



Jesse Thé
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**Tribal Emissions Inventory Software Solution
TEISS
Project Manager: Sarah Kelly
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Appendix C – Functional Specification



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Ref #	Requirement	Reference
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Emissions from Source Categories – Priority 1		
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1	Fuel Oil Combustion	AP-42 Vol.1 5th Ed., Ch 1.3, September 1998
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Inputs:

1. Type of measurement units
2. Purpose of boiler
 - Utility
 - Industrial
 - Commercial /institution / residential
3. Type of emission controls used
4. Type of oil combusted
 - No.1 (distillate)
 - No.2 (distillate)
 - No.3
 - No.4 (distillate -or- distillate/residual mix)
 - No.5 (residual)
 - No.6 (residual)
5. Type of process used to burn oil
 - >100 MMBtu/hr, normal firing
 - >100 MMBtu/hr, tangential firing
 - <100 MMBtu/hr, non-residential
 - <100 MMBtu/hr, residential furnace
6. Amount of fuel fired
7. Heat input of fuel fired
8. Percent of sulphur in oil fired; if unknown, calculations that use this value will not be performed.
9. Percent of nitrogen in oil fired; if unknown NOx calculations will be performed using the emission factors provided, else the equation from table 1.3-1 (d) will be used; equation only valid for industrial/commercial boilers firing residual (no.5 & no.6) oils

Controls:

- Uncontrolled emissions (default setting unless
- One of the other controls is present)
- Multiple cyclones
- Fabric filter



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Ref #	Requirement	Reference
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- Old electro-static precipitator
- New/rebuilt electro-static precipitator
- Wet scrubber: lime/limestone
- Wet scrubber: sodium carbonate
- Wet scrubber: magnesium oxide/hydroxide
- Wet scrubber: dual alkali
- Spray dryer
- Furnace injection
- Duct injection
- Load reduction
- Low excess air
- Staged combustion
- Burners out of service
- Flue gas recirculation
- Low NOx burners
- Reduced air preheat
- Selective non-catalytic reduction
- Conventional selective catalytic reduction
- Air heated SCR
- Duct SCR
- Activated carbon SCR
- Water/oil emulsified fuel

Outputs:

1. Emissions List (including HAPs)

- CO
- SO2
- SO3
- NOx
- TOC
- Methane
- NMOC
- CondensePM
- FilterPM
- Benzene
- EthylBenzene
- Formald
- Naphtha
- TrichloroE111
- Toluene



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Ref #	Requirement	Reference
	<ul style="list-style-type: none"> • OXylenes • Acenaphthene • Acenaphthylene • Anthracene • BenzAAnthra • BenzoBFluo • BenzoGHIPery • Chrysene • DibenzoAHAnthracene • Fluoranth • Fluorene • Indeno123Pyrene • Phenanth • Pyrene 	
2.	OCDD (dioxin)	
3.	Metals List <ul style="list-style-type: none"> • Arsenic • Beryllium • Cadmium • Chromium • Copper • Lead • Mercury • Manganese • Nickel • Selenium • Zinc 	
4.	Emission ratings	
2	Natural Gas Combustion	AP-42 Vol.1 5th Ed., Ch 1.4, July 1998
	<u>Inputs:</u>	
	<ol style="list-style-type: none"> 1. Type of measurement units 2. Type of process used to fire gas <ul style="list-style-type: none"> • Large wall-fired boilers, >100 MMBtu/hr, pre-NSPS • Large wall-fired boilers, >100 MMBtu/hr, post-NSPS • Small boilers, <100 MMBtu/hr • Tangentially-fired boilers (all sizes) • Residential furnaces, < 0.3 MMBtu/hr 3. Amount of gas fired 	



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- | | | |
|----|--|--|
| 4. | Heat input of gas fired; default values: 1020 btu/ft ³ (38000 kJ/m ³) | |
| 5. | sulphur content of the gas, in Grains / Million FT ³ ; if unknown, a default value of 2000 grains/10 ⁶ ft ³ is used | |
| 6. | Controls <ul style="list-style-type: none"> • Uncontrolled emissions (default setting unless one of the other controls is present) • Flue gas recirculation • Low NOx burners • Selective non-catalytic reduction flag | |

Outputs:

1. Emissions List (including HAPs)
 - CO
 - CO2
 - NOx
 - SO2
 - CondensePM
 - FilterPM
 - TotalPM (Will include speciation calculation into PM2.5 and PM10)
 - Methane
 - TOC
 - VOC
 - MethylNaphtha
 - MethylChloranth
 - DimethylBenzAAnthracene
 - Acenaphthene
 - Acenaphthylene
 - Anthracene
 - BenzAAnthracene
 - Benzene
 - BenzoAPyrene
 - BenzoBFluor
 - BenzoGHIPery
 - BenzoKFluor
 - Butane
 - Chrysene
 - DibenzoAHAnthra
 - DichloroBenz
 - Ethane
 - Fluoranth



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Ref #	Requirement	Reference
	<ul style="list-style-type: none"> • Fluorene; • Formald • Hexane • Indeno123Pyrene • Naphtha • Pentane • Phenanth • Propane • Pyrene • Toluene 	
	2. Metals List <ul style="list-style-type: none"> • Arsenic • Barium • Beryllium • Cadmium • Chromium • Cobalt • Copper • Manganese • Mercury • Molybdenum • Nickel • Selenium • Vanadium • Zinc 	
	3. Emission ratings	
3	Liquefied Petroleum Gas Combustion	AP-42 Vol.1 5th Ed., Ch 1.5, October 1996
	<u>Inputs:</u> <ol style="list-style-type: none"> 1. Type of measurement units 2. Type of LP gas fired <ul style="list-style-type: none"> • Butane • Propane 3. Type of process used to fire LP gas <ul style="list-style-type: none"> • Industrial boilers, 10 to 100 MMBtu/hr • Commercial boilers, 0.3 to 10 MMBtu/hr 4. Amount of fuel fired 5. Sulphur content of LP gas fired, expressed in Grains / 100 FT³; if unknown calculations that use this value will not be performed. 	



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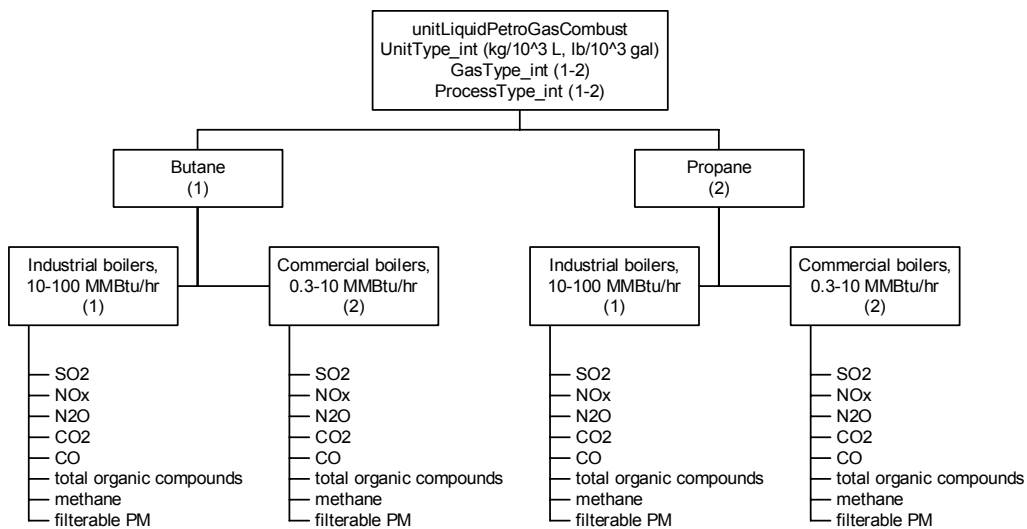
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Ref #	Requirement	Reference
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Outputs:

1. Emissions List
 - NOx
 - N2O
 - CO2
 - CO
 - TOC
 - Methane
 - FilterPM
2. Emission ratings

AP-42 Sec. 1.5: Liquefied Petroleum Gas Production
(C) Lakes Environmental Software



4 **Sand and Gravel Processing**

AP-42 Vol.1 5th Ed., Ch 11.19.1, November 1995

Inputs:

