



# USAEC's Air Emissions Factors from Munitions Use

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## Outline

- Test Program Overview
- Test and Factor Ratings
- Progress to Date
- Benefits to Publishing in AP-42
- Summary



## Program Goal

- **To provide scientifically defensible munitions emissions data to continue Army live fire training and testing.**

## Test Program Overview

- **No standardized emission factors from tactical ordnance use**
- **Defensible scientific data is necessary to defend training and testing operations**
- **Use data for potential future Army efforts such as development of sustainable ammunition**
- **Only tactical firing delivers representative results**





## Source Category Description

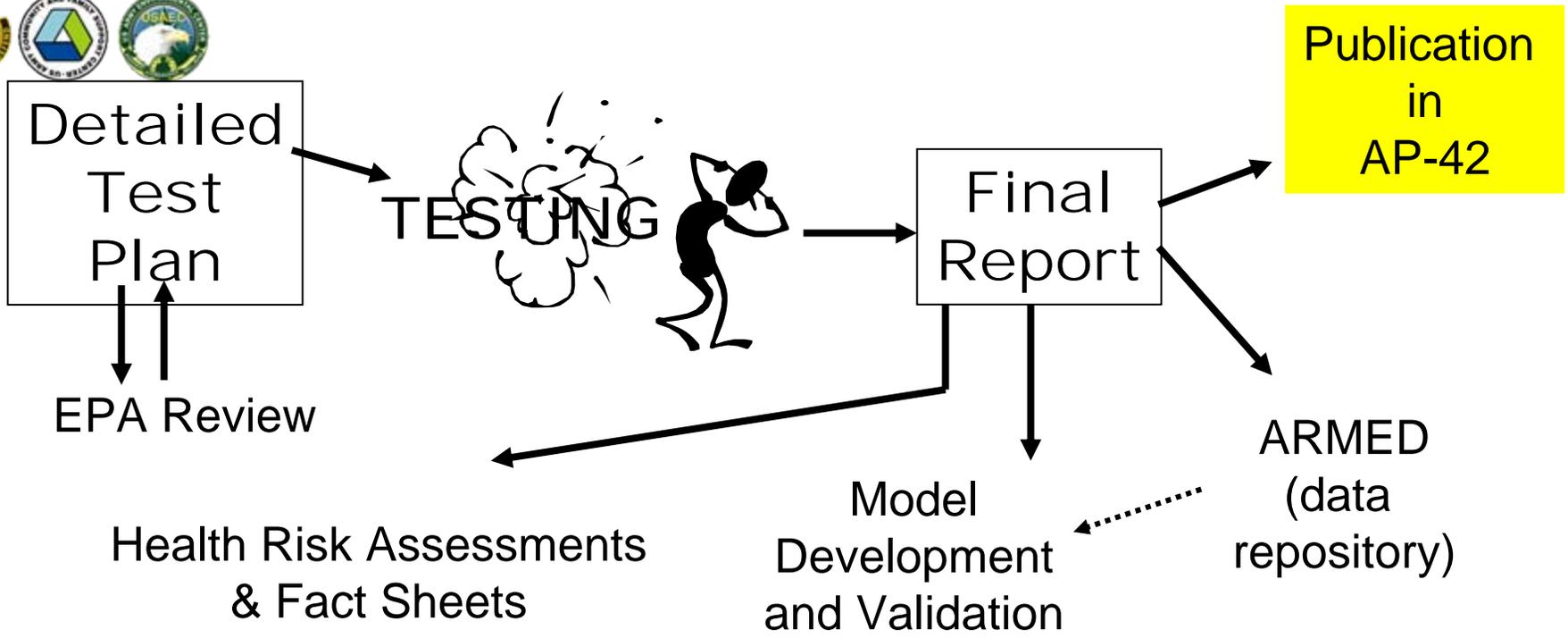


- ~125 Army installations operate ranges where ordnance are used for training and testing
- Categories of munitions used include:
  - Firing Point
    - Small caliber ( $\leq .50$  cal)
    - Medium caliber ( $\leq 81$  mm )
    - Large caliber ( $> 81$  mm)
  - Exploding Ordnance (point of impact)
    - $\frac{1}{4}$  lb to 40 lb net explosive weight
  - Smokes and Pyrotechnics
- Annual quantities of ordnance used per installation vary
- Criteria pollutant emissions vary





