Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions for Natural Gas Residential Furnaces (< 0.3 and 0.3-100 MMBTU/hr)

Are there any of these sources at the facility (1 = YES, 0 = NO)? **1**

Location (Building)	Rated Heat Input (BTU/hr)	Number at Location	Total Heat Input (MMBTU/hr)	For Heating Units greater than 1.0 MMBTU/hr: Manufacturer	Model Number	Heating Unit Type (1)
Heating Units < 0.5 MMBTU/hr						
Bldg. 1 (Water Heater)	70,000	1	0.07	--	--	--
Bldg. 1 (Rheem Boiler) U4	225,000	1	0.23	--	--	--
Bldg. 1 (Rheem Boiler) U5	125,000	1	0.13	--	--	--
Bldg. 1 (Carrier Boiler) U6	72,000	1	0.07	--	--	--
Bldg. 1 (Carrier Boiler) U7	72,000	1	0.07	--	--	--
Bldg. 1 (Rheem Boiler) U8	252,000	1	0.25	--	--	--
Bldg. 1 (Rheem Boiler) U13	80,000	1	0.08	--	--	--
Bldg. 1 (Trane Boiler) U11	270,000	1	0.27	--	--	--
Bldg. 1 (Carrier Boiler) U12	114,000	1	0.11	--	--	--
Bldg. 1 (Rheem Boiler) U10	150,000	1	0.15	--	--	--
Bldg. 1 (American Standard Boiler) U14	120,000	1	0.12	--	--	--
Bldg. 1 (Rheem Boiler) U15	135,000	1	0.14	--	--	--
Bldg. 1 (Carrier Boiler) U17	72,000	1	0.07	--	--	--
Bldg. 1 (Carrier Boiler) U19	72,000	1	0.07	--	--	--
Bldg. 1 (American Standard Boiler) U19A	80,000	1	0.08	--	--	--
Bldg. 1 (American Standard Boiler) U20	80,000	1	0.08	--	--	--
Bldg. 1 (American Standard Boiler) U21	80,000	1	0.08	--	--	--
Bldg. 1 (Trane Boiler) U23	250,000	1	0.25	--	--	--
Bldg. 4 (AO Smith Boiler)	400,000	1	0.40	--	--	--
Bldg. 4 (AO Smith Boiler)	400,000	1	0.40	--	--	--
Bldg. 5 (AO Smith Boiler)	300,000	1	0.30	--	--	--
Bldg. 6 (Rayovac Boiler)	180,000	1	0.18	--	--	--
Bldg. 6 (Rayovac Boiler)	180,000	1	0.18	--	--	--
Bldg 9 (ReVerberRay Boiler) U1	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U2	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U3	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U4	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U5	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U6	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U7	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U8	200,000	1	0.20	--	--	--
Bldg 9 (ReVerberRay Boiler) U9	175,000	1	0.18	--	--	--
Bldg 9 (ReVerberRay Boiler) U10	175,000	1	0.18	--	--	--
Bldg 9 (ReVerberRay Boiler) U11	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U12	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U13	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U14	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U15	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U16	125,000	1	0.13	--	--	--
Bldg 9 (ReVerberRay Boiler) U17	100,000	1	0.10	--	--	--
Bldg. 9 (Rheem Water Heater)	180,000	1	0.18	--	--	--

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

Location (Building)	Rated Heat Input (BTU/hr)	Number at Location	Total Heat Input (MMBTU/hr)	Manufacturer	Model Number	Heating Unit Type (1)
Bldg. 9 (Ruud Boiler))	360,000	1	0.36	--	--	--
Bldg. 10 (Water Heater)	75,100	1	0.08	--	--	--
Bldg. 10 (Water Heater)	75,100	1	0.08	--	--	--
Bldg. 10 (CoRayVac Boiler)	360,000	1	0.36	--	--	--
Bldg. 10 (CoRayVac Boiler)	360,000	1	0.36	--	--	--
Bldg. 10 (CoRayVac Boiler)	360,000	1	0.36	--	--	--
Bldg 12 (CoRayVac Boiler) U1	180,000	1	0.18	--	--	--
Bldg 12 (CoRayVac Boiler) U2	180,000	1	0.18	--	--	--
Bldg 12 (CoRayVac Boiler) U3	120,000	1	0.12	--	--	--
Bldg 12 (CoRayVac Boiler) U4	120,000	1	0.12	--	--	--
Bldg 12 (CoRayVac Boiler) U5	120,000	1	0.12	--	--	--
Bldg 12 (CoRayVac Boiler) U6	120,000	1	0.12	--	--	--
Bldg 15 (RheemWater Heater)	250,000	1	0.25	--	--	--
Bldg 15 (Trane Boiler) U2	130,000	1	0.13	--	--	--
Bldg 15 (Trane Boiler) U6	130,000	1	0.13	--	--	--
Bldg 15 (Trane Boiler) U3	200,000	1	0.20	--	--	--
Bldg 15 (Trane Boiler) U4	200,000	1	0.20	--	--	--
Bldg 15 (Trane Boiler) U5	200,000	1	0.20	--	--	--
Bldg 21 (Carrie Boiler) U3	72,000	1	0.07	--	--	--
Bldg 21 (Rheem Boiler)	252,000	1	0.25	--	--	--
Bldg. 21 (Rinnai Water Heater)	180,000	1	0.18	--	--	--
Bldg 21 (Rheem Boiler) U5	135,000	1	0.14	--	--	--
Bldg 21 (Rheem Boiler) U4	225,000	1	0.23	--	--	--
Bldg 21 (Rheem Boiler) U7	72,000	1	0.07	--	--	--
Bldg 25 (Water heater)	75,100	1	0.08	--	--	--
Bldg 25 (Water heater)	44,000	1	0.04	--	--	--
Bldg 27 (Rheem Water Heater)	50,000	1	0.05	--	--	--
Bldg 27 (Rayovac Boiler)	125,000	1	0.13	--	--	--
Bldg 27 (Rayovac Boiler)	125,000	1	0.13	--	--	--
Bldg 27 (Carrier Boiler) U5	76,000	1	0.08	--	--	--
Bldg 27 (Carrier Boiler) U6	76,000	1	0.08	--	--	--
Bldg 27 (Carrier Boiler) U4	125,000	1	0.13	--	--	--
Bldg 28 (Amana Boiler)	40,000	1	0.04	--	--	--
Bldg 28 (Dayton Boiler) U2	150,000	1	0.15	--	--	--
Bldg 28 (Trane Boiler)	150,000	1	0.15	--	--	--
Bldg 32 (Rheem)	40,000	1	0.04	--	--	--
Bldg 32 (Washrack)	320,000	1	0.32	--	--	--
Bldg 32 (ReVerberRay) U1	100,000	1	0.10	--	--	--
Bldg 32 (ReVerberRay) U2	100,000	1	0.10	--	--	--
Bldg 32 (ReVerberRay) U3	100,000	1	0.10	--	--	--
Bldg 32 (ReVerberRay) U4	100,000	1	0.10	--	--	--
Bldg 32 (ReVerberRay) U5	100,000	1	0.10	--	--	--
Bldg 32 (ReVerberRay) U6	60,000	1	0.06	--	--	--
Bldg 32 (ReVerberRay) U7	60,000	1	0.06	--	--	--
Bldg 32 (ReVerberRay) U8	60,000	1	0.06	--	--	--
Bldg 32 (Trane) U7	80,000	1	0.08	--	--	--

