shroud will work to prevent fugitive emissions from the discharge end of the conveyor (i.e., shrouding). This area must be enclosed with the exhaust emissions from the enclosure entering an appropriate air pollution control unit prior to discharge to the environment.

Response #4 *The kiln pressure is controlled by a pressure control loop (P-1201) as shown on SK 88-07 and described in the text.*

MAIN contacted Bob Anderson at the Toelle Army Depot. Fugitive emissions from the discharge end of the deactivator furnace is not an issue according to Bob. This is based upon operating experience as well as trial burns at other locations. Areas where fugitive emissions were a problem in the past, (the inlet conveyor and the kiln itself) have been modified to include a shroud.

The volume of the furnace is very large in comparison to the volume of gas associated with the detonation of a munition. If the furnace is operated properly, detonation occurs in the mid section of the kiln. The over pressurization shock wave dissipates before it can exit the furnace at the discharge end.

MAIN will incorporate Bob Anderson's comments in the trial burn plan. However, this argument may not satisfy DEC concerns. It is recommended that fugitive emissions in this area be monitored during the trial burn. If emissions occur, steps could be initiated at that point to solve the problem prior to operation. Alternatively particulate emissions could be controlled by construction of an additional shroud over the discharge end of the conveyor. ***MAIN seeks additional guidance from SEAD in this area.***

Comment #5 The last paragraph regarding the Automatic Waste Feed Monitoring System (AWFMS) must reference the map from the application labelled SK89-09-01. Figure 2.2 does not provide the necessary details. In addition, map SK89-09-01 references several other maps corresponding to the same series (i.e., SK89-09-02, SK89-09-03, etc...). None of these maps were found. Please include them with the revised application.

Response #5 *The paragraph has been revised to reference SK89-09-01. SK89-09-01 through 20 will be included in the RCRA Part B Submittal.*

Comment #6 2.2.2 Annex A consists of a series of maps showing engineering drawing details pertaining to the APE 1236 Rotary Kiln Incinerator. The maps are reduced copies of the original engineering drawing provided and are, for the most part, no longer readable. In addition, some represent the deactivation furnace at Toelle Army Depot (TEAD). Please omit Annex A from the TBP and present all engineering details by referencing the original maps provided with the application. Be sure to revise this throughout the entire TBP.

Response #6 *Annex A will be deleted. All appropriate drawings that relate to the trial burn will be included in the RCRA Part B submittal.* ***MAIN has requested several drawings from SEAD that have not yet been received.***

Comment #7 The full size engineering drawing ACT-377-200 as for the burner and blower assembly was not provided with the application. The reduced drawing in Annex A is unclear. Please provide the full size drawing with the revised application.

Response #7 *A full size drawing will be provided as part of the RCRA Part B submittal.* ***This drawing is required from SEAD.***

Comment #8 The minimum kiln temperature is stated to be 300 degrees Fahrenheit on page 2-6 of the Trial Burn Plan. Several munitions listed in Table 3-1 give the minimum kiln temperature to be 250 degrees Fahrenheit. Please revise where appropriate.

Response #8 *For the waste that will be treated 300°F is correct.*

Comment #9 Page 2-7; The information provided on the kiln speed versus the kiln residence time is based upon testing conducted at TEAD. Are the dimensions of the rotary kiln at SEAD exactly the same as the rotary kiln at Toelle? Please revise this information to omit reference to TEAD and making any necessary changes to the table provided to correspond to the rotary kiln incinerator at SEAD.

Response #9 *TEAD's deactivation furnace is identical to SEAD's. The reference has been revised to note this similarity.*

Comment #10 2.2.3 Details of the afterburner are shown on the Southern Technologies drawing 11268-10-3, not 11268-10-1. Please revise.

Response #10 *Incorrect. Details are shown on 11268-10-1 not 11268-10-3. 10-3 shows elevations not details. Both drawings will be included in the RCRA Part B submittal.*

Comment #11 Describe in the text of this section the purpose of the FSG panel. What do the letters "FSG" stand for?

Response #11 *FSG stands for Flame Safeguard Panel. A description of the function of the FSG will be included in the text.*

Comment #12 2.2.4 Please indicate how and where the high temperature and low temperature gas cooler exit temperatures will be measured.