1. Type of measurement units
2. Sand/gravel process
 - Sand dryer





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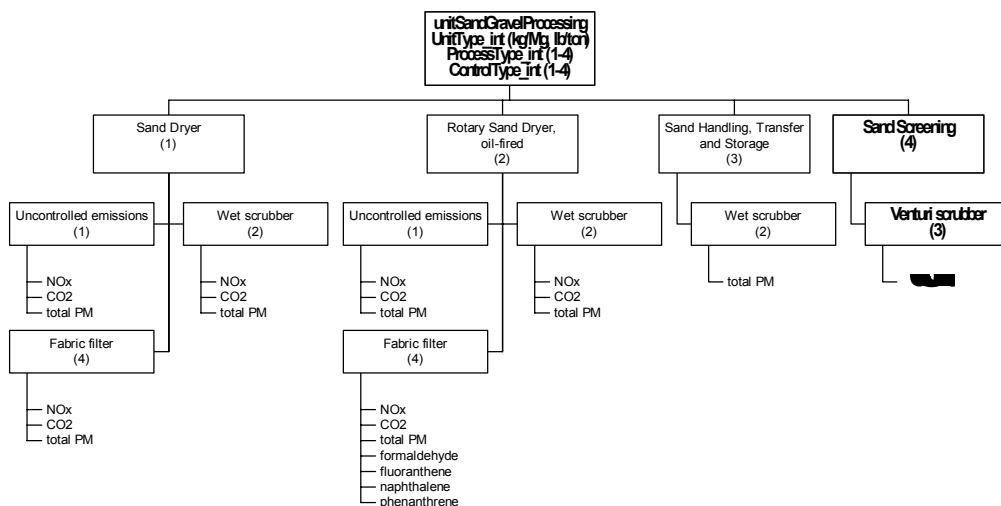
Ref #	Requirement	Reference
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- Rotary sand dryer, oil-fired
 - Sand handling, transfer, and storage
 - Sand screening
3. Type of emission controls used
- Uncontrolled emissions
 - Wet scrubber
 - Venturi scrubber
 - Fabric filter
4. Amount of dry sand/gravel produced

Outputs:

1. Emissions list
 - FilterPM
 - Nox
 - CO2
2. Emission ratings

AP-42 Sec. 11.19.1: Sand and Gravel Processing
(C) Lakes Environmental Software





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Ref #	Requirement	Reference
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5 **Windblown Dust**

ITEP Decided:

Not to use the existing method, which has recognized problems and will most likely be replaced within a year.

Inputs:

Outputs:

6 **Pesticide Application**

AP-42 Vol.1 5th Ed., Ch 9.2.2, January 1995

Notes:

Only the active ingredients with vapour pressures are included in this calculator (table 9.2.2-1); the trade name table (table 9.2.2-2) is NOT included.

Inputs:

1. Type of measurement units
2. Pesticide application method
 - Surface application
 - Soil incorporation
3. Type of formulation used in inert portion of pesticide
 - Oils (66%)
 - Solution/liquid (ready to use)(20%)
 - Emulsifiable concentrate (56%)
 - Aqueous concentrate (21%)
 - Gel, paste, cream (40%)
 - Pressurized gas (29%)
 - Flowable (aqueous) concentrate (21%)
 - Microencapsulated (23%)
 - Pressurized liquid/spray/fogger (39%)
 - Soluble powder (12%)
 - Impregnated material (38%)
 - Pellet/tablet/cake/briquette (27%)
 - Wettable powder (25%)
 - Dust/powder (21%)



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Ref #	Requirement	Reference
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- Dry flowable (28%)
 - Granule/flake (25%)
 - Suspension (15%)
 - Paint/coatings (64%)
4. Vapour pressure of active ingredient
 5. Percentage of active ingredient in pesticide
 6. Percentage of inert ingredients in pesticide
 7. VOC percentage in inert portion of pesticide
 8. Amount of pesticide applied

Outputs:

1. Emissions list
2. Pesticide emissions list
3. Emission ratings

7	Fertilizer Application	Documentation
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Notes:

Asman (1992) emission factors, as found in *Documentation for the Draft 1999 National Emissions Inventory for Criteria Air Pollutants, Area Sources*, for the 10 fertilizer types included in Table C-4 will be used for ammonia emissions and will override AP-42. AP-42 will be used for other pollutant types.

Nitrogen percentages for aqueous ammonia, calcium nitrate, and sodium nitrate is taken from a web-based nitrogen fertilizer guide (<http://taipan.nmsu.edu/mvpfpp/nitrogen.htm>). Nitrogen percentages used are:

- Aqua ammonia = 22.5% (average of min/max range, 20-25%)
- Calcium nitrate = 15%
- Sodium nitrate = 16%

For anhydrous ammonia that is gas injected, the NH₃ emissions are a sum of the volatile & fugitive emissions (12.0 + 0.41 = 12.41 lbm/ton nitrogen applied).

Inputs:

1. Type of measurement units
2. Type of fertilizer and application method

or the Draft NEI for Criteria Air Pollutants, Area Sources, Table C-4. See Notes.

DRAFT** AP-42 Vol.1 5th Ed., Ch 9.2.1, March 1999



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Ref #	Requirement	Reference
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- Gaseous: injection
 - Fluid: injection or deep band
 - Fluid: band, row or broadcast application
 - Fluid: aerial
 - Fluid: irrigation
 - Solid: broadcast application
3. Specific type of chemical fertilizer used
 - Anhydrous ammonia
 - Aqueous ammonia
 - Urea
 - Ammonium nitrate
 - Ammonium sulfate
 - Ammonium chloride
 - Nitrogen mixture
 - Nitrogen mixture with manure
 - Calcium nitrate
 - Sodium nitrate
 4. Amount of fertilizer applied
 5. Percentage of nitrogen found in fertilizer

Outputs:

1. Emissions list
 - NO
 - N2O
 - NH3
 - PM10
2. Emission ratings



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8 Residential Wood Stoves / Fireplaces

This item will be satisfied by two separate emissions estimation procedures:

Residential Wood Stoves

Residential Fireplaces

Notes:

The method for converting cords of wood to tons of wood, based on EIIP Volume II, Chapter 2, Residential Wood Combustion, January 2001, page 2.4-4 through 2.4-8 will be included in these calculators.

8.1 Residential Wood Stoves

AP-42 Vol.1 5th
Ed., Ch 1.10,
October 1996

Inputs:

1. Type of measurement units
2. Type of emission controls used:
 - Wood stove, conventional, pre-phase I
 - Wood stove, conventional, phase I
 - Wood stove, conventional, phase II
 - Wood stove, conventional, overall average
 - Wood stove, non-catalytic, pre-phase I
 - Wood stove, non-catalytic, phase I
 - Wood stove, non-catalytic, phase II
 - Wood stove, non-catalytic, overall average
 - Wood stove, catalytic, pre-phase I
 - Wood stove, catalytic, phase I
 - Wood stove, catalytic, phase II
 - Wood stove, catalytic, overall average
 - Pellet stove, certified, pre-phase I
 - Pellet stove, certified, phase I
 - Pellet stove, certified, phase II
 - Pellet stove, certified, overall average
 - Pellet stove, exempt, pre-phase I
 - Pellet stove, exempt, phase I
 - Pellet stove, exempt, phase II
 - Pellet stove, exempt, overall average
 - Masonry heater, exempt, pre-phase I
 - Masonry heater, exempt, phase I
 - Masonry heater, exempt, phase II



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- Masonry heater, exempt, overall average
3. Amount of fuel fired

Outputs:

1. Emissions List
 - CO
 - CO2
 - PM10
 - TOC
 - Methane
 - NOx
 - SOX
 - Ethane
 - Ethylene
 - Acetylene
 - Propane
 - Propene
 - IButane
 - NButane
 - Butenes
 - Pentenes
 - Benzene
 - Toluene
 - Furan
 - MEK
 - MethylFuran2
 - DiMethylFuran25
 - Furfural
 - OXylenes
 - Acenaphthene
 - Acenaphthylene
 - Anthracene
 - BenzAAnthra
 - BenzoBFluor
 - BenzoKFluor
 - BenzoGHIPery
 - BenzoAPyrene
 - BenzoEPyrene
 - Chrysene
 - DibenzoAHAnthra
 - Fluoranth
 - Fluorene



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- Indeno123Pyrene
 - Naphtha
 - Phenanth
 - Pyrene
2. Metal List
 - Cadmium
 - Chromium
 - Manganese
 - Nickel
 3. Emission ratings

8.2 **Residential Fireplaces**

AP-42 Vol.1 5th
Ed., Ch 1.9,
October 1996

Inputs:

1. Type of measurement units
2. Type of emission controls used
3. Amount of fuel fired

Outputs:

1. Emissions List
 - PM10
 - CO
 - SOx
 - NOx
 - N2O
 - CO2
 - VOC
 - Aldehydes
2. Emission ratings

9 **Gas Stations**

AP-42 Vol.1 5th
Ed., Ch 5.2.2.2 &
5.2.2.3, January
1995

Inputs:

1. Type of Measurement Units
2. Gas Station Operation
 - underground tank filling, submerged filling
 - underground tank filling, splash filling





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- underground tank filling, balanced submerged filling
 - underground tank breathing & emptying
 - vehicle refueling, uncontrolled displacement losses
 - vehicle refueling, controlled displacement losses
 - vehicle refueling, spillage
3. Fuel Throughput