## Characterization Process



G-3 approved priority list of items to test



## Detailed Test Plans

"These test plans are probably the most thorough that I have reviewed." - EPA



- **Coordinated with EPA (Emissions Measurement Center, RTP)**
- **Partial list of analytes:**
  - particulates (diameter  $\leq 10$  microns )
  - particulates (diameter  $\leq 2.5$  microns )
  - toxic metals
  - volatile organic compounds
  - polycyclic aromatic hydrocarbons
  - semi-volatile organic compounds
  - energetic materials
  - carbonyls/aldehydes
  - carbon monoxide
  - oxides of nitrogen
  - sulfur dioxide
  - acid gases
  - dioxins/furans
  - hydrogen cyanide



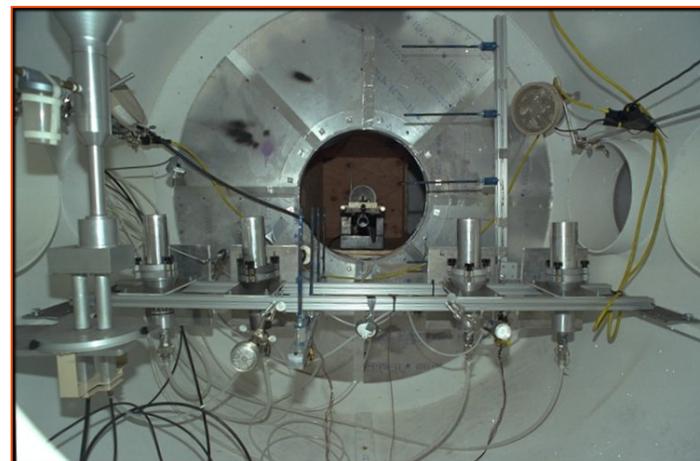
For each target compound, the DTP specifies the sampling equipment; sampling and analysis method (EPA, NIOSH, etc.); modifications to methods, number of samples; sample procedure, location, and duration; sample holding times, measurement quality objectives, and data quality controls.



## Firing Point Emissions



- Multiple sampling ports
- Movable gun mounts
- Sealed volume

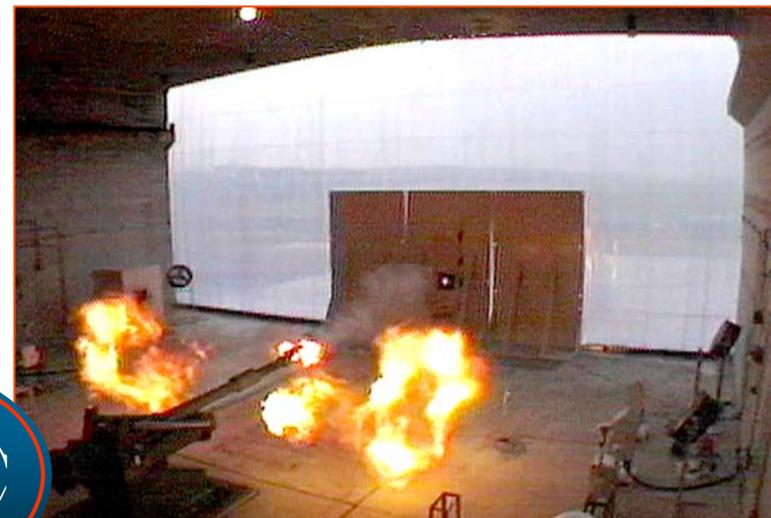


- Adjustable volume up to 500 ft<sup>3</sup>
- Chemically inert
- 7' diameter X 15' long



## Firing Point Emissions

- Volume ~ 186,000 ft<sup>3</sup>
- Sealed volume
- Plastic strip door



- Steel blast shield with remotely operated firing port door
- High volume fans for rapid emissions mixing



## Exploding Ordnance Emissions



- Bang Box Facility (DPG)
- Large Octagon Test Chamber (ATC)
- Blast Sphere (ATC)





## Smoke and Pyro Testing



- Designed for smoke/pyrotechnic munitions that release dyes and/or smoke
- Consists of converted refrigerator trailer
- Aluminum inner walls