Response #12 *A description will be provided and locations shown on the appropriate figures or drawings. Figure 6.1 which may show the locations is missing and has been requested from SEAD.*

Comment #13 2.2.6 Please provide the engineering drawing showing the design details of the cyclone.

Response #13 *Attempts will be made to obtain drawings from the vendor.* ***However, MAIN may not be able to satisfy this requirement.***

Comment #14 2.2.7 Please provide the engineering drawing showing the design details of the baghouse.

Response #14 *Attempts will be made to obtain design drawings from the vendor.* ***However, MAIN may not be able to satisfy this requirement.***

Comment #15 Describe at what differential pressure the jet-pulse cleaning system in the baghouse would begin to operate.

Response #15 *The jet pulse cleaning system operates with variable timer and duration controls and is not based on differential pressure. Differential pressure, however is monitored and alarmed. Baghouse dp is maintained between 2" and 6" of water. Less than 2" would indicate a broken bag condition will greater than 6" indicates excessive fouling. This is described in Section 2.2.7.*

Comment #16 Describe at what temperature at the baghouse exist would the control panel alarm sound.

Response #16 *The baghouse temperature alarm is set for a fire condition.* ***The set point temperature for this alarm has been requested from Bob Anderson.*** *The temperature of the baghouse is controlled by the low temperature gas cooler, which maintains a gas exit temperature of 350°F. This results in a Baghouse temperature of approximately 300°F. The low temperature gas cooler also has a high exit temperature alarm.* ***The set point for this alarm will also be provided by Bob Anderson.***

Comment #17 Page 2-14; top of page: "...waste feed can not be fed if baghouse is bypassed? How is this compatible with the "c" which says baghouse will be bypassed during start-up? Is non-hazardous fuel fed during start-up? Please address.

Response #17 *Section 2.4 describes start-up procedures. The baghouse is only bypassed prior to waste feed. During startup, No. 2 fuel oil is used until the deactivation furnace reaches its operations temperature, at that point the baghouse is brought on-line, and then and only then, is waste feed to the furnace.*

2.3 Instrumentation

Comment #18 The continuous monitoring system must be installed and operational prior to conducting the trial burn. Verification of operational status should include completion of the manufacturer's written requirements or recommendations for installation, operation, and calibration of the device. In addition, include as part of the Trial Burn Plan the protocol for the 168 hour Performance Specification Test (PST) for the CO and O_2 monitors.

The PST requires relative accuracy (RA) tests, calibration error (CE) tests, calibration drift (CD) tests, and response time (RT) tests to be conducted to determine conformance of the CEMs with the specification. These procedures are outlines in Appendices B and F, respectively, of 40 CFR 60. Please indicate on the test schedule when these performance tests are planned. A protocol for the PST must be submitted to this office, 60 days before the scheduled date of monitor performance testing. The protocol must include exact monitor locations, monitor model and serial numbers, together with a description of the entire Continuous Emission Monitoring System. Keep in mind the tests are to be complete 120 days prior to the trial burn with a written result of the results prepared and submitted to the Department for its approval prior to the trial burn. Be sure to list these activities on the Trial Burn schedule in Table 8.1.

Response #18 *No PST was included in the original trial burn plan. However, the submittal of a PST is required for the acceptance of the trial burn plan.* ***Preparation of the PST is currently outside MAINs scope of work.***

Comment #19 Include a QA/QC Plan for the operation of the continuous emission monitors during the trial burn period. It is the responsibility of the owner/operator to assure proper calibration, maintenance, and operation of the CEM on a continual basis. Include guidelines on daily calibration of monitors, in addition to guidelines on the daily inspection of calibration data, the recording system, the central panel warning lights, and sample transport/interface systems (e.g., flowmeters, filters, etc...), as appropriate.

Response #19 *No QA/QC Plan for the CEM system was included in the original trial burn plan. However, the submittal of a QA/QC Plan is required for the acceptance of the trial burn plan. Preparation of the QA/QC Plan is currently outside MAINs scope of work.*

Comment #20 2.3.1 Page 2-16: The CO monitor must have dual ranges, 0-500 ppm and 0-3000 ppm. This will ensure that spikes up to 3000 ppm are included in the rolling average. If the monitor only had a 500 ppm range, it would be impossible to have the 500 ppm 10 minute rolling average trip.