Outputs:

1. General Emissions
 - TOC

10 **Prescribed Burning and Wildfires**

Notes:

AP-42 Vol.1, Chapter 13.1, October 1996 methods are used to calculate emissions from wildland fires. The tribes can calculate emissions from this source type on a fire-by-fire basis, instead of just annually as the AP-42 method intends. For each fire that occurred during the year being inventoried, the TEISS user would enter the data required by the above referenced AP-42 method and the following elements required by the WRAP fire tracking policy:

- Start date of fire
- End date of fire
- Blackened area (given in acres)
- Burn location – would give users two options: 1. allow entry of a blackened area/burn location in GIS, as a shape; 2. Give location as a township, range, section, quarter-section, and quarter-quarter section.
- "Anthropogenic" or "Natural" Classification

In the TEISS reporting function, emissions, the activity data, and the elements listed above for each fire will be added together to give an annual total for the year being inventoried. The annual emissions rates for wildland burning will be the number put into the NIF format to be transferred to EPA. The total for all fires will also be included in any other TEISS reporting functions meant to summarize the EI data for that year. There will also be a reporting function that allows each of the data elements (those listed above AND Fuel Type, Pre-Burn Fuel Loading, and Type of Burn as required by the AP-42 method) for each fire separately. This report could be used to report fire activity to the FEJF.

As per ITEP’s recommendation, the following EF will be used to calculate ammonia emissions from wildfires and prescribed fires: 0.00911 lb ammonia/lb of CO emitted. This is the factor that was used by ENVIRON for the CARB NH3 emission inventory

AP-42 Vol.1 5th Ed., Ch 13.1, October 1996; Development of Emissions Inventory Methods for Wildland Fire, Final Report, Feb 2002, Battye and Battye; and additional elements as determined by ITEP and outlined in notes.



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(as per Gerard Mansell). Derived from *Development of Emissions Inventory Methods for Wildland Fire, Final Report, February 2002, Prepared for US EPA, Prepared by Battye and Battye, EC/R International*, using the average ratio of NH₃ to CO given in Table 27 for “Averages, all measurements” and converting it to mass units.

Inputs:

1. Type of measurement units
2. Type of fuel loading, if fuel load is unknown default values for fuel load base on type can be found in table 13.1-1 of the reference
3. Type of prescribed burning used
4. Fuel type for calculating greenhouse gases
5. Amount of fuel loading (mass/area)
6. Amount of land area burned -or- fuel mass burned
7. Wildfires flag = wildfire calcs will be performed
8. Prescribed burn flag = prescribed burning calcs will be performed
9. Greenhouse gas flag = greenhouse gas calcs will be performed
10. Start date of fire
11. End date of fire
12. Blackened area (given in acres)
13. Burn location – would give users two options: 1. allow entry of a blackened area/burn location in GIS, as a shape; 2. Give location as a township, range, section, quarter-section, and quarter-quarter section.
14. "Anthropogenic" or "Natural" Classification

Outputs:

1. Emissions list
2. Fire Configuration emissions list
3. Emission ratings

Notes:

Wildfires - Values for fuel loading is taken from table 13.1-1. Calculations use equations (1) and (2) found on pg. 13.1-3; the emissions and emission factors found in table 13.1-2 are not used.

Table 13.1-4 (Emissions Factors for Prescribed Burning by U.S. Region) is not included, as it should be used for general planning, not for creating emission inventories.

Great care should be exercised when using this calculator as the values that it



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generates can vary by up to 50% (or more) from actual readings. See the reference for more information.

11 **Agricultural Tilling**

Notes:

This will be based on the document “ProceduresDoc_NEI.pdf” (pg. 4-274) as provided by Doug Solomon on 11 October 2002.

Inputs:

1. Type of Measurement Units
2. Number of Tillings Per Year
3. Silt Content of Surface Soil as a Mass Fraction
 - known fraction = value
 - unknown fraction = base silt content on soil type
 - silt loam
 - sandy loam
 - sand
 - loamy sand
 - clay
 - clay loam
 - organic material
 - loam
4. Area of Land Planted

Outputs:

0. General Emissions
 - PM-10

PROCEDURES
Document For
National Emission
Inventory,
Criteria Air
Pollutants,
1985-1999

12 **Paved Road Dust**

Inputs:

1. Type of measurement units
2. Silt loading = amount of silt loading on paved road; if unknown, emissions based on a range of silt loadings based on type of road, and default values (pg. 13.2.1-4 thru 13.2.1-6)
3. Average daily traffic
4. Average vehicle weight; if unknown, emissions based on a range of weights will be calculated

AP-42 Vol.1 5th
Ed., Ch 13.2.1,
October 2002



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5. Total vehicle distance travelled on road
6. Silt load known = true: calcs based on onsite data or false: calcs based on default values
7. Vehicle weight known = true: calcs based on avg vehicle weight false: calcs base on range of vehicle weights
8. Public road type = calcs for public paved roadways
9. Limited_road type = calcs for limited access roadways
10. Industrial_road type = calcs for industrial access roadways

Outputs:

1. Emissions list
2. EmissionsMinMax list
3. Emission ratings

Notes:

A new draft of section 13.2.1 is available that includes modified equations for wet deposition of silt to the road. This calculator currently does not include information from the new draft. The final deliverable will include the latest version.

The emission values and ratings are valid if applied within the range of source conditions that were tested during development of equation (1):

- Silt loading: 0.02-400 g/m² (0.03-570 grains/ft²)
- Mean vehicle weight: 1.8-38 tonnes (2.0-42 tons)
- Mean vehicle speed: 16-88 kph (10-55 mph)

13 Unpaved Road Dust

AP-42 Vol.1 5th
Ed., Ch 13.2.2,
October 2001
Draft

Inputs:

1. Type of measurement units
2. Type of industry that road is used for
3. Type of control method used to control fugitive dust emissions
4. Percentage of silt in unpaved road; if UNKNOWN, the industry type usage is used to determine the average silt percentage and silt percentage range
5. Percentage of moisture in unpaved road; if UNKNOWN, a default value of 0.2% will be used
6. Average weight of vehicles using road; on public access unpaved roads, if UNKNOWN, a default value of 2.2 tons will be used (for all other industries, it is assumed that on-site traffic data will allow for a mean



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- vehicle weight to be determined)
7. Average number of rain days/year that road experiences
 8. Current average speed of all vehicles on road
 9. New average speed of all vehicles on road
 10. Total volume of resin CONCENTRATE (not solution) applied to unpaved road
 11. Total vehicle distance travelled
 12. SiltPercentKnown_bln = flag to signify if silt percentage is known
 13. MoistureKnown_bln = flag to signify if road moisture content is known
 14. VehicleWtKnown_bln = flag to signify if average vehicle weight is known
 15. IncludeRainfall_bln = flag to signify if precipitation mitigation will be included in calculations
 16. Monthly_bln = flag to signify that resin surface treatment is applied monthly
 17. Biweekly_bln = flag to signify that resin surface treatment is applied every 2 weeks

Outputs:

1. Emissions list
2. EmissionsMinMax list
3. Emission ratings

Notes:

A new draft of section 13.2.1 is available that includes modified equations that separates unpaved industrial roads from unpaved public access roads, and a figure that provides control effectiveness estimates for watered roads. This calculator currently does not include information from the new draft. The final version will include the latest revisions.

The emission values and ratings are valid if applied within the range of source conditions that were tested during development of equation (1):

- Surface silt content: 1.2-35%
- Surface moisture content: 0.03-20%
- Mean vehicle weight: 1.4-260 tonnes (1.5-290 tons)
- Mean vehicle speed: 8-88 kph (5-55 mph)
- Mean no. of wheels 4-7

The calculator allows for extrapolation of road emissions using the mean annual number of "wet" days (eq'n 2, pg. 13.2.2-5). This does not extend to the procedure and assumptions for the finer temporal and spatial resolutions as outlined in the reference text.



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Controls are included in a limited capacity. "Surface improvements" is not included - for paved roads, users should use the Paved Roads calculator; gravel/slag roads are a variant of unpaved roads, but with a (on average) lower silt content. Road watering surface treatments are not included as it modifies the water content of the road and is, therefore, a variant of unpaved roads.

