

Fugitive Dust Handbook and Website



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THE COUNTESS ENVIRONMENTAL TEAM

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Fugitive Dust Originates from Many Different Source Categories





Intent of Handbook and Website

- Support technical and policy evaluations addressing specific air quality issues (e.g., regional haze implementation plans)
- Provide a comprehensive resource on emission estimation methodologies and control measures to reduce fugitive dust emissions in areas within the WRAP region classified as nonattainment for PM₁₀



Overview

- The handbook addresses the estimation of uncontrolled emissions and emission reductions achieved by demonstrated control measures for eight major fugitive dust source categories.
- It focuses on fugitive dust emissions “at-the-source” and does not evaluate factors related to the transport and impact of emissions on downwind locations.
- The methods for estimating dust emissions rely on AP-42 and alternative methods adopted by air quality agencies in the WRAP region.



Overview (continued)

- The handbook and website will be updated as new information becomes available.
- The handbook is not intended to suggest any preferred method in the preparation of SIPs and/or conformity analyses, but rather to present the methodologies adopted in the western US.
- The information in the handbook has been derived from many sources each with its own accuracy and limitations.
- Because many formulae and factors incorporate default values that have been derived for average US conditions, area-specific factors should be used when available.



Overview (continued)

- Estimates of the relative contribution of fugitive dust to ambient PM concentrations based on the analysis of exposed filters are much lower than that based on emission inventory estimates.
- Part of this discrepancy is due to the near-source deposition losses of freshly generated fugitive dust.
- It is not an objective of the handbook to resolve this discrepancy. Rather, modelers should incorporate deposition losses into their dispersion models, as well as account for the formation of secondary PM.



Handbook Features

- Comprehensive documentation of emission estimation methods adopted by federal and state agencies plus methods in the developmental stage
- Detailed discussion of demonstrated control measures
- Lists of published control efficiencies for a large number of fugitive dust control measures for each fugitive dust source category



Handbook Features (continued)

- Example regulatory formats adopted by state and local agencies in the WRAP region
- Compliance tools (record keeping, site inspection, on-site monitoring) to assure that the regulations are being followed
- Detailed methodology for calculating the cost-effectiveness of different control measures
- Sample calculations for control measure cost-effectiveness for each fugitive dust source category



Emission Calculation Procedure

Estimated emission rate: $R = SE e (1 - c)$,
where

- R = estimated mass emission rate in the specified particle size range
- SE = source extent (i.e., activity level)
- e = uncontrolled emission factor in the specified particle size range (i.e., mass of uncontrolled emissions per unit of source extent)
- c = fractional efficiency of control



Emission Factors: Sample

Uncontrolled fugitive dust emissions from publicly accessible unpaved roads are calculated using the AP-42 emission factor equation:

$$E = 1.8 (s/12) (S/30)^{0.5} / (M/0.5)^{0.2} - C, \text{ where,}$$

- E = PM10 emission factor (lb/VMT)
- s = surface material silt content (%)
- S = mean vehicle speed (mph)
- M = surface material moisture content (%)
- C = emission factor for 1980's vehicle fleet exhaust, plus break/tire wear

NOTE: The denominators in each of the multiplicative terms of the equation constitute normalizing default values, in case no site-specific correction parameter data are available.



Emission Estimation Methodologies for Eight Fugitive Dust Source Categories

CATEGORY	AP-42	CARB	OTHER
Agricultural Tilling		X	
Construction and Demolition		X	MRI
Materials Handling	X		
Paved Roads	X	X	
Unpaved Roads	X	X	
Agricultural Wind Erosion		X	
Open Area Wind Erosion	X		MacDougall
Storage Pile Wind Erosion	X		