Response #20 *The CO monitor is a dual range device with a 0-200 ppm and a 0-3000 ppm range. The text has been revised accordingly.*

Comment #21 2.3.2 Page 2-17, Paragraph 2; Reference engineering drawing SK88-07 in the description of the process controllers.

Response #21 *The reference has been included.*

Comment #22 2.3.3 For clarity, the subsection regarding the AWFMS should be labelled 2.3.3 instead of 2.3.2. Please correct.

Response #22 *The text has been revised accordingly.*

Comment #23 Page 2-20, Table 2.1: The maximum kiln pressure must be changed to -0.08 in. wc (below atmospheric).

Response #23 *The table has been revised accordingly.*

Comment #24 Page 2-20, Table 2.1, Note 1: The second sentence must be corrected to read "Waste feed is shut off when the rolling average of the CO corrected for O_2 on a dry basis is above 100 ppm. The waste feed can only be restarted when the rolling average drops below 100 ppm."

Response #24 *The table has been revised accordingly.*

Comment #25 Page 2-21, Table 2.2: The status of the Baghouse Bypass must be recorded.

Response #25 *The baghouse states (on-line versus standby) is recorded in the internal memory of computer control system. This information is not normally printed but can be easily retrieved if required.*

2.4 Operating Procedures

Comment #26 2.4.3 Page 2-23, Section 2.4.3: A separate section must be included for the emergency AWFSO procedures. This section seems to imply that the procedures listed here happen simultaneously if the AWFSO systems trips the waste feed. This should not be the case as, at a minimum, kiln and afterburner temperature must be maintained until all waste is out of the kiln. When waste feed is to be restarted, it must always be restarted by the operator, not automatically. In another separate section, those events that will cause the opening of the baghouse bypass must be discussed.

Response #26 *Section 2.4.3 has been revised to clarify shutdown procedures. A new separate section which discusses baghouse bypass scenarios is included in the TBP.*

Comment #27 2.4.4 Please provide details on the inspection of the scrap metal and residue from the demilitarization operation used to determine whether or not reprocessing is required. Discuss the conditions under which reprocessing will occur. To avoid this situation, SEAD may need to consider changes in operating procedures such as an increase in combustion chamber temperature or greater residence time.

Response #27 *For the purpose of the trial burn, scrap metal, residue, ash from the baghouse, ash from the gas coolers and all other waste solids will be treated as a hazardous waste.*

3.0 WASTE CHARACTERIZATION

Comment #28 Munitions that are not characterized can not be incinerated. This includes munitions for which the composition, ash content, chlorine content, metal content, and feed rate has not yet been determined. It would be in SEAD's best interest to determine this information prior to the TB in order for appropriate limits to be established.

Response #28 *SEAD will not burn any waste which is not characterized. Tables 3-1, 3-2, and 3-3 have been revised to remove uncharacterized wastes. However, DEC has also requested information on casing and projectile compositions be included.* ***MAIN is awaiting guidance from SEAD on this issue. Inclusion of this data is not in MAIN's scope of work.***

Comment #29 Table 3-1; The chlorine content per pound of munition M66A2 is incorrect. Please correct table.

Response #29 *The table has been revised accordingly.*

Comment #30 Table 3-1; The Department has the authority to establish permit requirements necessary to protect human health and the environment. This includes controls on metal emissions and HC1 not to exceed health-based levels consistent with EPA "Guidance on Metals and HC1 Controls for Hazardous Waste Incinerators", August 1989. SEAD must provide the Department with metal feed rate data (e.g., lb metal/lb munition feed) in order to demonstrate compliance with all NYS hazardous waste and air regulations, State Air Guide-1 (proposed 1991 edition), as well as all applicable state and EPA guidance. Please revise Table C-1 to reflect this change. Keep in mind that determination of compliance with both the metal and HC1 standards considers such factors as stack height and other release specifications, as well as the effect of variability in meteorology and terrain (updated USGS map required). Include this information in the appropriate sections of the TBP.