14 **Hot Mix Asphalt Plants**

AP-42 Vol.1 5th
Ed., Ch 11.1,
December 2000

Inputs:

1. Type of measurement units
2. Hot mix asphalt plant process
3. Fuel type used in process
4. Emission control type
5. Asphalt volatility % loss-on-heating value; if unknown, default value of -0.5 is used (table 11.1-14(a))
6. HMA mixing temperature; if unknown, default value of 325°F (163°C) is used (table 11.1-14 (a))
7. Amount of hot mix asphalt produced
8. Flag for asphalt volatility value being known
9. Flag for mixing temperature being known

Outputs:

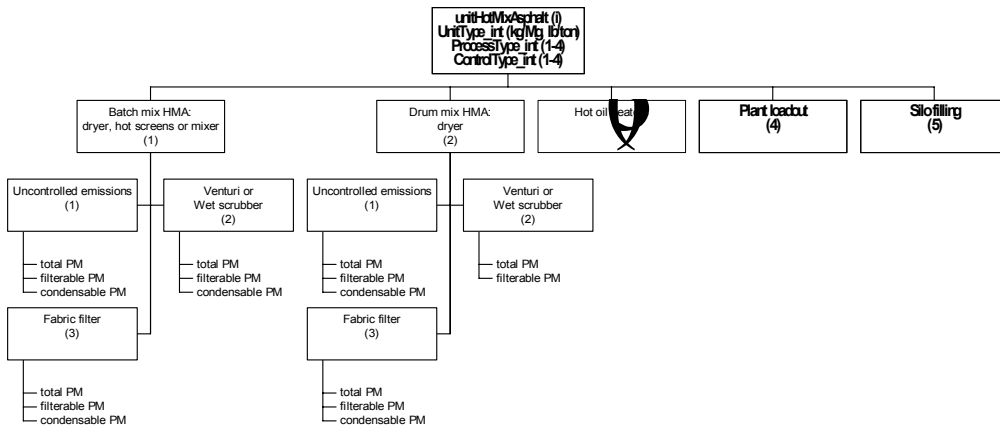
1. Emissions list
2. Metals list
3. Dioxins list
4. Emission ratings



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AP-42 Sec. 11.1: Hot Mix Asphalt Plants (I)
(c) Lakes Environmental Software



15 **Landfills**

Notes:

The US EPA Landfill Air Emissions Estimation Model is PC-based software for estimating emissions of methane, carbon dioxide, nonmethane organic compounds, and hazardous air pollutants from municipal solid waste landfills. These emissions are generated by decomposition of refuse in landfills. The mathematical model used in Landfill is based on a first order decay equation that can be run using site-specific data supplied by the user for the parameters needed to estimate emissions or, if data are not available, using default value sets included in Landfill.

US EPA
Landfill Air
Emissions
Estimation
Model v. 2.01.

16 **Open Burning of Solid Waste**

Notes:

For tire burning, the pollutant Methyl, Methylethyl Benzene was not included because it appears twice in the Organic Compounds table with different emission values for each entry (table 2.5-4).

The emission factors are provided in both lbm/ton and kg/tonne. The decision to use only the lbm/ton factors was made on the assumption that the US-EPA would have originally calculated the factors in those units, and then performed a conversion to create the kg/tonne tables.

AP-42 Vol.1 5th
Ed., Ch 2.5,
October 1992
(Reformatted
January 1995);
Development of
Emissions
Inventory
Methods for
Wildland Fire,
Final Report, Feb
2002, Battye and





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Battye.

Clear burning of orchard crops use an average emission factor for each of the criteria pollutants.

For Agricultural Burning, the following EF will be used to calculate ammonia emissions: 0.0158 lb ammonia/lb of CO emitted. This is the factor that was used by ENVIRON for the CARB NH3 emission inventory (as per Gerard Mansell). Derived from *Development of Emissions Inventory Methods for Wildland Fire, Final Report, February 2002, Prepared for US EPA, Prepared by Battye and Battye, EC/R International*, using the average ratio of NH3 to CO given in Table 27 for overall Grasses and Sage and converting it to mass units.

Inputs:

1. Type of measurement units
2. General type of refuse burn
 - Municipal refuse
 - Automobile components
 - Tires only, chunks
 - Tires only, shredded
 - Agricultural materials, field crops
 - Agricultural materials, vine crops
 - Agricultural materials, weeds
 - Agricultural materials, orchard crops
 - Agricultural materials, forest residues
 - Leaf burning
 - Agricultural plastic film, unused, piled
 - Agricultural plastic film, unused, piled w/ forced air current
 - Agricultural plastic film, used, piled
 - Agricultural plastic film, used, piled w/ forced air current
3. Specific type of refuse burn
 - Unspecified field crops
 - Asparagus, <15% moisture
 - Asparagus, >15% moisture
 - Barley
 - Corn
 - Cotton
 - Grasses
 - Pineapple, <20% moisture
 - Pineapple, >20% moisture, headfire burned
 - Rice, <15% moisture
 - Rice, >15% moisture
 - Safflower



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- Sorghum
- Sugar cane, state of Louisiana
- Sugar cane, state of Florida
- Sugar cane, state of Hawaii
- Sugar cane, other states (enter fuel loading factor)
- Alfalfa, headfire burned
- Alfalfa, backfire burned
- Bean (red), headfire burned
- Bean (red), backfire burned
- Hay (wild), headfire burned
- Hay (wild), backfire burned
- Oats, headfire burned
- Oats, backfire burned
- Pea, headfire burned
- Wheat, headfire burned
- Wheat, backfire burned
- Unspecified weeds
- Tumbleweed
- Tales (wild reeds)
- Orchard removal, clear burning
- Unspecified orchard crops
- Almond
- Apple
- Apricot
- Avocado
- Cherry
- Citrus (orange, lemon)
- Date palm
- Fig
- Nectarine
- Olive
- Peach
- Pear
- Prune
- Walnut
- Unspecified forest residues
- Hemlock
- Douglas fir
- Cedar
- Ponderosa pine
- Unspecified leaf species
- Black ash
- Modesto ash



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- White ash
 - Catalpa
 - Horse chestnut
 - Cottonwood
 - American elm
 - Eucalyptus
 - Sweet gum
 - Black locust
 - Magnolia
 - Silver maple
 - American sycamore
 - California sycamore
 - Tulip
 - Red oak
 - Sugar maple
4. Fuel loading factor for agricultural burning, in waste mass/area amount of fuel fired

Outputs:

1. Emissions List (including HAPs)
 - TotalPM (Will include speciation calculation into PM2.5 and PM10)
 - SOx
 - NOx
 - CO
 - Methane
 - NonMethane
 - NH3
2. Metal List
 - Aluminum
 - Antimony
 - Arsenic
 - Barium
 - Calcium
 - Chromium
 - Copper
 - Iron
 - Lead
 - Magnesium
 - Nickel
 - Selenium
 - Silicon
 - Sodium



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- Titanium
 - Vanadium
 - Zinc
3. Emission ratings

17 **Agricultural Burning**

Using the **Open Burning of Solid Waste** described above.

18 **Mobile Sources**

18.1 **On-road**

Using USEPA MOBILE 6 model

18.2 **Non-road**

June 2000 Draft
US EPA Nonroad
Model

Note: As of January 3, 2003 ITEP is seeking availability of the 2002 version of Nonroad. If available, development will be pursued for the 2002 version.

The draft version of the nonroad emissions model predicts emissions for all nonroad equipment categories listed above with the exception of commercial marine, locomotive, and aircraft emissions; future model updates will include modules for estimating emissions from those sources. The model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating. Fuel types include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG).

The NONROAD model estimates emissions for six exhaust pollutants: hydrocarbons (HC), NO_x, carbon monoxide (CO), carbon dioxide (CO₂), sulfur oxides (SO_x), and PM. The user selects among five different types for reporting HC - as total hydrocarbons (THC), total organic gases (TOG), non-methane organic gases (NMOG), non-methane hydrocarbons (NMHC), or volatile organic compounds (VOC). Particulate matter can be reported as total PM, PM of 10µ or less (PM₁₀), or PM of 2.5µ or less (PM_{2.5}). The model also estimates emissions of non-exhaust HC for six modes - hot soak, diurnal, refueling, resting loss, running loss, and crankcase emissions. All emissions are reported as short tons (i.e., 2000 lbs).

18.3 **Trains**

NEI:
Documentation



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Notes:

Developed as per the document “air-cmv-rail99v2.wpd” as provided by Doug Solomon on 10 October 2002.