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

Location (Building)	Rated Heat Input (BTU/hr)	Number at Location	Total Heat Input (MMBTU/hr)	Manufacturer	Model Number	Heating Unit Type (1)
Bldg 32 (Trane) U8	69,000	1	0.07	--	--	--
Bldg. 33 (Carrier Boiler) U13	72,000	1	0.07	--	--	--
Bldg. 33 (Trane Boiler) U10	60,000	1	0.06	--	--	--
Bldg. 33 (Rheem Boiler) U14	96,000	1	0.10	--	--	--
Bldg. 33 (Reznor Boiler) U1	75,000	1	0.08	--	--	--
Bldg. 33 (Reznor Boiler) U2	75,000	1	0.08	--	--	--
Bldg. 33 (Reznor Boiler) U3	75,000	1	0.08	--	--	--
Bldg. 33 (Reznor Boiler) U4	75,000	1	0.08	--	--	--
Bldg. 34 (Bradford Water Heater)	199,990	1	0.20	--	--	--
Bldg. 34 (Rheem Boiler) U8	150,000	1	0.15	--	--	--
Bldg. 34 (Carrier Boiler) U7	150,000	1	0.15	--	--	--
Bldg. 34 (Carrier Boiler) U18	72,000	1	0.07	--	--	--
Bldg. 34 (Rayovac Boiler) U1	120,000	1	0.12	--	--	--
Bldg. 34 (Rayovac Boiler) U2	120,000	1	0.12	--	--	--
Bldg. 34 (Rayovac Boiler) U3	120,000	1	0.12	--	--	--
Bldg. 34 (Rayovac Boiler) U4	120,000	1	0.12	--	--	--
Bldg. 34 (Reznor Boiler)	175,000	1	0.18	--	--	--
Bldg. 34 (Reznor Boiler)	350,000	1	0.35	--	--	--
Bldg. 35 (Bradford Boiler)	365,000	1	0.37	--	--	--
Bldg. 35 (Rayovac Boiler) U1	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U2	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U3	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U4	120,000	1	0.12	--	--	--
Bldg. 34 (Reznor Boiler)	175,000	1	0.18	--	--	--
Bldg. 34 (Reznor Boiler)	350,000	1	0.35	--	--	--
Bldg. 35 (Bradford Boiler)	365,000	1	0.37	--	--	--
Bldg. 35 (Rayovac Boiler) U1	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U2	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U3	120,000	1	0.12	--	--	--
Bldg. 35 (Rayovac Boiler) U4	120,000	1	0.12	--	--	--
Bldg. 40 (A.O. Smith Boiler)	75,000	1	0.08	--	--	--
Bldg. 40 (A.O. Smith Boiler)	75,000	1	0.08	--	--	--
Bldg. 40 (A.O. Smith Boiler)	75,000	1	0.08	--	--	--
Bldg. 40 (York Boiler) U6	160,000	1	0.16	--	--	--
Bldg. 40 (Rheem Boiler) U5	100,000	1	0.10	--	--	--
Bldg. 40 (Rheem Boiler) U8	100,000	1	0.10	--	--	--
Bldg. 40 (Rheem Boiler) U9	100,000	1	0.10	--	--	--
Bldg. 40 (Rheem Boiler) U10	100,000	1	0.10	--	--	--
Bldg. 40 (Rheem Boiler) U7	100,000	1	0.10	--	--	--
Bldg. 41 (A.O. Smith Boiler) U8	50,000	1	0.05	--	--	--
Bldg. 41 (Coleman Boiler) U1	75,000	1	0.08	--	--	--
Bldg. 41 (Coleman Boiler) U2	100,000	1	0.10	--	--	--
Bldg. 41 (Rheem Boiler) U6	80,000	1	0.08	--	--	--
Bldg. 42 (Water Heater)	222,500	1	0.22	--	--	--
Bldg. 42 (Trane Boiler) U5	350,000	1	0.35	--	--	--
Bldg. 42 (Raypack Boiler)	300,000	1	0.30	--	--	--