Response #30 *Metal feed rates have been included in revised tables in Section 3. These feed rates will be used to determine the components that will be selected for the trial burn. Air Guide -1 and volume IV of the hazardous waste incineration guidance series entitled "Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerator" dated August 1989 have been reviewed. Based on this review an air permit, air emission modelling and a risk assessment will be required.* ***These Items are not currently In MAIN's scope of work.***

Comment #31 Table C-1 in Annex C of the TBP contains a listing of the composition of the various munitions incinerated as SEAD. The data (i.e., munition name, numbers of munition, etc..) presented do not correspond to the data presented in Tables A-1, A-2, and A-3 of Appendix A of the incinerator/storage portion of the application. Please explain and revise accordingly.

Response #31 *Appendix A and Annex C of the trial burn will be revised to correlate.*

Comment #32 Table 3-4 lists munitions components that SEAD has proposed to occasionally burn. SEAD must provide information on feed rates, ash, chlorine, and metal content for those materials that were not included in Annex C. SEAD must also revise the list to eliminate the use of trade names.

Response #32 *Table 3-4 has been deleted. No uncharacterized munitions will be destroyed in the deactivation furnace. An attempt to correlate trade names to chemical compounds will be made.*

Comment #33 It appears several of the waste streams would be potential producers of high metals, ash, and/or chlorine emissions, and these cases are not necessarily covered by the proposed trial burn. Lead compounds and other metals pose problems, as well as chlorine compounds, such as hexachlorobenzene, polyvinylchloride, chlorates and perchlorates. In addition, sulfur and nitrogen present in the waste pose problems. How will the sulfur dioxide emissions be managed in the case of aluminum or antimony trisulfide, for example, and for sulfur? How will nitrogen dioxide emissions be manage din light of significant amounts of nitrated compounds in the waste? These cases are not adequately covered in the trial burn plan. Please revise.

Response #33 ***Sections 4.0 and 5.0 have been revised to address these concerns. Some issues, such as Air Permits, Air Modeling, the development of test procedures, etc. are outside of MAIN's scope of work.***

4.0 TRIAL BURN WASTE SELECTION

Page 4-1, Section 4.1 should reflect the concerns described in comments 1.0 and 3.0, comments 3 and 6.

4.2 POHC and Waste Feed Item Selection

Comment #34 SEAD has selected two Principle Organic Hazardous Constituents (POHCs) to be measured during the Trial Burn in the determination of the Destruction and Removal Efficiency (DRE) based solely upon heats of combustion. The two compounds [nitroglycerine (NG) and dinitrotoluene (DNT)] have lower heats of combustion compared to the other available candidates, but relatively high heats of combustion in terms of the Appendix 23 constituents listed in Part 373-1. Based upon experimental data conducted at the University of Dayton Research Institute (UDRI) regarding the development of an appropriate ranking system the selection of just NG and DNT as the most difficult to incinerate based solely on heats of combustion may not be appropriate. The selection of the POHC's should encompass both heat of combustion and low oxygen thermal stability hierarchies. Therefore, SEAD should select a POHC from the thermal stability at low oxygen ($TSLoO_2$) index presented in EPA "Guidance on Setting Permit Conditions and Reporting Trial Burn Results", January 1989. One of the compounds found in the munitions, hexachlorobenzene, is rated as one of the compounds most difficult to destroy, Class 1. If Seneca Army Depot desires to treat wastes in this class, or any class, then SEAD must demonstrate during the trial burn the incinerator's ability to destroy a constituent contained in that particular class or higher.

Response #34 *Section of POHC will be based upon research conducted by UDRI as presented in Volume II of the hazardous waste incineration guidance series entitled "Guidance on Setting Permit Conditions and Reporting Trial Burn Results", dated January 1989.*

Comment #35 Metals emissions must be determined. During the trial burn, the kiln and afterburner must be operated at their maximum temperatures. In addition, the waste feed must contain the maximum metals and maximum organo-metallics. If small arms ammunition will be destroyed, please address the presence of lead.

Response #35 *The trial burn protocol has been revised so that metals are included.*

Comment #36 Will any of the munitions contain radioactive materials?