Inputs:

1. Type of Measurement Units
2. Type of Locomotive
 - SCCs 2285002006 through 2285002010
3. Emissions Control Type
4. Emission Calculation Method
 - All U.S. except for California –or- California only
5. Percentage of Engine Types in Use
 - 2-Stroke Engines
 - 4-Stroke Engines
6. Amount of Fuel Oil Consumed

for Aircraft,
Commercial
Marine Vessel,
Locomotive,
and Other
Nonroad
Components of
the National
Emission
Inventory,
Vol.1 -
Methodology,
30 September
2002

Outputs:

1. General Emissions
 - CO
 - NOx
 - SOx
 - VOC
 - PM-10
 - PM-2.5
2. HAP Emissions List
 - 1,3-Butadiene
 - 2,2,4-Trimethylpentane
 - Acenaphthene
 - Acetaldehyde
 - Acrolein
 - Anthracene
 - Benzene
 - Benzo(a)Anthracene
 - Benzo(a)Pyrene
 - Benzo(b)Fluoranthene
 - Benzo(k)Fluoranthene
 - Benzo(ghi)Perylene
 - Chrysene
 - Dibenz(a,h)Anthracene
 - Ethylbenzene
 - Fluoranthene



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- Fluorene
 - Formaldehyde
 - n-Hexane
 - Indeno(1,2,3-cd)Pyrene
 - Naphthalene
 - Phenanthrene
 - Propionaldehyde
 - Pyrene
 - Styrene
 - Toluene
 - Xylene
3. Metals List
- Beryllium
 - Cadmium
 - Lead
 - Mercury
 - Chromium
 - Arsenic
 - Manganese
 - Nickel

18.4 Recreational boats

June 2000 Draft
US EPA Nonroad
Model

Note: As of January 3, 2003 ITEP is seeking availability of the 2002 version of Nonroad. If available, development will be pursued for the 2002 version.

US EPA Nonroad Model June 2000 Draft

18.5 Aircraft

NEI:
Documentation
for Aircraft,
Commercial
Marine Vessel,
Locomotive,
and Other
Nonroad
Components of
the National
Emission

Notes:

Developed as per the document “air-cmv-rail99v2.wpd” as provided by Doug Solomon on 10 October 2002.

Inputs:

1. Type of Measurement Units
2. Type of Aircraft
 - Commercial Aircraft
 - Air Taxis, Piston Engines
 - Air Taxis, Turbine Engines



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- General Aviation, Piston Engines
 - General Aviation, Turbine Engines
 - Military Aircraft
3. Type of Emission Controls
 4. Number of Complete Landing/Takeoff Cycles

Inventory,
Vol.1 -
Methodology,
30 September
2002

Outputs:

1. General Emissions
 - NOx
 - CO
 - SOx
 - VOC
 - PM-10
2. HAP Emissions List
 - 1,3-Butadiene
 - 2,2,4-Trimethylpentane
 - Acetaldehyde
 - Acrolein
 - Benzene
 - Ethylbenzene
 - Formaldehyde
 - Naphthalene (gas-phase)
 - n-Hexane
 - Propionaldehyde
 - Styrene
 - Toluene
 - Xylene
3. PAH Emissions List
 - Acenaphthene
 - Acenaphthylene
 - Anthracene
 - Benzo(a)Anthracene
 - Benzo(a)Pyrene
 - Benzo(b)Fluoranthene
 - Benzo(k)Fluoranthene
 - Benzo(ghi)Perylene
 - Chrysene
 - Fluoranthene
 - Fluorene
 - Indeno(1,2,3-cd)Pyrene



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- Naphthalene
- Phenanthrene
- Pyrene

19 **Coal Combustion**

19.1 **Coal Combustion: Bituminous & Sub-Bituminous Coal Combustion**

AP-42, 5th
Edition, Sections
1.1

Inputs:

1. Type of measurements
2. Type of coal fired
3. Firing configuration
4. Amount of coal feed fired
5. Heat input of coal fired
6. Coal Information
 - Carbon percentage in coal
 - Ash content in coal
 - Sulfur content in coal
 - Trace elements present in ppm
 - a. Antimony
 - b. Arsenic
 - c. Beryllium
 - d. Cadmium
 - e. Chromium
 - f. Cobalt
 - g. Lead
 - h. Manganese
 - i. Nickel
7. Control equipment in use
 - Process controls
 - a. Coal ash reinjection
 - b. Multiple cyclones
 - c. Fabric filters
 - d. Electrostatic precipitators
 - e. Venturi scrubbers
 - SO₂ controls
 - a. Wet scrubber: lime/limestone
 - b. Wet scrubber: sodium carbonate
 - c. Wet scrubber: magnesium oxide/hydroxide
 - d. Wet scrubber: dual alkali
 - e. Spray dryer absorber
 - f. Furnace injection



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- g. Duct injection
- NOx controls
 - a. Load reduction
 - b. Operational modifications (BOOS, LEA and/or BF)
 - c. Overfire air
 - d. Low NOx burners
 - e. Reburn
 - f. Selective non-catalytic reduction
 - g. Selective catalytic reduction
 - h. Fluidized bed combustor information as a molar calcium:sulfur ratio

Outputs:

1. General Results
 - CO
 - CO2
 - Total condensable PM
 - Inorganic condensable PM
 - Organic condensable PM
 - Filterable PM
 - Filterable PM-10
 - Methane
 - Total non-methane organic compounds
 - N2O
 - SOx
 - NOx
 - Hydrogen Chloride
 - Hydrogen Fluoride
2. PAH Emissions
 - Biphenyl
 - Acenaphthene
 - Acenaphthylene
 - Anthracene
 - Benzo(a)anthracene
 - Benzo(a)pyrene
 - Benzo(b,j,k)fluoranthene
 - Benzo(g,h,i)perylene
 - Chrysene
 - Fluoranthene
 - Fluorene
 - Indeno(1,2,3-c,d)pyrene

- Naphthalene
- Phenanthrene
- Pyrene
- 5-methyl chrysene
- 3. Organic Emissions
 - Acetaldehyde
 - Acetophenone
 - Acrolein
 - Benzene
 - Benzyl chloride
 - Bis(2-ethylhexyl)phthalate
 - Bromoform
 - Carbon disulfide
 - 2-chloroacetophenone
 - Chlorobenzene
 - Chloroform
 - Cumene
 - Cyanide
 - 2,4-dinitrotoluene
 - Dimethyl sulfate
 - Ethyl benzene
 - Ethyl chloride
 - Ethylene dichloride
 - Ethylene dibromide
 - Formaldehyde
 - Hexane
 - Isophorone
 - Methyl bromide
 - Methyl chloride
 - Methyl ethyl ketone
 - Methyl hydrazine
 - Methyl methacrylate
 - Methyl tert butyl ether
 - Methylene chloride
 - Phenol
 - Polycyclic organic matter
 - Propionaldehyde
 - Tetrachloroethylene
 - Toluene
 - 1,1,1-trichloroethane
 - Styrene



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- Xylenes
- Vinyl acetate
- 4. Dioxins/Furans
 - 2,3,7,8-TCDD
 - Total TCDD
 - Total PeCDD
 - Total HxCDD
 - Total HpCDD
 - Total OCDD
 - Total PCDD
 - 2,3,7,8-TCDF
 - Total TCDF
 - Total PeCDF
 - Total HxCDF
 - Total HpCDF
 - Total OCDF
 - Total PCDF
- 5. Trace Metals
 - Antimony
 - Arsenic
 - Beryllium
 - Cadmium
 - Chromium
 - Chromium VI
 - Cobalt
 - Lead
 - Magnesium
 - Manganese
 - Mercury
 - Nickel
 - Selenium

19.2 Coal Combustion: Anthracite Coal Combustion

AP-42, 5th
Edition,
Sections 1.2

Inputs:

1. Type of units
 2. Type of coal
 - Anthracite coal
 - Anthracite culm
 3. Type of emission source
-



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- Stoker-fired boilers
- Pulverized coal boilers
- Residential space heaters
- Hand-fired units
- 4. Type of emissions control equipment
 - Uncontrolled emissions
 - Fabric filters
 - Electrostatic precipitators
 - Wet scrubbers
 - Cyclones
- 5. Amount of coal fired
- 6. Coal information
 - Coal ash content
 - Sulfur content

Outputs:

1. General Results
 - SO_x
 - NO_x
 - CO
 - CO₂
 - Filterable PM
 - Condensable PM
 - Total organic compounds
 - Methane
2. Organic Emissions
 - Acenaphthene
 - Acenaphthylene
 - Anthanthrene
 - Anthracene
 - Benzo(a)anthracene
 - Benzo(a)pyrene
 - Benzo(e)pyrene
 - Benzo(g,h,i)perylene
 - Benzo(k)fluoranthrene
 - Biphenyl
 - Chrysene
 - Coronene
 - Fluoranthrene



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- Fluorene
 - Indeno(1,2,3-c,d)pyrene
 - Naphthalene
 - Perylene
 - Phenanthrene
 - Pyrene
3. Trace Metals
- Antimony
 - Arsenic
 - Beryllium
 - Cadmium
 - Chromium
 - Lead
 - Manganese
 - Mercury
 - Nickel
 - Selenium



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Emissions from Source Categories – Priority 2

1 Paper Mills

This section includes Lumber, Pulp Bleaching, and Papermaking. EPA has suspended all work on these subjects. Development may take place again in the future if EPA considers it warranted.