## Data Review

- **USAEC:** Reviews for scientific accuracy (Analytical, Organic and Physical Chemists)
- **ATC/DPG:** Reviews for overall quality control (Chemists, Engineers, and Test Directors)
- **EPA:** Reviews for methodology and standardization
- **Legal/Security – USAEC, APG, DPG**
- **Air Force – AFCEE**
- **Navy – NFESC, NAVAIR**
- **Marine Corp - MCHQ**
- **Contract Support:** Independent auditor reviewing overall data quality and formatting
- **CHPPM:** input and review of DTP and Final Reports; sampling and analysis, Health Risk Assessments/Fact Sheets

# How the Army Utilizes Emissions Factors

- **Installation and HQ Support**

- Standardized emission factors
- Guidance on site-specific health risk assessments
- Health Risk Assessments/Fact Sheets
- Support Army Training and Testing practices
- Emissions database
- TRI – EPCRA





## Third Party Review

- EPA requested that USAEC use an independent reviewer
- Role of independent reviewer
  - Assign test data ratings
  - Assign emission factor ratings
  - Prepare data for publication in AP-42

# Test Data Ratings

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



# Test Data Ratings

## Specific Criteria Considered

- 1 Source operation**
- 2 Test methods and sampling procedures**
- 3 Process information**
- 4 Analysis and calculations**



## Test Data Ratings

### Source Operations

- **Ordnance were deployed in a manner to mimic deployment in field**
- **Tests appear to have replicated typical ordnance operating parameters**
- **Test data rated “A” for this criterion**



# Test Data Ratings

## Test Methods and Sampling Procedures

- **Appropriate and consistent with EPA test methods or sound methodology**
- **Few issues of any significance noted**
  - **CEM QC activity data not always provided**
  - **Tentatively identified compounds**
- **Test data rated “A” for this criterion except CEM data (rated “B”) and TICs (rated “C”)**



# Test Data Ratings

## Process Information

- **Ordnance are manufactured to tight tolerances and are expected to deploy in a very repeatable fashion**
- **Large relative percent differences in data occasionally noted**
- **Test data rated “A” for this criterion except RPD > 100% rated “C”**



# Test Data Ratings

## Analysis and Calculations

- **Raw data and example calculations were available**
- **Emission factors presented in test reports were duplicated or differences explained**
- **Test data rated “A” for this criterion except for compounds present in method blanks or for which holding times exceeded**



## Test Data Ratings

- Test data that received an “A” rating for all 4 criteria were rated “A”
- Test data that received less than an “A” rating for any criteria were downgraded to lowest rating received, either “B” or “C”

# Emission Factor Ratings

- A Excellent. Developed primarily from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. Source category population was sufficiently specific to minimize variability.**
- B Above average. Developed primarily from A- or B-rated test data from a moderate number of facilities. Source category population was sufficiently specific to minimize variability.**
- C Average. Developed primarily from A-, B- and/or C-rated test data from a reasonable number of facilities. Source category population was sufficiently specific to minimize variability.**
- D Below average. Developed primarily from A-, B-, and C-rated test data from a small number of facilities. Evidence of variability within the source category population.**
- E Poor. Developed from C- and D-rated test data from a very limited number of facilities. Evidence of variability within the source category population.**

# Emission Factor Ratings



- **Developed using primarily A-rated test data, but only 1 or 2 tests were conducted for each type of ordnance**
  - **A or B rating considered inappropriate**
- **Negligible variability within each type of ordnance and items were randomly selected**
  - **E rating considered inappropriate**
- **C or D rating chosen, depending on test data rating**

# Data Preparation for AP-42

- Prepared an AP-42 section for each ordnance tested
  - AP-42 Chapter 15
- Prepared a background document for each test series
  - Document third party review, emission factors
- Prepared supporting documentation
  - Emission factor calculations





## Current Status

### Accomplishments To Date:

- **Over 185 munitions have been tested**
- **60 HRAs/Fact Sheets have been completed**
- **57 AP-42 Background Documents sent to EPA**

## Benefits to Publishing in AP-42

- Will result in more accurate (measured instead of modeled) estimates of atmospheric releases during ordnance use
- Ensures consistency of emission factor use
- Sharing data with EPA enhances data credibility while providing greater overall quality control and improved public relations





## Summary

- **Defensible scientific data to defend training and testing operations**
- **57 Emission Factors including background documentation submitted to the EPA**
- **Data can be used for various future Army efforts**



## QUESTIONS?

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