Response #36 *No munition that will be treated in the deactivation furnace are radioactive.*

Comments #37 Page 4-2: Current EPA guidance concerning metals emissions requires special monitoring of organo-metallic compounds. Organo-metallics will need to be addressed in the trial burn.

Response #37 *The trial burn protocol has been revised to include organo-metallic compounds.* ***Developing sampling procedures, etc. is outside MAIN's scope of work.***

4.3 Particulate Feed Item Selection

Comments #38 The particulate size distribution of the metals involved should be determined in order to estimate the performance of the cyclone and the Nomex filter media in the air pollution control equipment. The presence of gaseous metallic compounds and their control should also be discussed.

Response #38 *Particulate size distribution will be determined as part of the trial burn. Protocols for sampling and analyses would require development in accordance with state and federal regulations and applicable guidance documents.* ***This is currently not in MAIN's scope of work.***

4.4 HCl Considerations

Comment #39 See 3.0, Comment 3. In addition, munitions M26 and M81 contain potential chlorine feed rates close to the 4 lb/hr limit. The slightest error in feeding these wishes could put the facility out of compliance.

Response #39 *The feed rates of munitions M26 and M81 (and other munitions) will be reduced so that the nominal chlorine feed rate does not exceed 2 lb/hr.*

5.0 TRIAL BURN PROTOCOL

Comment #40 Page 5-1: Please discuss why tests 2 and 3 cannot be combined into one test.

Response #40 *The trial burn protocol has been revised in its entirety.*

Comment #41 Page 5-2, Table 5.2: Please discuss the waste feed rate in greater detail, including the size of individual units to be introduced, and the frequency.

The trial burn must show DRE with the largest size packages.

Response #41 *The trial burn protocol has been revised in its entirety. In the revised Section 5.0, the items mentioned above have been discussed in greater detail, than was presented in the previous submittal.*

Comment #42 Table 5-2; The feed rates of each munition to be burned during the trial burn was not included in the operations summary table. Please revise the table to include a listing of each munition and their potential feed rates.

Response #42 *The revised table includes the feed rate of all the munitions selected.*

Comment #43 Annex D - Calculations. Explain why the DNT component feed rate is 19.2 lbs DNT/hr per 240 lbs of munition M1 in Annex D and 28.8 lbs DNT/hr per 240 lbs of munition M1 in Table 3-1. Please revise where appropriate.

Response #43 *This calculation has been revised.*

Comment #44 Table 5-2; Please state in the "Trial Burn Operations Summary" that for each test case to be performed, three runs will be held.

Response #44 *The revised table includes three runs for each test performed.*

6.0 SAMPLING AND ANALYSIS PLAN

Comment #45 6.1 Overview

Page 6-2, Table 6.1: Testing for chlorine, HCl, metals, PICs and possibly dioxins/furans in emissions and discharges using worst case waste feeds must be added as explained in comments 1.0, 3.0 comments 3 and 6, and 4.2 comment 2. It should also be made clear that samples from different runs are not composited.

Response #45 *Metals, PIC's, and dioxins/furans will be addressed in the trial burn. Testing for chlorine and HCl is not required since the feed rates are less than 2 lb/hr.*

Comment #46 *Page 6-2: NO_x must be measured for all tests.*

Response #46 *NO_x will be measured for all tests.*

Comment #47 SEAD must provide sampling locations and transverse points to be approved prior to testing.

Response #47 *Sampling locations will be shown on Figure 6.1. This drawing has been requested from SEAD.*

6.2 Sampling Procedures

Comment #48 Page 6-3: The normal procedure for semivolatile POHC sampling (SW-846, 3rd edition, page 0010-11) requires a minimum 105.9 dscf (3 dscm) for DRE determination. Sample volume calculations are given in Annex D for collection of only 30 dscf (0.85 dscm). Please submit performance data that shows how the actual detection limits (0.025 ug) were determined in past tests. Include all the details of the data and calculations and all performance audit results. Were the determinations done on each of the five individual sections? How was the spiking done? Please include all the details needed for recalculating the results.

Response #48 *The response for comment #48 was developed as a result of a telephone conversation with Brian Jones of the AEHA Aberdeen, Maryland. Brian's first comment is that this is an EPA approved method.*

A sample volume of only 30 dscf is required due to the high mass of materials when measuring DNT and NG. The calculations in Annex D in fact show that this sample volume is adequate.