An alternate reference “Handbook of Substance-Specific Information for National Pollutant Release Inventory Reporting, 2001” (NCASI) might be used, subject to approval by ITEP, and provided that the restrictions placed on the reference by NCASI are overcome.

As of January 3, 2003, ITEP was still researching applicability of the NCASI resources.

Inputs:

Outputs:

2 Oil and gas operations (includes pipeline and wellhead compressors, dehydrators, separators, and exploration and production related emissions.)

Preferred estimation methods from EIIP Vol.2, Ch 10, September 1999

Inputs:

1. Type of Measurement Units
2. Type of Oil/Gas Process Operation
 - Emergency & Process Vents
 - Gas Actuated Pumps
 - Pressure/Level Controllers
 - Blowdown
 - Well Blowouts
 - Well Testing
 - Loading Liquid Losses: Tank Truck & Cars
 - Loading Liquid Losses: Marine Vessels
 - Sulfur Recovery Units
 - Flares: VOC & HAP Emissions
 - Flares: SO2 & H2S Emissions



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- Incinerators
- 3. Emissions Control Type
- 4. Process Specific Information
 - Emergency & Process Vents, Gas Actuated Pumps, Pressure/Level Controllers, Blowdown, Well Blowouts, Well Testing
 - Molecular Weight of Gas
 - Emission Calculations for VOC, HAP and/or Methane
 - Percentage of VOC, HAP and/or Methane in Stream
 - Loading Liquid Losses: Tank Truck & Cars
 - Loading Method
 - Tank Temperature
 - True Vapor Pressure in Tank
 - Vapor Molecular Weight
 - Loading Liquid Losses: Marine Vessels
 - Vessel's Arrival Condition
 - True Vapor Pressure of Loaded Crude Oil
 - Vapor Molecular Weight
 - Vapor Temperature
 - Mass Fraction of VOC in Vapor
 - Sulfur Recovery Units
 - Mole Fraction of H₂S in Inlet Stream
 - Sulfur Recovery Factor
 - SO₂ Production Factor
 - H₂S Production Factor
 - Sulfur Recovery Efficiency
 - Flares: VOC & HAP Emissions
 - Mole Fraction of VOC in Inlet Stream
 - VOC Molecular Weight
 - Destruction/Removal Efficiency
 - Flares: SO₂ & H₂S Emissions, Incinerators
 - Molecular Weight of Gas
 - Mole Fraction of H₂S in Inlet Gas
 - Molar Conversion Ratio of H₂S to SO₂
- 5. Processing Rate
- 6. Operating Period

Outputs:

1. General Emissions
 - Total Composite Emissions
 - VOC



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- HAP
- Hydrogen Sulfide
- SO2
- Methane

3 Dry Cleaning

AP-42 Vol.1 5th
Ed., Ch 4.1, April
1981
(reformatted
January 1995)

Inputs:

1. Type of measurement units
2. Method of dry cleaning
3. Specific source used by the process
4. General type of dry cleaning operation
5. Amount of clothes dry cleaned
6. Number of people in a specific area
7. Emission calcs based on a process
8. Emission calcs based on area population
9. Specific source is in industry average condition
10. Specific source is in well-controlled/maintained condition

Outputs:

1. Emissions list
2. EmissionsMinMax list
3. Emission ratings

4 Non-Industrial Surface Coating

AP-42 Vol.1 5th
Ed., Ch 4.2.1,
September 1991
(reformatted
January 1995)

Inputs:

1. Type of measurement units
2. Type of surface coating
 - Architectural
 - Automobile refinishing
3. Number of persons involved in coating
4. Emission calcs based on no. of employees
5. Emission calcs based on area population

Outputs:

1. Emissions list





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2. Emission ratings

5 **Construction Sites**

AP-42 Vol.1 5th
Ed., Ch 13.2.3,
January 1995

Notes:

The following areas for emission factors for construction operations have not been implemented:

- Demolition & Debris Removal: truck transport of debris (this uses either the paved or unpaved road emission factors)
- General Construction: all (these functions may end up being calculated by aliasing to them in the final interface)
- Emission from off-site road traffic and wind erosion are not included in this calculator, except for scrapers in travel mode on unpaved surfaces.
- Unpaved road emissions (when used) is only performed using eq'n 1 from section 13.2.2 (pg. 13.2.2-3. Annual precipitation is not currently used.

The user has the option to perform either an operation specific emissions release, or determine the overall emissions using the general factors provided on pg. 13.2.3-1.

Inputs:

1. Type of measurement units
2. Construction phase
3. Specific construction operation
4. Moisture content of soil; if unknown, a default value/range will be used, if available
5. Silt content of soil; if unknown, a default value/range will be used, if available
6. Average vehicle weight; if unknown, a default value/range will be used, if available
7. Average vehicle speed; if unknown, a default value/range will be used, if available
8. Feed used for determining emissions; the actual type and units will vary based on the operation being calculated for
9. Average wind speed of construction site
10. Moisture content known flag
11. Silt content known flag
12. Vehicle weight known flag



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13. Vehicle speed known flag

Outputs:

1. Emissions list
2. EmissionsMinMax list
3. Emission ratings

6 **Consumer / Commercial Solvents**

AP-42 Vol.1 5th
Ed., Ch 4.10,
April 1981
(reformatted
January 1995)

Inputs:

1. Type of measurement units
2. Type of solvent use
 - Aerosol products
 - Household products
 - Toiletries
 - Rubbing compounds
 - Windshield washing
 - Polished waxes
 - Non-industrial adhesives
 - Space deodorant
 - Moth control
 - Laundry detergent
 - Total usages
3. Type of emission controls used
4. Calculate by annual per capita emission factors
5. Calculate by daily per capita emission factors
6. Area population

Outputs:

1. Emissions list
2. Emission ratings

7 **Graphic Arts**

AP-42 Vol.1 5th
Ed., Ch 4.9.1 &
4.9.2, April 1981
(reformatted
January 1995)

Inputs:

1. Type of units



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2. Type of printing process
 - Web offset lithography, publication
 - Web offset lithography, newspaper
 - Web letterpress, publication
 - Web letterpress, newspaper
 - Rotogravure, publication
 - Rotogravure, packaging
 - Flexography, packaging
3. Type of emission controls used
 - No controls used
 - Carbon adsorption
 - Incineration
 - Waterborne inks
4. Density of solvent used in ink; default value: 0.742 kg/L (6.2 lbm/gal)
5. Amount of ink used -or- number of persons in target population
6. Calculations based on process info
7. Calculations based on per capita info
8. Flag for hot air dryer used
9. Flag for direct flame dryer used

Outputs:

1. Non-Methane Organic Compounds
2. VOC - Min
3. VOC - Max
4. VOC Total

8 **Structure Fires**

EIIP Vol.3, Ch
18, January 2001
(revised final,
drafted January
31, 2001)

Notes:

All emissions assume that no information regarding structure types and extent of material burned was collected. A default fuel loading value of 1.15 tons per fire was, therefore, used.

Inputs:

1. Type of units
 2. Method type used to calculate emissions (1 preferred, 2 alternates)
 3. Number of fires in activity area
-



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4. County population of concern
5. State population of concern

Outputs:

- Total PM (Will include speciation calculation into PM2.5 and PM10)
- TOC
- Hydrogen Cyanide
- Formaldehyde
- Acrolein
- Hydrochloric Acid
- VOC
- NOx
- CO

9 **Surface Mining**

Notes:

Metallic mining operations includes emissions from overburden removal, drilling & blasting, and loading/unloading during the mining operations.

Non-metallic mining operations include emissions from overburden removal, drilling & blasting, and loading/unloading during the mining operations.

Coal mining operations includes emissions from overburden removal, drilling & blasting, and loading/unloading, and overburden replacement.

Calculations begin with PM-10 emissions. PM-2.5 emissions are estimated by multiplying the PM-10 emissions by the particle adjustment parameter of 0.2. (ref. pg.7)

Inputs:

1. Type of Measurement Units
2. Type of General Mining Operation
 - metallic mining operations
 - non-metallic mining operations
 - coal mining operations
3. Emissions Control Type
4. Total Material Processed During Operations

NEI Mining & Quarrying document (Mining&Quarrying_ReadMe.wpd) as provided to Lakes Environmental by Doug Solomon on 10/10/02.