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

Location (Building)	Rated Heat Input (BTU/hr)	Number at Location	Total Heat Input (MMBTU/hr)	Manufacturer	Model Number	Heating Unit Type (1)
Bldg. 44 (Am Standard Water Heater)	270,000	1	0.27	--	--	--
Bldg. 44 (Am Standard Water Heater)	270,000	1	0.27	--	--	--
Bldg. 44 (Am Standard Water Heater)	270,000	1	0.27	--	--	--
Bldg. 44 (Am Standard Water Heater)	270,000	1	0.27	--	--	--
Bldg. 49 (GE Boiler)	38,000	1	0.04	--	--	--
Bldg. 49 (A.O. Smith Boiler)	75,500	1	0.08	--	--	--
Bldg. 49 (Ajax Boiler)	350,000	1	0.35	--	--	--
Flightline (Pressure Washer)	320,000	1	0.32	--	--	--
Heating Units (Heating Units 0.5 -100 MMBTU/hr)						
Bldg. 5 (Laars Boiler)	2,450,000	1	2.45	Laars	HH2450IN18KCACQ	--
Bldg. 5 (water heater)	535,000	1	0.54	Water Heater	--	--
Bldg. 9 (RHEEM Boiler)	720,000	1	0.72	Rheem	RF180-96	--
Bldg. 9 (RHEEM Boiler)	720,000	1	0.72	Rheem	RF180-96	--
Bldg. 9 (Bryan Boiler)	2,700,000	1	2.70	Bryan	CL 270-W-160-GI	--
Bldg. 10 (Ajax Boiler)	1,150,000	1	1.15	Ajax	WEFD-1125	--
Bldg. 12 (McLain Boiler)	910,000	1	0.91	McLain	LGB-8	--
Bldg. 12 (Ruud Boiler)	720,000	1	0.72	Ruud	GL84A-720	--
Bldg. 12 (Ruud Boiler)	720,000	1	0.72	Ruud	GL84A-720	--
Bldg. 35 (Rite Boiler)	900,000	1	0.90	Rite	90.0	--
Bldg. 40 (Ajax Boiler)	800,000	1	0.80	Ajax	WFG800	--
Bldg 44 (Modcon Boiler)	500,000	1	0.50	Modcon	500HL	--
Bldg 44 (Modcon Boiler)	500,000	1	0.50	Modcon	500HL	--
Bldg 44 (Modcon Boiler)	500,000	1	0.50	Modcon	500HL	--
Bldg 49 (Weber - Jared Boiler)	700,000	1	0.70	Weber-Jared	AJHWR-70NG	--
Bldg 4 (Bryan Boiler)	1,800,000	1	1.80	Bryan boiler	HECLM180-W-FDG	--
Bldg 4 (Bryan Boiler)	1,800,000	1	1.80	Bryan boiler	HECLM180-W-FDG	--
Aircraft Paint Booth	1,944,000	1	1.94	RUUP	CF4227	--
Total, Heating Units <0.5 MMBTU/hr			**21.71**			
Total, Heating Units 0.5-100 MMBTU/hr			**20.07**			

2.0 *Hourly PTE Fuel Usage*

Hourly potential to emit fuel usage is based on all furnaces and water heaters running at the same time

Total heat input (<0.5 MMBTU/hr) = 21.71 MMBTU/hr

Total heat input (0.5-100 MMBTU/hr) = 20.07 MMBTU/hr

Conversion = To convert from lb/10^6 scf to lb/MMBTU/hr ÷ 1020

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

3.0 Emission factors, from AP-42, Section 1.4 Tables 1.4-1 and 1.4-2, Residential Furnaces

Constituent	Emission Factors for Heating Units < 0.3 MMBTU/hr	
CO	40	lb/1,000,000 ft^3
NOx	94	lb/1,000,000 ft^3
PM-10 (1)	7.6	lb/1,000,000 ft^3, condensible and filterable
PM-2.5 (1)	7.6	lb/1,000,000 ft^3, condensible and filterable
SO_2	0.6	lb/1,000,000 ft^3
VOC, non-methane	5.5	lb/1,000,000 ft^3

(1) Combination of both filterable and condensible particulate matter. All particulate matter is assumed to be less than 1.0 micrometer in diameter (i.e., the emission factor applies to Total PM, PM-10, and PM-2.5), see AP-42, Table 1.4-2.
(2) If the combustion source is controlled, the uncontrolled emission factors would be multiplied by the efficiency of the control device, or (1-CE).

Emission factors, from AP-42, Section 1.4 Tables 1.4-1 and 1.4-2, Small Commercial Heating Units

Constituent	Emission Factors for Heating Units 0.3-100 MMBTU/hr	
CO	84	lb/1,000,000 ft^3
NOx	100	lb/1,000,000 ft^3
PM-10 (1)	7.6	lb/1,000,000 ft^3, condensible and filterable
PM-2.5 (1)	7.6	lb/1,000,000 ft^3, condensible and filterable
SO_2	0.6	lb/1,000,000 ft^3
VOC, non-methane	5.5	lb/1,000,000 ft^3

(1) Combination of both filterable and condensible particulate matter. All particulate matter is assumed to be less than 1.0 micrometer in diameter (i.e., the emission factor applies to Total PM, PM-10, and PM-2.5), see AP-42, Table 1.4-2.
(2) If the combustion source is controlled, the uncontrolled emission factors would be multiplied by the efficiency of the control device, or (1-CE).

4.0 Calculation of Criteria Pollutant Emission Rates.

Constituent	Hourly PTE <0.5 MMBTU/hr (lb/hr) (1)	Hourly PTE 0.5-100 MMBTU/hr (lb/hr) (1)	Annual PTE <0.5 MMBTU/hr (lb/yr) (2)	Annual PTE 0.5-100 MMBTU/hr (lb/yr) (2)
CO	0.85	1.65	7,457	14,478
NOx	2.00	1.97	17,523	17,236
PM-10	0.16	0.15	1,417	1,310
PM-2.5	0.16	0.15	1,417	1,310
SO_2	0.01	0.01	112	103
VOC	0.12	0.11	1,025	948

(1) Hourly potential to emit fuel usage is based on all heating units running at the same time.
(2) Annual potential to emit is based on 8,760 hr/yr.

Calculation of Annual Emissions

$$([\text{Emission Factor (lb/mmcf)} \times \text{Fuel Usage (cf/yr)}]_{<0.5\ \text{MMBTU/hr}} + [\text{Emission Factor (lb/mmcf)} \times \text{Fuel Usage (cf/yr)}]_{0.5\text{-}100\ \text{MMBTU/hr}}) / 10^6\ \text{cf/mmcf} = \text{Actual Emissions (lb/yr)}$$

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

4.2 Calculation of Hourly PTE

([Emission Factor (lb/mmcf) x Fuel Usage (cf/hr)]$_{<0.5\ MMBTU/hr}$ + [Emission Factor (lb/mmcf) x Fuel Usage (cf/hr)]$_{0.5\text{-}100\ MMBTU/hr}$) / 10^6 cf/mmcf = Emissions (lb/hr)

4.3 Calculation of Annual PTE

Hourly PTE (lb/hr) x 8760 hr/yr = Potential Emissions (lb/yr)

5.0 Emission rate calculations for organic HAPs.

HAP constituents obtained from AP-42, Section 1.4, Table 1.4-3 (3/98).