Since this method has been approved Brian does not feel that it is necessary to include performance data, however he will send us a paper *which we can submit to the DEC that may answer some of there concerns.*

Comment #49 6.2.3 SEAD has proposed waste feed sampling for the M1 and M7 propellants. Please describe what laboratory tests will be performed on these waste streams and what type of lab is capable of handling these types of materials. The Army has emphasized the high degree of quality control maintained in manufacturing munitions and the dangers of analysis related to the waste. Describe how the analysis of these propellants is different from other munitions.

Response #49 *M1 has been selected for the trial burn.* ***Waste sampling procedures are currently outside MAIN's scope of work.***

6.3 Sample Recoveries and Analytical Procedures

Comment #50 6.3.2 Page E-1: Explain the justification for placing the XAD-2 resin tube (page E-5) into the ice bath. Text on page E-3 says it will be housed in a dry compartment.

Response #50 *The XAD-2 resin tube is not put directly into the ice bath, rather it is placed in a water type sleeve, and in turn this whole assembly is placed in the ice bath. This is described in the text.*

Comment #51 Page E-3, section 6a: Describe the soap used in the soapy tap water wash. How is it assured that the soap does not leave a residue.

Response #51 *Ordinary lab soap is used.*

Comment #52 Page E-2: Spiking at 4X the 99.99% DRE level is too high a spiking level. Spiking at the 99.99% DRE level is the highest that would be acceptable. Spiking at three to five times the detection level would be even more acceptable.

Response #52 *According to Brian Jones from AEHA, spiking at 4 times the 99.99% DRE level is part of the approved procedure and cannot be revised.*

Comment #53 Page E-3: SW-846, 3rd edition, Method 0010, Appendix A describes a cleaning procedure that is acceptable for the XAD-2 sorbent resin. If this the "soxhlet extraction" method referred to in Section 6b(2)? Please reference this method or give the details of any alternative procedure.

Response #53 *The text has been modified to reference Method 0010, Appendix A.*

Comment #54 Does the AEHA MM5 procedure included as Annex E represent the entire procedure reviewed by EPA's Larry Johnson and referred to in the Annex F, August 18, 1986 approval memo? If not, please submit any other material considered by Mr. Johnson for that approval. Also submit any historical data (trial burn data for use of the described method including the soxhlet follow-up extraction data) that may have been generated after the August 18, 1986 EPA approval memo.

Response #54 *See response to comment #48 Brian Jones from AEHA will send a paper which may provide more information. This paper will be made available to DEC.*

Comment #55 It will also be advantageous to obtain an updated EPA approval for the method. It is noted that the method was approved specifically for NG DNT may be run on the sam e train if it is the only other POHC. Otherwise DNT should be run by the standard MM5 train.

Response #55 *According to Brian Jones from AEHA an updated approval from the EPA is not required. NG and DNT will both be run on the AEHA sampling train. Toluene will be sampled using a VOST train.*

Comment #56 Page F-2, Section (2), should include the surrogate spiking of the trains in the procedure description for AEHA MM5.

Response #56 ***A procedure describing AEHA MM5 spiking procedures is requested from SEAD.***

Comment #57 Page F-2, Section 1 (3): Please explain "and summing this adjusted weight with the weight increase of the filter...", or clarify that particulates will be calculated from weight gain of sample filter minus weight gain of acetone blank filter. Show the formula that will be used.

Response #57 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #58 Page F-3, Section (3): NG and DNT are only very slightly soluble in water. An appropriate organic solvent must be used to rinse the impingers and connecting glassware to remove what may be adhering to the walls. Please revise.

Response #58 *Toluene is used as described on Page F-3, Section (4).*

Comment #59 Page F-3, Section (4): Please explain how the procedure described satisfies the EPA memo requirement, items 3 and 4, on page F-7. Three whole sequential extractions are called for. Also, what is done with the three samples from each section (15 samples per cartridge)? How will the results be calculated and reported? The condition #2, page F-7, whereby more than 10% of the total sorbent catch found on the last section would nullify the run should the included in the procedures on page F-3. Calculations, determination of actual detection limit, QA and reporting must be presented in greater detail.