Outputs:



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**Tribal Emissions Inventory Software Solution
TEISS**

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1. General Emissions

- PM-10
- PM-2.5

10 **Asphalt Paving**

AP-42 Vol.1 5th
Ed., Ch 4.5, July
1979
(reformatted
January 1995)

Inputs:

1. Type of measurement units
2. Type of asphalt used for paving
 - asphalt cement
 - cutback asphalt, rapid cure
 - cutback asphalt, medium cure
 - cutback asphalt, slow cure
 - emulsified asphalt
3. Density of diluent in cutback asphalt; default values:
 - RC = 0.7 kg/L (5.84 lbm/gal)
 - MC = 0.8 kg/L (6.68 lbm/gal)
 - SC = 0.9 kg/L (7.51 lbm/gal)
4. Density of cement used in asphalt; default value: 1.1 kg/L (9.18 lbm/gal)
5. Percent volume of diluent in asphalt; default value:35%; valid range: 25-45%
6. Amount of asphalt used for paving
7. Local records re-paving is available

Outputs:

1. Emissions list
2. Emission ratings

Notes:

The "linear interpolation" mentioned in table 4.5-1(c) uses curve fit equations to interpolate between known data points for rapid cure (RC), medium cure (MC) and slow cure (SC) cutback asphalt.

$$RC: \% \text{ evaporated} = 0.534473786727 * (\text{vol}\% \text{ diluent})^{1.07329579494}$$

$$MC: \% \text{ evaporated} = -1 + 0.6 * (\text{vol}\% \text{ diluent})$$

$$SC: \% \text{ evaporated} = -22.4147026052 + 8.52897428511 * \ln(\text{vol}\% \text{ diluent})$$

The equations method outlined in the example on pg 4.5-2 is also implemented, and is the preferred method to calculate the VOC emissions. This method will generate a more accurate value; it does not lose accuracy due to rounding.



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11 **Bulk Terminals / Plants**

TANKS is a Windows-based computer software program that estimates volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from fixed- and floating-roof storage tanks. TANKS is based on the emission estimation procedures from Chapter 7 of EPA's Compilation Of Air Pollutant Emission Factors (AP-42).

Note that SCCs for desired processes would be needed to perform proper queries within FIRE.

TANKS v.4.09b
(Estimation software based on AP-42, Ch. 7).

12 **Petroleum Refineries**

AP-42 Vol.5 5th
Ed., Ch 5.1, 1995

Note:

There are five major categories of refinery processes and associated operations:

1. Separation processes

- a. Atmospheric distillation
- b. Vacuum distillation
- c. Light ends recovery (gas processing)

2. Petroleum conversion processes

- a. Cracking (thermal and catalytic)
- b. Reforming
- c. Alkylation
- d. Polymerization
- e. Isomerization
- f. Coking
- g. Visbreaking

3. Petroleum treating processes

- a. Hydrodesulfurization
- b. Hydrotreating
- c. Chemical sweetening
- d. Acid gas removal
- e. Deasphalting

4. Feedstock and product handling

- a. Storage
- b. Blending
- c. Loading
- d. Unloading

5. Auxiliary facilities



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- a. Boilers
- b. Waste water treatment
- c. Hydrogen production
- d. Sulfur recovery plant
- e. Cooling towers
- f. Blowdown system
- g. Compressor engines

Inputs:

Feed rate

Outputs:

Particulate
Sulfur Oxides
CO
Total Hydrocarbons
Nitrogen Oxides
Aldehydes
Ammonia

13 **Dairy Farms**

Battye et. al.
(1994), Table 2-9

Notes:

EFs and livestock categories as given in Battye et. al. (1994), Table 2-9. This particular category will use Emission Factors that are classified as Dairy & calf cows. Additional livestock emissions can be found in the following section Livestock Waste.

Work being conducted in 2002 by Sonoma Technologies, Inc. and the Lake Michigan Air Directors Consortium (LADCO) indicates that the Battye et. al. emission factors for livestock may need to be decreased by 25%-50% for cattle and swine, decreased by a factor of 3 for laying chickens, and decreased by a factor of 4 for turkeys. Emissions factors for livestock change or are refined frequently. If this is an important source on a reservation, research into current factors may be desirable.



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14 **Livestock Waste**

Battye et. al.
(1994), Table 2-9

Notes:

EFs and livestock categories as given in Battye et. al. (1994), Table 2-9. Cattle and Calves- Composite; Hogs and Pigs- Composite; Poultry – Chickens – Composite; for Other Poultry, Ducks kept as a separate category with its own EF, just one category of “Turkeys” with an EF of 0.858 kg NH3/animal; Sheep and Lambs – Composite; all separate miscellaneous farm animal EFs, for domestic animals, only include the EF for Horses.

Work being conducted in 2002 by Sonoma Technologies, Inc. and the Lake Michigan Air Directors Consortium (LADCO) indicates that the Battye et. al. emission factors for livestock may need to be decreased by 25%-50% for cattle and swine, decreased by a factor of 3 for laying chickens, and decreased by a factor of 4 for turkeys. Emissions factors for livestock change or are refined frequently. If this is an important source on a reservation, research into current factors may be desirable.



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Emissions from Source Categories – Priority 3

1 **Publicly Owned Water Treatment Works** Battye et. al. (1994), Table 6-5

Notes:

Emission Factors for Publicly Owned Water Treatment Works as given in Battye et. al. (1994) Table 6-5, English units (lb/million gallons).

“Work being conducted in 2002 by Sonoma Technologies, Inc. and the Lake Michigan Air Directors Consortium (LADCO) indicates that the Battye et. al. emission factors for Sewage Treatment Plants may be significantly over-estimating ammonia emissions. If this is an important source on a reservation, research into current factors may be desirable.”

2 **Restaurant Grills** EIIP Vol.3 (Area Sources), Area Source Method Abstract - Charbroiling, December 2000

Notes:

Most of the PM emissions is assumed to be PM-2.5 or smaller.

Emission factors used are based on an average throughput per restaurant with a charbroiler of 1,160 lb cooked per week.

Inputs:

1. Type of Measurement Units
2. Type of Charbroiling Process
 - direct-fired grills
3. Emissions Control Type
4. Amount of Ground Beef Charbroiled

Outputs:

1. Total PM (Will include speciation calculation into PM2.5 and PM10)
2. Reactive Organic Gases (assumed to be equivalent to VOC)

3 **Soil Ammonia** CMU NH3 Inventory v. 2.1 Table 6.

Notes:

The methods in the CMU User Guide bases emission factors from Cass et. Al. (1994)





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that are associated with Anderson Land Use Codes. Land use data is available in GIS format that has compatible Land Use codes. This will enable users to determine how many acres of each land use type are in their study area.

Inputs:

1. Land Use Code
2. Area

Outputs:

1. Emissions

4 **Surface Cleaning**

Reference: AP-42
Vol.1 5th Ed., Ch
4.6, April 1981
(reformatted
January 1995)

Notes:

Assuming that surface cleaning is performed with solvents.

VOC emissions are assumed to be uncontrolled, since there is no information in the reference to infer what emission reductions would be like in any other case.

Inputs:

1. Type of measurement units
2. Type of degreasing method
3. Any control equipment used
4. Any operating procedures followed
5. Amount of solvents used -or- number of units in operation -or- total surface area cleaned per hour number of hours spent cleaning\degreasing
6. Calc emissions by solvent consumed
7. Calc emissions by cleaning\degreasing units used
8. Calc emissions by surface area cleaned & duty cycle

Outputs:

1. Emissions list
2. EmissionsMinMax list
3. Emission ratings

5 **Adhesives**

EIIP, Vol.3:
Ch.5, August
1996.

Inputs:

1. Type of Measurement Units
2. Type of Commercial Usage
 - personal care products
 - household products



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- automotive aftermarket products
 - adhesives & sealants
 - FIFRA-regulated products
 - coatings and related products
 - miscellaneous products
 - total for all consumer & commercial products
3. Emissions Control Type
- uncontrolled emissions
4. Total Local Population

Outputs:

1. General Emissions
- VOC
 - HAP
 - acetamide
 - acetophenone
 - acrylic acid
 - benzene
 - carbon tetrachloride
 - chlorobenzene
 - chloroform
 - dibenzofurans
 - 1,4-dichlorobenzene
 - 1,2-dichloroethane
 - 1,3-dichloropropene
 - dimethyl formamide
 - 1,4-dioxane
 - ethyl benzene
 - ethylene oxide
 - formaldehyde
 - glycol ethers
 - hexane
 - hydrochloric acid
 - hydrogen fluoride
 - isophorone
 - methanol
 - methyl bromide
 - methyl ethyl ketone
 - methyl isobutyl ketone
 - methyl-tert-butyl ether
 - methylene chloride



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- naphthalene
- 2-nitropropane
- perchloroethylene
- toluene
- 1,1,1-trichloroethane
- trichloroethylene
- triethylamine
- vinyl acetate
- xylenes

6 Industrial Waste Water

WATER9
Version 1.0.0

Using USEPA WATER9 model. WATER9 is a Windows based computer program and consists of analytical expressions for estimating air emissions of individual waste constituents in wastewater collection, storage, treatment, and disposal facilities; a database listing many of the organic compounds; and procedures for obtaining reports of constituent fates, including air emissions and treatment effectiveness.