Constituent	Emission Factor ($lb/10^6 ft^3$)	Hourly PTE <0.5 MMBTU/hr (lb/hr) (1)	Hourly PTE 0.5-100 MMBTU/hr (lb/hr) (1)	Annual PTE <0.5 MMBTU/hr (lb/yr) (2)	Annual PTE 0.5-100 MMBTU/hr (lb/yr) (2)
Benzene	0.002	4.47E-05	4.13E-05	0.39	0.36
Formaldehyde	0.075	1.60E-03	1.48E-03	13.98	12.93
Toluene	0.003	7.24E-05	6.69E-05	0.63	0.59
Naphthalene	6.10E-04	1.30E-05	1.20E-05	0.11	0.11
Hexane	1.8	3.83E-02	3.54E-02	335.55	310.24
Polycyclic Organic Matter	8.80E-05	1.66E-06	1.29E-06	0.01	0.01
Total		**0.040**	**0.037**	**351**	**324**

5.1 Calculation of Annual Emissions

(Emission Factor (lb/mmcf) x [Fuel Usage (cf/yr)$_{<0.5\ MMBTU/hr}$ + Fuel Usage (cf/yr)$_{0.5\text{-}100\ MMBTU/hr}$])/ 10^6 cf/mmcf = Actual Emissions (lb/yr)

5.2 Calculation of Hourly PTE

(Emission Factor (lb/mmcf) x [Fuel Usage (cf/hr)$_{<0.5\ MMBTU/hr}$ + Fuel Usage (cf/hr)$_{0.5\text{-}100\ MMBTU/hr}$])/ 10^6 cf/mmcf = Emissions (lb/hr)

5.3 Calculation of Annual PTE

Hourly PTE (lb/hr) x 8760 (hr/yr) = Potential HAP Emissions (lb/yr)

Table A-1
Emission Calculations for Natural Gas Residential Heating Units (< 0.5-100 MMBTU/hr)
162nd FW, Tucson, Arizona

6.0 Emission rate calculations for inorganic HAPs.

HAP constituents obtained from AP-42, Section 1.4, Table 1.4-4 (3/98).

Constituent	Emission Factor ($lb/10^6 ft^3$)	Hourly PTE <0.5 MMBTU/hr (lb/hr) (1)	Hourly PTE 0.5-100 MMBTU/hr (lb/hr) (1)	Annual PTE <0.5 MMBTU/hr (lb/yr) (2)	Annual PTE 0.5-100 MMBTU/hr (lb/yr) (2)
Arsenic	2.00E-04	4.26E-06	3.94E-06	0.037	0.034
Beryllium	1.20E-05	2.55E-07	2.36E-07	0.002	0.002
Cadmium	0.001	2.34E-05	2.16E-05	0.205	0.190
Chromium	0.001	2.98E-05	2.75E-05	0.261	0.241
Cobalt	8.40E-05	1.79E-06	1.65E-06	0.016	0.014
Lead	5.00E-04	1.06E-05	9.84E-06	0.093	0.086
Manganese	3.80E-04	8.09E-06	7.48E-06	0.071	0.065
Mercury	2.60E-04	5.53E-06	5.12E-06	0.048	0.045
Nickel	0.002	4.47E-05	4.13E-05	0.391	0.362
Selenium	2.40E-05	5.11E-07	4.72E-07	0.004	0.004
Total		**0.0001**	**0.0001**	**1.1297**	**1.0445**

6.1 Calculation of Annual Emissions

(Emission Factor (lb/mmcf) x[Fuel Usage $(cf/yr)_{<0.5\ MMBTU/hr}$ + Fuel Usage $(cf/yr)_{0.5\text{-}100\ MMBTU/hr}$])/ 10^6 cf/mmcf = Actual Emissions (lb/yr)

6.2 Calculation of Hourly PTE

(Emission Factor (lb/mmcf) x [Fuel Usage $(cf/hr)_{<0.5\ MMBTU/hr}$ + Fuel Usage $(cf/hr)_{0.5\text{-}100\ MMBTU/hr}$])/ 10^6 cf/mmcf = Emissions (lb/hr)

6.3 Calculation of Annual PTE

Hourly PTE (lb/hr) x 8760 (hr/yr) = Potential HAP Emissions (lb/yr)

Table A-2
Emission Calculations for Emergency Generators
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions for Generators (< 600 HP)

Are there any diesel engines of this class at the facility (1 = YES, 0 = NO)? | 1 |

Location of Unit	Generator Rating		Heat Input 30% effic.	Run Time
	(kw)	(hp output)	(MMBTU/hr)	(hr/yr)
Backup Generators/Emergency Equipment [1]				
Bldg. 12 CAMS	60	80.5	0.681	500
Bldg. 12: Fire Pump	284	380.8	3.224	500
Bldg. 21 CE	60	80.5	0.681	500
Bldg. 28 EOC	125	167.6	1.419	500
Bldg. 10 AATC	80.0	107.3	0.908	500
Bldg. 50: Fire Department	35	46.9	0.397	500
Runway Standby Unit 11 [1]	15	20.1	0.170	500
Runway Standby Unit 29R [1]	5	6.7	0.057	500
Bldg. 39 POL	200	268.2	2.271	500
Bldg. 44 Ops.	60	80.5	0.681	500
Total:		**1,239**	**10.49**	

Note:
[1] Diesel to be used as primary generator fuel. All emergency generators may run off diesel or JP-8. For puposes of calculating an emissions inventory , all fuel was assumed to be diesel.

1.1- Calculation of Unit Rating
Unit rating (kw) x 1.341 (hp/kw) = Unit rating (hp)

1.2 Calculation of Heat Input
Generator Rating (kw) x 1.341 (hp/kw) x 7000 (BTU/hp-hr) / 1,000,000 (BTU/MMBTU) = Heat Input (MMBTU/hr)

Note: The emission factors in AP-42 take into account the approximately 35% efficiency of internal combustion engines.

2.0 Emission Factors for Criteria Pollutants, from AP-42, Section 3.3. Table 3.3-1 (10/96)

Constituent	Emission Factor (lb/hp-hr)
CO	6.68E-03
NOx	0.031
PM-10 (1)	2.20E-03
PM-2.5 (1)	2.20E-03
SO_2	2.05E-03
VOC	0.003

(1) All particulate matter is assumed to be less than 1.0 micrometer in diameter (i.e., the emission factor applies to Total PM, PM-10, and PM-2.5).

Table A-2
Emission Calculations for Emergency Generators
162nd FW, Tucson, Arizona

3.0 Calculation of Criteria Pollutant Emissions

Constituent	Gen. Hourly PTE (lb/hr) (1)	Annual PTE (lb/yr) (2)
CO	8.28	4,139
NOx	38.41	19,206
PM-10	2.73	1,363
PM-2.5	2.73	1,363
SO_2	2.54	1,270
VOC	3.12	1,558

(1) Hourly potential to emit emissions are based on all engines running simultaneously.