Response #59 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #60 Page 6-5, Table 6.2, must be made consistent with the Annex F procedures. Note that this table says the resin section are barch-extracted. This is inconsistent with the requirement.

Response #60 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #61 Page F-3, Section 2(5): What will be the measure of recovery of POHCs (example, surrogate spiking?) from filter, front half of filter housing, 90° elbow and probe wash? The details for the filter procedure must also be more explicit. "Some shaking" is not acceptable. 24 hours on a shaker would be better than a 24-hour soak in the cold, unless performance data is submitted to show that the procedure described on page F-3 and 6-5 is adequate.

Response #61 *Sampling and analytical procedures are being reviewed by MAIN and Aquatech.*

Comment #62 Please give exact details for the extraction of the ash.

Response #62 ***The procedure for ash sampling is outside MAIN's scope of work.***

Comment #63 The exact analytical and QA/QC procedures for all analyses must be referenced and/or described in detail in the trial burn plan. If an SW-846, 3rd edition method exists for the type analysis, that method including its QA/QC is required to be used.

Response #63 *Sampling methods will be referenced in Section 6.0.*

Comment #64 Field and laboratory audits, including analysis performance audits will be required to be added to the trial burn plan. See Sections 3.4, 3.5, 7.4.2, and 7.5.2 to 7.5.4 of EPA/625/6-89/023, January 1990 for example.

Response #64 *A description of audits procedure will be included with the TBP in accordance with the requirements of EPA/625/6-89/023.*

6.4 Quality Assurance

Comment #65 Page G-2, first paragraph: The indicated 95% completeness is not acceptable. For data points considered critical to the investigation, the data quality objective for completeness should be 100 percent. The Department's RCRA policy is that any data report representing less than 100 percent completeness be assessed on a case-by-case basis according to the priority of the data, with the potential decision for repeat of sampling and/or analysis. Samples for which the critical data points fail accuracy or precision data quality objectives, and therefore, completeness objectives, will require reanalysis of samples until the quality objectives are met.

Response #65 *Appendix G will be revised in its entirety.*

Comment #66 Page G-2: The QA/QC Plan must also reference and comply with the "EPA Handbook, Quality Assurance/Quality Control (QA/QC) Procedures for Hazardous Waste Incineration, EPA/625/6-89/023, January 1990, or later revision. All chapters of this handbook must be complied with, as a minimum for the requirements.

Response #66 *Appendix G will reference and comply with EPA/625/6-89/023.*

Comment #67 Page G-4, Table G-1, item 1e: The correlation coefficient must be corrected to 0.995.

Response #67 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #68 Paged G-4 and G-5: QA/QC objectives, procedures, summaries and reporting must conform to EPA/625/6-89/023, as cited in 6.4, comment 2.

Response #68 *Appendix G will comply with EPA/625/6-89/023.*

Comment #69 Page G-7: EPA/625/6-89/023, January 1990, page 39, calls for filter drying to constant weight showing weight change < 0.5 mg. Check must agree within ±0.5 mg before and after weighing each sample filter. The balance accuracy should be good to 0.1 mg.

Response #69 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #70 Page 6-4, Section 6.3.1, says all sample recoveries will be done in the field. This contradicts the EPA memo requirement that reextraction of the sorbent resin be done in an approved laboratory. It is not clear what laboratory is doing each of the analyses and what the credentials of the laboratories are. New York State law (Environmental Conservation Law, Article 3-0119) requires and Environmental Laboratory Approval Program (ELAP) - certified laboratory be used, if certification exists for the given category of analysis. This should be discussed with the NYSDEC RCRA QA Officer, M. Detlefsen, who can be reached at (518)457-7269.

Response #70 *Sampling and analytical procedures are being reviewed by MAIN.*

Comment #71 Page 6-7: The QA/QC Plan should contain all of the elements described in EPA/625/6-89/023, January 1990, Chapter 2. See Table 2-2 of this reference for the recommended outline.