Published PM10 Control Efficiencies for Control Measures Show Large Variability

Source Category	Control Measure	Control Efficiency
Agricultural Tilling	Conservation management practices	25 - 100%
Construction/Demolition	Water unpaved surfaces	10 – 74%
Materials Handling	Implement wet suppression	50 – 70%
Paved Roads	Sweep streets	4 – 26%
Unpaved Roads	Apply water	10 – 74%
Wind Erosion (all categories)	Erect artificial wind barriers	4 – 88%



Sample Regulatory Format (Agricultural Tilling)

Control Measure	Goal	Threshold	Agency
Pre-activity requirements: pre-watering, phasing of work, applying water during active ops	Limit visible dust emissions to 20% opacity		SJVAPCD Rule 8021 11/15/2001
Implement one of following during inactivity: restricting vehicle access or applying water or chemical stabilizers	Sets stabilization requirements		SJVAPCD Rule 8021 11/15/2001
Use mowing or cutting instead discing and maintain at least 3" stubble above soil (Also requires pre-application of watering if discing for weed abatement)			SCAQMD Rule 403 12/11/1998
Cease of tilling or mulching		Wind speeds greater than 25 mph	SCAQMD Rule 403.1 1/5/1993 (Coachella Valley)



Sample Compliance Tools (Materials Handling)

Record keeping	Site inspection/monitoring
<p>Site map; work practices and locations; material throughputs; type of material and size characterization; typical moisture content when fresh; vehicle/equipment disturbance areas; material transfer points and drop heights; spillage and cleanup occurrences; wind fence/enclosure installation and maintenance; dust suppression equipment and maintenance records; frequencies, amounts, times, and rates for watering and dust suppressants; meteorological log.</p>	<p>Observation of material transfer operations and storage areas (including spills), operation of wet suppression systems, vehicle/equipment operation and disturbance areas; surface material sampling and analysis for silt and moisture contents; inspection of wind sheltering including enclosures; real-time portable monitoring of PM; observation of dust plume opacities exceeding a standard.</p>



Evaluation of Fugitive Dust Control Measure Options

Due to large uncertainties in published control cost-effectiveness estimates, which range over several orders of magnitude, a standardized methodology was developed to calculate the cost-effectiveness of fugitive dust control measures rather than presenting published estimates.



Handbook Technical Approach

- Developed a uniform step-by-step methodology for calculating the cost-effectiveness for different control measures
- Provided a generic sample calculation for each fugitive dust source category
- Included lists of published control efficiencies for different control measures
- Evaluation of control measure options should be based on cost data and assumptions applicable to the specific situation (location, season, etc.)



Handbook Table of Contents

PREFACE

EXECUTIVE SUMMARY

INTRODUCTION

FUGITIVE DUST SOURCE CATEGORY (#1 thru #8)

- Characterization of Source Emissions
- Emission Estimation Method(s)
- Demonstrated Control Techniques
- Sample Regulatory Formats
- Compliance Tools
- Sample Cost-Effectiveness Calculation
- References

GLOSSARY

APPENDICES



Glossary: Sample

Areal extent—Fraction (or percentage) of the source area that is affected by the control measure.

Aerodynamic particle size—Diameter of a sphere of unit density which behaves aerodynamically as a particle with different sizes, shapes, and densities.

Aggregate material—Mineral particles, such as sand or stone, typically derived from a mechanical process.

Agricultural tilling—Mechanical disturbance of agricultural soil by discing, shaping, chiseling, and leveling using a tractor or implement.

Annual interest rate—The yearly cost of borrowing money, expressed as a percentage of the amount borrowed.