(2) Annual potential to emit is based on 500 hr/yr for backup generators

3.1 Calculation of Hourly PTE:

Emission Factor (lb/hp-hr) x Generator Rating (hp) = Emissions (lb/hr)

3.2 Calculation of Annual Emissions:

Emission Factor (lb/hp-hr) x Annual Power Output (hp-hr/yr) = Emissions (lb/yr)

Hourly PTE (lb/hr) x 500 hr/yr = Emissions (lb/yr)

4.0 Calculation of HAP Emissions

HAP constituent emission factors obtained from AP-42, Section 3.3, Table 3.3-2 (10/96)

Constituent	Emission Factor (lb/MMBTU)	Gen. Hourly PTE (lb/hr)	Annual PTE (lb/yr)
Acetaldehyde	7.67E-04	8.05E-03	4.02
Acrolein	9.25E-05	9.70E-04	0.49
Benzene	9.33E-04	9.79E-03	4.89
1,3-Butadiene	3.91E-05	4.10E-04	0.21
Formaldehyde	0.001	1.24E-02	6.19
Naphthalene	8.48E-05	8.90E-04	0.44
Polycyclic Organic Matter	8.32E-05	8.73E-04	0.44
Propylene	0.003	2.71E-02	13.53
Toluene	4.09E-04	4.29E-03	2.15
Xylenes	2.85E-04	2.99E-03	1.49
Total:		**0.068**	**33.9**

4.1 Calculation of Actual Annual Emissions:

Emission Factor (lb/MMBTU) x Annual Heat Input (MMBTU/yr) = Emissions (lb/yr)

4.2 Calculation of Hourly PTE:

Emission Factor (lb/MMBTU) x Heat Input (MMBTU/hr) = Emissions (lb/hr)

4.3 Calculation of Annual PTE:

Hourly PTE (lb/hr) x 500 hr/yr = Emissions (lb/yr)

Table A-3
Emission Calculations for Natural Gas Generators
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions for Generators using Natural Gas

Are there any generators of this class at the facility (1 = YES, 0 = NO)? | 1 |

Heat Content For Natural Gas = 1,050 Btu/ft^3

Sulfur Content for Natural Gas = 0.007% (assumed)

Location of Unit	Generator Rating (kW)	Run Time (hr/yr)
Backup Generators/ Emergency Equipment		
Bldg. 1: O&T (1)	40.0	500.0
Total:	**40**	

2.0 Emission factors, from AP-42, Section 3.4 Tables 3.4-1 Gaseous Emission Factors for Large Stationary Diesel and All Stationary Dual-Fuel Engines

	Emission Factor	
Constituent	**lb/hp-hr**	**kg/kW-hr**
CO	0.0075	0.005
NOx	0.018	0.011
PM_{10}	0.002	0.001
$PM_{2.5}$ (1)	0.002	0.001
SOx (2)	6.70E-07	4.07E-07
VOC	0.001	8.03E-04

(1) The emission factor for PM_{10} from natural gas generators was assumed to represent $PM_{2.5}$ emissions.

(2) The SOx emission factor is calculated from $(4.06E\text{-}04 \times S_1) + (9.57E\text{-}03S_2)$ where S_1 and S_2 are the sulfur content of natural gas and diesel, respectively. The S_2 is set to zero, because only natural gas is used.

3.0 Calculation of Criteria Pollutant Emissions

Constituent	Generators Hourly PTE (lb/hr) (1)	Annual PTE (lb/yr) (2)
CO	0.40	201
NOx	0.97	483
PM_{10}	0.12	59
$PM_{2.5}$	0.12	59
SOx	0.0000	0.02
VOC	0.07	35

(1) Hourly potential to emit emissions are based on all engines running simultaneously.

(2) Annual potential to emit is based on 500 hr/y

Table A-3
Emission Calculations for Natural Gas Generators
162nd FW, Tucson, Arizona

3.1 Calculation of Annual Emissions:

Annual Emissions (lb/yr) = Emission Factor (kg/kW-hr) x Annual Power Output (kW-hr/yr) x 2.205 (lb/kg)

3.2 Calculation of Hourly PTE:

Hourly PTE (lb/hr) = Emission Factor (kg/kW-hr) x Total Generator Rating (kW) x 2.205 (lb/kg)

3.3 Calculation of Annual PTE:

Backup Generator Hourly PTE (lb/hr) x 500 hr/yr
Emissions (lb/hr)

4.0 Calculation of HAP Emissions

Because the VOC emission rate is very small and HAPs are assumed to be a fraction of total VOCs, HAP emissions are assumed to be negligible.

Table A-4
Emission Calculations for Gasoline Aircraft Arresting Barrier Engines
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions for Aircraft Arresting Barrier Engines (< 600 hp)

Are there any gasoline engines of this class at the facility (1 = YES, 0 = NO)? | 1 |

Location or Unit	Engine Rating (hp)	Heat Input [1] (MMBtu/hr)
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
Barrier Maint.	65.0	0.55
TOTAL:	**520**	**4.40**

2.0 Emission Factors for Criteria Pollutants, from AP-42, Section 3.3. Table 3.3-1 (10/96) [1]

Constituent	Emission Factor (lb/hp-hr)
CO [1]	0.00696
NOx	0.011
PM-10 [2]	7.21E-04
PM-2.5 [2]	7.21E-04
SO_2	5.91E-04
VOC	0.022

(1) AP-42 Editorial Correction, March 24, 2009, from Table 3.3-1
(2) All particulate matter is assumed to be less than 1.0 micrometer in diameter (ie. the emission factor applies to Total PM, PM-10, and PM-2.5).

3.0 Calculation of Criteria Pollutant Emissions

Gasoline Engines	
Constituent	Annual PTE (lb/yr) (1)
CO	543
NOx	858
PM-10	56
PM-2.5	56
SO_2	46
VOC	1,684

Notes:
(1) Annual potential to emit is based on the 500 hours per engine per year.

Table A-4
Emission Calculations for Gasoline Aircraft Arresting Barrier Engines
162nd FW, Tucson, Arizona

3.1 Calculation of Annual Emissions:

Emission Factor (lb/hp-hr) x Annual Power Output (hp-hr/yr) = Emissions (lb/yr)

3.2 Calculation of Potential Annual Emissions:

Emission Factor (lb/hp-hr) x Total Horsepower (hp) x (500 hr/yr) = Emissions (lb/yr)

4.0 Calculation of HAP Emissions

HAP constituent emission factors obtained from AP-42, Section 3.3, Table 3.3-1.