Response #71 *The QA/QC plan will comply with EPA/625/6-89/023.*

Comment #72 Page 6-8 and 6-9: The QA/QC Plan must identify key personnel, their qualifications, and their QA/QC responsibilities, as described in Section 2.1.4 of the EPA/625/6-89/023 reference. A single individual must be designated as Quality Assurance Coordinator and perform the functions described in this reference.

Response #72 *This requires input from SEAD.*

Comment #73 Data reduction, validation and reporting should comply with Section 2.1.11 of this reference. At a minimum, the trial burn test report should contain the following:

1. A summary containing a concise description of the test program including reasons for testing, number and type of test, technical approach, etc. A summary table will be included comparing measured results with compliance limits.

2. A description of the test locations, sampling trains, and special equipment used for the tests.

3. A description of sampling and analytical procedures.

4. A summary of test results. Pollutant emission and process sample results will be presented for each test in concentration units (gr/dscf, lbs/dscf, ppm/v, mg/L, etc.) and in mass rate units (lb/hr) as appropriate, for comparison with permit limits.

5. Test data summary tables with raw and calculated data and the associated QA/QC data for all the data.

6. A discussion section which will include comments concerning any unusual process conditions or difficulties experienced with testing or analyses. Inconsistencies in the data will be discussed and, if possible, explained.

7. A summary of the data validation procedures and criteria indicating how the data met the validation criteria and QA/QC objectives stated in the approved Trial Burn Plan and approved methodology.

8. Completed chain of custody forms, analysis request forms and a key relating lab sample identification numbers to Trial Burn sample identification numbers.

9. Example calculations used in each determination and all the raw data needed for traceability of the results calculated.

Response #73 *The trial burn test report will comply with the requirements of EPA/625/6-89/023.*

6.5 Process Monitoring

Comment #74 If the expected CO level in the stack gas exceeds the 100 ppm rolling hourly average corrected to 7% O_2 and dry, total hydrocarbons (THC) measurement will be required to evaluate the risks from products of incomplete combustion (PICs). To avoid having to perform a repeat of the Trial Burn, SEAD should provide for THC measurements during the proposed burn. Please include details on this parameter in the TBP. Include monitoring methods and frequencies, in addition to the procedures to be followed to ensure no unacceptable risk from PICs.

Response #74 *The trial burn plan has been modified to measure PICs for all tests.*

7.0 AUTOMATIC WASTE FEED SHUT OFF PROCEDURES

Comment #75 Page 7-1: Change "periodically tested" to "tested weekly".

Response #75 *The text has been revised accordingly.*

Comment #76 Page 7-2: The stack gas carbon monoxide AWFSO check is not adequate. It must include the rolling average and must not reset until the rolling average is below 100 ppm.

Response #76 *The text will be revised accordingly.*

8.0 TRIAL BURN TEST SCHEDULE

Comment #77 Tentative dates for the Trial Burn should be listed in this section, and if subject to change, should be revised accordingly.

Response #77 *MAIN will develop a schedule. This schedule will be included in the revised TBP.*

Comment #78 Page 8-1, Table 8.1: The schedule may not be allowing enough time to performance test the field laboratory once set up. Please revise accordingly.

Response #78 *MAIN will develop a schedule. This schedule will be included in the revised TBP.*

Comment #79 Page 8-1: Please provide a schedule showing the necessity for 3 days for each test condition.

Response #79 *MAIN will develop a schedule. This schedule will be included in the revised TBP.*

Comment #80 Also, holding samples until day 15 before submitting for analysis requires justification. The trial burn plan must contain a summary of sample handling, preservation and holding times for each parameter of analysis. It must comply, at a minimum, with Sections 2.1.7 and Chapter 3 of the above reference.

MISCELLANEOUS

Comment #81 The demilitarization furnace at Seneca Army Depot (SEAD) must be operated by expert personnel who are trained and knowledgeable in the burning of hazardous waste. Supervision during the operation of the unit must be by technically qualified individuals. SEAD must submit as part of the Part 373 Permit Application, an outline of the training program to familiarize facility personnel with the recent design and operational changes to the Ammunition Peculiar Equipment (APE) 1236 Deactivation Furnace. In addition, SEAD must include a listing of all personnel working in this hazardous waste management area and their qualifications.

Response #81 ***This is currently outside MAIN's scope of work.***