Appendices

- Appendix A: Emission Quantification Techniques
- Appendix B: Alternative Emission Estimation Methods
 - methods in developmental stage for categories addressed in handbook
 - methods for categories not addressed in handbook
- Appendix C: Methodology for Calculating Cost-Effectiveness of Different Control Measures

Appendix A

Emission Quantification Techniques

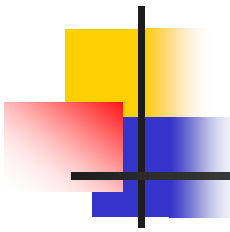
- Contains a discussion of two basic test methods used to quantify fugitive dust emission rates
- Upwind-downwind method that involves the measurement of upwind and downwind particulate concentrations, utilizing ground-based samplers under known meteorological conditions, followed by a calculation of the source strength (mass emission rate) with atmospheric dispersion equations.
 - Exposure-profiling method that involves simultaneous, multipoint measurements of particulate concentration and wind speed over the effective cross section of the plume, followed by a calculation of the net particulate mass flux through integration of the plume profiles.



Appendix B

Alternative Emission Estimation Methods

- Agricultural tilling
- Agricultural harvesting
- Cattle feedlots
- Open area wind erosion
 - Draxler method
 - UNLV method
 - Great Basin Unified APCD method
 - DEJF method
- Storage pile wind erosion
- Uncovered haul trucks
- Unpaved shoulders



Appendix C – Methodology for Calculating Cost-Effectiveness of Control Measures

- Identify applicable emission factor equation
- Select a specific control measure for the fugitive dust source
- Specify the basic parameters required to calculate uncontrolled and controlled emissions
 - parameters used in the emission factor equation
 - source extent (activity level)
 - control measure implementation schedule (freq./application rate)
- Calculate emission factor from the applicable emission factor equation



Appendix C (continued)

- Calculate the annual uncontrolled emission rate as the product of the emission factor and the source extent
- Determine the control efficiency of control measure
- Calculate annual controlled emission rate as the product of uncontrolled emission rate and control efficiency
- Calculate emissions reduction due to control measure (uncontrolled minus controlled emission rate)
- Gather cost estimates for implementing control measure
 - annualized capital costs
 - annual O&M/overhead/enforcement/compliance costs



Appendix C (continued)

- Calculate annualized capital investment cost as the product of annual capital cost and capital recovery factor (CRF), where:
$$\text{CRF} = [i (1 + i)^n] / [(1 + i)^n - 1],$$
 i = annual interest rate (fraction), and n = number of payment years
- Calculate total annualized cost by combining annualized capital investment cost with annual O&M/overhead/enforcement/compliance costs
- Calculate cost-effectiveness (\$/ton PM10 reduction) of selected control measure (total annualized costs divided by the emissions reduction)

Fugitive Dust Website

www.wrapair.org/forums/dejf/fdh

- Currently finalizing the website design
 - resembles WRAP website
 - primary menu laid out by chapter
 - includes links to other useful resources
- Website populated with material from handbook
- Downloadable files include:
 - text files (Word, PDF) for each chapter plus for entire handbook
 - cost-effectiveness calculation spreadsheets with lookup tables for default values (Excel) for each source category



Downloadable Files from Website

- Entire Handbook
 - Word (3.6 MB)
 - PDF (1.5 MB)
- 15 Individual Sections
 - Word (32 – 862 KB)
 - PDF (34 – 353 KB)
 - Excel (~30 KB) for 8 source categories



Useful Links

- USEPA www.epa.gov/ttn/chief/ap42
- CARB
 - www.arb.ca.gov/ei/areasrc/areameth.htm
 - www.arb.ca.gov/drdb/drdb.htm (control measures)
- Clark County (NV) Dept. of Air Quality
www.co.clark.nv.us/air_quality
- Maricopa County (AZ) Environmental Services Dept.
www.maricopa.gov/envsvc/air
- San Joaquin Valley (CA) Air Pollution Control District
www.valleyair.org



Useful Links (continued)

- Clark County website includes test methods for:
 - Soil stabilization (Drop ball test; Rock test method; Threshold friction velocity)
 - Opacity
 - Silt content
 - Silt loading test
- Maricopa County website includes extensive glossary plus test methods for:
 - Soil stabilization
 - Opacity



Website Demonstration



ANY QUESTIONS?



For further information, contact:
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