Constituent	Emission Factor (lb/mmBTU)	Annual PTE (lb/yr)
Aldehydes	0.070	154.1
TOTAL:		**154.1**

4.1 Calculation of Actual Annual Emissions:

Emission Factor (lb/MMBtu) x Annual Heat Input (MMBtu/yr) = Emissions (lb/yr)

4.2 Calculation of Potential Annual Emissions:

Emission Factor (lb/MMBtu) x Aggregate Heat Input (MMBtu/yr) x (500 hr/yr) = Potential Emissions (lb/yr)

Table A-5
Emission Calculations for Uninstalled Engine Test Cell
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions from Engine Test Cell

(a) Obtain information on aircraft type, engine type, # of trim tests performed, power settings and duration of each setting during the test. Information about the test profile can be obtained from the technical orders applicable to the test engine. These technical orders are kept in the engine shop. ANG personnel usually run the test or a portion of the test more than once, hence it is essential to estimate the average number of test cycles that the maintenance personnel perform on a particular engine.

(b) Emission Factors can be obtained from the following sources:

(i) "Air Emissions Inventory Guidance Document For Mobile Sources at Air Force Installations", Tables 3-3, 3-5, IERA, December 2003 (for criteria pollutants and HAP emission factors)

(ii) "Air Emissions Inventory Guidance Document For Mobile Sources at Air Force Installations", Table 3-6, IERA, December 2003 (only for SOx emission factor calculation and the weight percent sulfur content of the fuel, per geographic region)

2.0 Calculation of Potential Criteria Pollutant Emissions

Emission Factor (lb/1,000 lb fuel) x Fuel Flow Rate (lb fuel/hr) x Potential # of Engines Tested (#/yr) x Duration (hrs) = Emissions (lb/yr)

Engine Type	Potential # of Engines Tested (1)	Power Setting	Duration (hrs)	Fuel Flow Rate (lb fuel/hr)	Emission Factor (lb/1000 lb fuel) (2)						Potential Emissions (lb/yr)					
					CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
F100-PW-220	800	Idle	1.00	1,500	35.30	7.94	4.61	0.96	2.06	2.06	42,360.0	9,528.0	5,532.0	1,152.0	2,472.0	2,472.0
(Uninstalled)	800	Military	0.20	8,000	0.86	1.79	29.3	0.96	1.33	1.33	1,100.8	2,291.2	37,529.6	1,228.8	1,702.4	1,702.4
	800	Afterburner	0.10	37,000	12.0	1.53	8.37	0.96	1.15	1.15	35,490.4	4,528.8	24,775.2	2,841.6	3,404.0	3,404.0
POTENTIAL EMISSIONS (lb/yr)											78,951	16,348	67,837	5,222	7,578	7,578

(1) Potential number of engines tests is based on current permit limit of 800 total engine tests per year.

(2) SO_2 emission factors (lb SO_2/1,000 lb fuel) were calculated as follows: 20 x weight percent sulfur content of the fuel, per geographic region (specifically 0.048 in the West Coast region U.S.).

PM_{10} emissions are assumed to be representative of $PM_{2.5}$ emissions.

3.0 Calculation of Annual Potential HAP Emissions

Emission Factor (lb/1,000 lb fuel) x Fuel Flow Rate (lb fuel/hr) x Potential # of Engines Tested (#/yr) x Duration (hrs) = Emissions (lb/yr)

Engine Type	Potential # of Engines Tested (1)	Power Setting	Duration (hrs)	Fuel Flow Rate (lb fuel/hr)	Emission Factor (lb/1000 lb fuel) (2)									Total HAPs
					Form-aldehyde	Acet-aldehyde	Acrolein	Napthalene	Benzene	Toluene	Ethyl-benzene	Xylenes	Styrene	
F100-PW-220	800	Idle	1.00	1,500	8.20E-01	2.00E-01	9.70E-02	6.40E-02	9.80E-02	2.00E-02	4.80E-03	3.60E-02	4.80E-03	
(Uninstalled)	800	Military	0.20	8,000	6.00E-03	1.10E-02	No Data	3.70E-04	3.00E-03	5.00E-03	2.40E-03	2.60E-02	No Data	
	800	Afterburner	0.10	37,000	1.50E-02	1.30E-02	No Data	4.80E-04	7.70E-03	1.20E-02	2.20E-02	2.50E-02	No Data	
POTENTIAL EMISSIONS (lb/yr)					1,036.1	292.6	116.4	78.7	144.2	65.9	74.0	150.5	5.8	1,964

(1) Potential number of engines tests is based on current permit limit of 800 total engine tests per year.

(2) A blank emission factor indicates that the compound was not detected during Air Force testing of this type of engine under representative engine load conditions.

Emission factors of zero indicate a detected ambient pollutant concentration greater than that detected in exhaust stream.

Table A-6
Emission Calculations for Horizontal Fixed Roof Tanks
162nd FW, Tucson, Arizona

1.0 Calculation of Criteria Pollutant Emissions

Tank Specifications								Throughput(1)		Breating Loss & Working Loss(4)		Total VOC Emissions (lbs/year)
Tank No.(*)	Location of Tank (*)	Color Of Tank (*)	Tank Length(*) (ft) (L)	Tank Diameter(*) (ft) (D)	Tank Volume(*) (gal) (V)	Breather Vent Pressure Setting (*) (K_{BP})	Breather Vent Vacuum Setting (*) (K_{BV})	Stock Annual Actual Throughput(*) (gal/yr) (Q)	Stock Annual Potential Throughput(*) (gal/yr) (Q_P)	Potential Working Loss (lb/yr) (L_{WP})	Potential Standing Loss (lb/yr) (L_{SP})	Total Potential VOC Emissions (lb/year)
ABOVEGROUND STORAGE TANKS												
Jet-A Tanks												
TC-2	Test Cell 2	Green	28.44	6.85	2,500	0.030	-0.030	78,212	301,557	2.16	0.16	2.32
Diesel Tanks												
BSS-D	Base Service Station	White	36.28	6.85	10,000	0.030	-0.030	27,087	104,438	2.99	1.46	4.45
Gasoline Tanks												
BSS-G	Base Service Station	White	36.28	6.85	10,000	0.030	-0.030	26,724	103,038	1031.71	1350.00	2381.70
TOTAL EMISSIONS										1036.9	1351.6	2388.5

Total Emission Not Including Gasoline = 6.77

Notes:

(1) Source: Installation contact

(2) Total Actual Losses (L_T) = Standing Storage Loss (L_S) +Actual Working Loss (L_W)

(3) Potential throughput = actual throughput x [(8,760 hours / year) / (2,272 hours / year) operating schedule]

(4) Source: Tanks 4.0.9d output file.