7 Incineration

Three types of incineration is considered here:

- Medical waste
- Sewage sludge
- Refuse waste

7.1 Medical Waste Incineration

AP-42 Vol.1 5th
Ed., Ch 2.3, July
1993
(reformatted
January 1995)

Notes:

The emission factors are provided in both lbm/ton and kg/tonne. The decision to use only the lbm/ton factors was made on the assumption that the US-EPA would have originally calculated the factors in those units, and then performed a conversion to create the kg/tonne tables.

Inputs:

1. Type of measurement units
2. Type of process/heater used to burn



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- Controlled-air incinerator
 - Excess-air incinerator (no emission factors provided by AP-42)
 - Rotary kiln incinerator
3. Type of control
- Uncontrolled emissions
 - Low energy scrubber (Low-E scrubber) / fabric filter (FF)
 - Medium energy scrubber (Med-E scrubber) / FF
 - Fabric filter (FF) only
 - Low energy scrubber only
 - High energy scrubber (high-E scrubber) only
 - Dry sorbent injection (DSI) + FF
 - Dry sorbent injection + carbon injection + FF
 - Dry sorbent injection + any scrubber + FF
 - Dry sorbent injection + electrostatic precipitator (ESP)
 - Spray dryer + FF
 - Spray dryer + carbon injection + FF
4. Amount of fuel fired

Outputs:

1. Emissions List (including HAPs)
 - NOx
 - CO
 - SO2
 - TotalPM (Will include speciation calculation into PM2.5 and PM10)
 - TOC
 - HydroChlor
 - HydroBrom
 - HydroFluor
 - Chlorine
 - TotalPCB
2. Metals List
 - Aluminum
 - Antimony
 - Arsenic
 - Barium
 - Beryllium
 - Cadmium
 - Chromium
 - Copper
 - Iron
 - Manganese
 - Mercury



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- Nickel
 - Silver
 - Thallium
3. CDD/CDF List
- TCDD2378
 - TCDD
 - HxCDD123678
 - HxCDD123789
 - HpCDD1234678
 - OCDD
 - TotalPCDD
 - TCDF2378
 - TCDF
 - PeCDF12378
 - PeCDF23478
 - HxCDF123478
 - HxCDF123678
 - HxCDF234678
 - HpCDF1234678
 - HpCDF1234789
 - OCDF
 - TotalPCDF
4. Emission ratings

7.2 Sewage Sludge Incineration

AP-42 Vol.1 5th
Ed., Ch 2.2,
January 1995

Notes:

The controls used during the calculation of PM-10 & PM-2.5 emissions are a best guess based on the text provided on pg.2.2-9 of the reference. All emissions are calculated in lbm/ton.

Inputs:

1. Type of measurement units
2. Type of incinerator
 - Multiple hearth furnace
 - Fluidized bed incinerator
 - Electric infrared incinerator
3. Type of emission controls used
 - Uncontrolled emissions
 - Cyclone



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- Cyclone / impingement
 - Cyclone / venturi
 - Cyclone / venturi / impingement
 - Electrostatic precipitator
 - Fabric filter
 - Impingement
 - Venturi
 - Venturi / impingement/afterburner
 - Venturi / impingement
 - Venturi / impingement/wet ESP
 - Venturi / wet ESP
4. Amount of sewage incinerated

Outputs:

1. Emissions list
 - FilterPM
 - SO2
 - NOx
 - CO
 - Lead
 - NNMOC
 - Sulphuric acid
 - Hydrochloric Acid
 - TriChloroE111
 - DiChloro12
 - DiChloro14
 - NitroPhenol2
 - Aceton :
 - Acrylonitrile
 - Benzene
 - Bis2EthylPhthal
 - BromoDichloroMeth
 - CarbTetra
 - ChloroBenz
 - ChloroF
 - EthylBenzene
 - MEK
 - MethyleneChlor
 - Naphtha
 - PerchloroEthylene
 - Phenol
 - Toluene



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- Trans12DichloroEthene
 - TriChloroEthene
 - VinylChloride
 - Xylenes
2. Metal list
- Aluminum
 - Antimony
 - Arsenic
 - Barium;
 - Beryllium
 - Cadmium
 - Calcium
 - Chromium
 - Cobalt
 - Copper
 - Gold
 - Iron
 - Manganese
 - Magnesium
 - Nickel
 - Phosphorous
 - Potassium
 - Selenium
 - Silicon
 - Silver
 - Sodium
 - Sulphur
 - Tin
 - Titanium
 - Vanadium
 - Zinc
3. Dioxin list
- TCDD
 - PeCDD
 - HxCDD
 - HpCDD
 - OCDD
 - TCDF2378
 - TCDF
 - PeCDF
 - HxCDF
 - HpCDF
 - OCDF



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- TotalPCDD
 - TotalPCDF
4. Emission ratings

7.3 Refuse Waste Incineration

AP-42 Vol.1 5th
Ed., Ch 2.1,
October 1996

Notes:

All calculations are performed with emission factors in lbm/tons; this is the reason some of the tables from this section were not referenced. The un-referenced tables contained information in kg/tonne.

Inputs:

1. Type of measurement units
2. General type of combustor/combustor method used
 - Municipal solid waste
 - Industrial / commercial
 - Trench
 - Flue-fed single chamber
 - Flue-fed (modified)
 - Domestic single chamber
3. Specific type of combustor used, if applicable
 - Municipal Solid Waste (MSW): mass burn waterwall
 - MSW: mass burn rotary waterwall
 - MSW: mass burn refractory wall
 - MSW: refuse-derived fuel-fired
 - MSW: modular excess-air
 - MSW: modular starved-air
 - Industrial / commercial: multiple chamber
 - Industrial / commercial: single chamber
 - Trench: wood
 - Trench: rubber tires
 - Trench: municipal refuse
 - Domestic single chamber: without primary burner
 - Domestic single chamber: with primary burner
4. Emission control equipment used, if any
 - Uncontrolled
 - Electrostatic precipitator (ESP)
 - Fabric filter (FF)
 - Dry sorbent injection / ESP
 - Spray dryer/ESP



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- Dry sorbent injection/FF
 - Spray dryer/FF
5. Heating value of refuse
 6. Amount of refuse combusted

Outputs:

1. Emissions list
 - SO2
 - Hydrochloric acid
 - NOx
 - CO
 - CO2
 - FilterPM
2. Metal list
 - Arsenic
 - Cadmium
 - Chromium
 - Mercury
 - Nickel
3. Dioxin list
4. Emission ratings

*

8 **Grain Elevator**

AP-42 Vol.1 5th
Ed., Ch 9.9.1,
May 1998

Notes:

Grain Receiving - wheat flour mills, corn dry mills, durum mills, rye mills & oat mills use the grain elevator grain receiving emission factors for calculating PMs; does not include ship or barge receiving.

Grain Cleaning - animal feed mills, corn dry mills & oat mills use the grain elevator grain cleaning emission factors for calculating PMs.

Grain Drying - corn dry mills use the grain elevator grain drying emission factors for calculating PMs.

Grain Handling - wheat flour mills, corn dry mills & rye mills use the grain elevator grain handling emission factors for calculating PMs.

Inputs:

1. Type of measurement units



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2. Type of grain handling facility
 - Grain elevators
 - Animal feed mills
 - Wheat flour mills
 - Corn dry mills
 - Rice mills
 - Durum mills
 - Rye mills
 - Oat mills
 - Barley malting
3. Facility emission source type
 - Grain receiving
 - Grain cleaning
 - Cleaning house
 - Pre-cleaning/handling
 - Grain drying
 - Headhouse/internal handling
 - Grain handling
 - Storage bin (vent)
 - Storage
 - Grain shipping
 - Shipping
 - Packaging/shipping
 - Grain milling
 - Mixer
 - Conditioning
 - Pelletizing
 - Bulk loading
 - Degermer/milling
 - Rice drying
 - Parboiling
 - Mill house
 - Paddy cleaner
 - Aspirator
 - Bran handling
 - Trumbel
 - Trieurs
 - Separators
 - Drying/cooling
 - Grading/sizing
 - Hulling
 - Cutting
 - Steaming/conditioning



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- Flaking
- Screening
- Gas-fired malt kiln
- 4. Specific source process (if applicable)
 - Trucks (unspecified)
 - Straight truck
 - Hopper truck
 - Railcar
 - Barge
 - Ship
 - Internal vibrating
 - Stationary enclosed
 - Column dryer
 - Rack dryer
 - Hammer mill
 - Flaker
 - Grain cracker
 - Pellet cooler
 - Roller mill
- 5. Emission control type
 - Uncontrolled emissions
 - Cyclone
 - Self-cleaning screens (<50 mesh)
 - Baghouse
 - High-efficiency cyclone
 - Fabric filter
- 6. Amount of grain handled/processed

Outputs:

1. Emissions list
2. Emission ratings