Table A-6
Emission Calculations for Horizontal Fixed Roof Tanks
162nd FW, Tucson, Arizona

2.0 Calculation of HAP Emissions

2.1 HAP Emissions from Diesel

Constituent	Vapor Mass Fraction [1]	Potential Emissions (lb/yr)
Benzene	0.002	0.01
Ethylbenzene	0.003	0.01
Hexane (*n*-hexane)	0.0004	0.00
Toluene	0.023	0.10
Xylenes	0.060	0.27
Total		**0.39**

2.2 HAP Emissions from JP-8

Constituent	Vapor Mass Fraction [1]	Potential Emissions (lb/yr)
Benzene	0.007	0.02
Ethylbenzene	0.022	0.05
Hexane (*n*-hexane)	0.128	0.30
Naphthalene	0.014	0.03
Toluene	0.065	0.15
Xylenes	0.045	0.10
Total		**0.65**

(1) Source: EPA TANKS model 4.0.9d

HFRT COMBINED (POTENTIAL) [1]

VOCs & Toxic Components	Total Emissions
VOCs	6.8
Benzene	0.0
Ethylbenzene	0.1
Hexane (-n)	0.3
Naphthalene	0.0
Toluene	0.3
Xylenes	0.4
Total HAPs	**1.04**

Table A-7
Emission Calculations for Internal Floating Roof Tanks
162nd FW, Tucson, Arizona

ESTIMATION OF POTENTIAL EMISSIONS FROM INTERNAL FLOATING ROOF TANKS

Tank No. (1)	Diameter (1) (ft)	Volume (gal)	Annual Potential Throughput (2) (gal/yr) (Q_P)	Potential Rim Seal Losses (3) (lb/yr) (L_R)	Potential Withdrawal Losses (3) (lb/yr) (L_{WD})	Potential Deck Fitting Losses(3) (lb/yr) (L_F)	Potential Deck Seam Losses(3) (lb/yr) (L_D)	Total Potential Losses (3) (lb/yr) (L_T)
Jet A Tanks								
Bulk Storage #1	31	210,000	26,622,380	3.41	202.5	2.79	0.00	208.7
Bulk Storage #2	31	210,000	26,622,380	3.41	202.5	2.79	0.00	208.7
Total Jet A VOC Emissions								417.3

(1) Source: Installation Contact

(2) Potential throughput = actual throughput (6,654,900) x [(8,760 hours / year) / (2,272 hours / year) operating schedule]

(3) Results are from Tanks 4.0.9d output file.

Table A-7
Emission Calculations for Internal Floating Roof Tanks
162nd FW, Tucson, Arizona

2.0 Calculation of HAP Emissions

2.1 HAP Emissions From Jet A

Tank T1 (Potential)	Losses (lbs)				
VOCs & Toxic Components	Rim Seal Loss (3)	Withdrawal Loss (3)	Deck Fitting Loss (3)	Deck Seam Loss (3)	Total Emissions
VOC	3.41	202.45	2.79	0.00	**208.65**
Hexane	0.07	0.01	0.06	0.00	**0.14**
Benzene	0.03	0.01	0.03	0.00	**0.07**
Toluene	0.33	0.32	0.27	0.00	**0.92**
Ethylbenzene	0.11	0.31	0.09	0.00	**0.51**
Xylenes	0.07	0.22	0.05	0.00	**0.34**
Naphthalene	0.02	0.07	0.02	0.00	**0.11**
Total HAPs Emissions					**2.09**

Tank T2 (Potential)	Losses (lbs)				
VOCs & Toxic Components	Rim Seal Loss (3)	Withdrawal Loss (3)	Deck Fitting Loss (3)	Deck Seam Loss (3)	Total Emissions
VOC	3.41	202.45	2.79	0.00	**208.65**
Hexane	0.07	0.01	0.06	0.00	**0.14**
Benzene	0.03	0.01	0.03	0.00	**0.07**
Toluene	0.33	0.32	0.27	0.00	**0.92**
Ethylbenzene	0.11	0.31	0.09	0.00	**0.51**
Xylenes	0.07	0.22	0.05	0.00	**0.34**
Naphthalene	0.02	0.07	0.02	0.00	**0.11**
Total HAPs Emissions					**2.09**

(3) Results are from Tanks 4.0.9d output file.

Table A-8
Emission Calculations for Gasoline Service Station
162nd FW, Tucson, Arizona

1.0 Calculation of Emissions from Gasoline Service Station *

Potential

Activity	Loading Type	Potential Qty of Fuel Transferred [2] (1000 gal/yr)	Displacement VOC Emission Factor[3] (lb/1000 gal)	Spillage VOC Emission Factor[3] (lb/1000 gal)	Displacement PTE Annual VOC Emissions (lb/yr)	Spillage PTE Annual VOC Emissions (lb/yr)	Potential Annual VOC Emissions [4][5][7] (lb/yr)
Gasoline							
Tank Working and Breathing Losses [4]	Splash	103.0					**2,381.7**
Vehicle Refueling Operations	Uncontrolled	103.0	1.1	0.70	113.30	72.10	**185.4**
TOTAL EMISSIONS FOR GASOLINE (lb/year)							**2,567.1**

Notes:

* Source: "USAF Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations", December 2003: Section 15.

(1) Source: Installation Contact. There is no control equipment installed in the fuel transfer equipment.

(2) No significant operational changes have occurred since 2001.

Potential throughput = actual throughput x [(8,760 hours / year) / (2,272 hours / year) operating schedule]

(3) Source: "USAF Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations", December 2003: Table 15-1 (Section 15).

The installation uses Stage II vapor recovery system.

(4) Working and Breathing Losses are from the TANKS 4.0.9d program results

(5) Source: "USAF Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations", December 2003: Section 15-2

(6) Actual VOC Emissions = (Actual Quantity of Fuel transferred (1000 gal/yr))*(Displacement Emission Factor + Spillage Emission Factor).

(7) Potential VOC Emissions = (Potential Quantity of Fuel transferred (1000 gal/yr))*(Displacement Emission Factor + Spillage Emission Factor).

2.0 Calculation of HAP Emissions (Gasoline)

			Potential Tank Losses (lbs/yr)				
Components	**Liquid Mass Fraction [1]**	**Vapor Mass Fraction [1]**	**Working Loss [1]**	**Breathing Loss [1]**	**Vehicle Refueling Loss**	**Fuel Spillage Loss**	**Total Emissions**
VOCs			1031.71	1350.00	113.30	72.10	2,567.1
Benzene	0.0180	0.0068	7.02	9.18	0.77	0.49	17.46

Table A-8
Emission Calculations for Gasoline Service Station
162nd FW, Tucson, Arizona

Ethylbenzene	0.0140	0.0005	0.52	0.67	0.06	0.04	1.28
Hexane (-n)	0.0100	0.0061	6.29	8.23	0.69	0.44	15.66
Cumene (Isopropyl benzene)	0.0050	0.0010	1.03	1.35	0.11	0.07	2.57
Toluene	0.0700	0.0078	8.05	10.53	0.88	0.56	20.02
Xylenes	0.0700	0.0022	2.27	2.97	0.25	0.16	5.65
						Total HAPs	**62.6**

(1) Obtained from TANKS 4.0.9d output file.

Table A-9
Emission Calculations for Fuel Transfer Losses
162nd FW, Tucson, Arizona

1.0 Calculation of Emissions from Fuel Transfer Operations

Transfer Activity	Loading Type	Actual Qty of Fuel Transferred [1] (1000 gal/yr)	Potential Qty of Fuel Transferred [2] (1000 gal/yr)	Saturation Factor [3]	Liquid Vapor Pressure [4] (psia)	Vapor Molecular Weight [4] (lb/lb-mole)	Liquid Temperature [4] (° R)	Control Efficiency [1] (%)	Potential Annual VOC Emission (lb/yr)
Diesel									
Storage Tanks to Vehicles	splash	27.09	104.45	1.45	0.0093	130	528.42	0%	4.32
SUBTOTAL FOR DIESEL									4.32
Jet A									
Storage Tanks to Fuel Tank Truck	splash	13,311.57	51,324.54	1.45	0.0093	130	528.42	0%	2,121.57
Fuel Tank Truck to Aircraft	splash	13,162.09	50,748.20	1.45	0.0093	130	528.42	0%	2,097.75
Aircraft to fuel truck (defueling)	splash	24.96	96.24	1.45	0.0093	130	528.42	0%	3.98
Fuel Tank Truck to AGE	splash	80.99	312.28	1.45	0.0093	130	528.42	0%	12.91
Fuel Tank Truck to Test Cell Tanks	splash	78.21	301.55	1.45	0.0093	130	528.42	0%	12.46
SUBTOTAL FOR Jet A									4,248.68
TOTAL EMISSIONS (lb/yr)									**4,252.99**

Notes:

(1) Source: Installation Contact. The installation uses Stage II vapor recovery, with estimated efficiency of 90% (AF Guidance Document, 15.1.c)

(2) Potential Quantity of Fuel Transferred = The Potential Tank Throughput

(3) Source: "USAF Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations", December 2003: Table 14-1(Section 14).

(4) Source: Tanks 4.0.9d output file.

(5) Actual VOC Emissions = (Actual Quantity of Fuel transferred (1000 gal/yr))*(12.46*Saturation Factor*Vapor Press*Mol. wt/Temp.)*(1-(Eff(%)/100)).

Table A-9
Emission Calculations for Fuel Transfer Losses
162nd FW, Tucson, Arizona

2.0 Calculation of HAP Emissions

2.1 HAP Emissions From Diesel

Constituent	Weight Fraction [1]	Annual Pot. to Emit (lb/yr)
Benzene	0.0019	0.008
Ethylbenzene	0.0032	0.014
Hexane (n-hexane)	0.0004	0.002
Toluene	0.0228	0.098
Xylenes	0.0601	0.259
Total		**0.382**

[1] Obtained from TANKS 4.0.9d output file.

2.2 HAP Emissions From Jet-A

Constituent	Weight Fraction [1]	Annual Pot. to Emit (lb/yr)
Benzene	0.0065	27.62
Ethylbenzene	0.022	93.47
Hexane (n-hexane)	0.128	543.83
Naphthalene	0.014	59.48
Toluene	0.065	276.16
Xylenes	0.045	191.19
Total		**1191.75**

[1] Obtained from TANKS 4.0.9d output file.

Table A-10
Emission Calculations for Fuel Cell Maintenance
162nd FW, Tucson, Arizona

1.0 Calculation of Potential VOC Emissions from Fuel Cell Maintenance of F-16

Type of Aircraft	Fuel Cell Designation	Capacity of Fuel Cell (gal)	Capacity of Fuel Cell (ft^3)	No. of Cells Maintained (cells/yr)	Quantity of Jet-A Purged per Cell (lb) (1)	Quantity of Jet-A Remaining per Cell (lb) (2)	Quantity of Jet-A Emitted by ESF Drying (lb)	Total Jet-A Purged from Fuel Cells (lb/yr)
F-16	A-1 Tank	336.3	44.96	159	0.011	0.85	0.00	136.94
F-16	F-1 Cell	296.5	39.64	2	0.010	0.85	0.00	1.72
F-16	F-2 Tank	105.2	14.07	68	0.004	0.85	0.00	58.04
F-16	Wing Tank	87.9	11.75	50	0.003	0.85	0.00	42.65
F-16	Reservoir	68.0	9.09	153	0.002	0.85	0.00	130.40
F-16	External Wing Tank	370.0	49.47	106	0.012	0.85	0.00	91.42
F-16	External Center- Line Tank	300.0	40.11	48	0.010	0.85	0.00	41.28
Total				586				**502.45**

Notes:

Average ambient and liquid temperature: 71 Degrees F

Saturation vapor density of Jet-A (Wv) at 71 Degrees F: 0.00013 lbs/ft^3 (1)

[Obtained from USAF Air Emissions Inventory Guidance Document for Stationary Sources at Air Force Installations, December 2003, Section 11 using Jet-A data from the TANKS model]

(1) Assume that during each purge, two tank volumes of air saturated with Jet-A is emitted.

(2) Approximately 1 pint of Jet-A remains after cell vacuuming. Source: Installation contact.

Total VOC emissions from Fuel Cell Maintenance = Total number of purges * lbs Jet-A emitted per purge
(Assuming JP-8 is 100% VOCs)

= 502.45 lbs of VOCs

2.0 Calculation of Potential VOC Emissions from Fuel Cell Maintenance of F-16

Assuming that fuel cell maintenance emissions are generated during a standard, 2,272 hours/year work schedule, potential emissions are calculated as follows:

Potential VOC Emissions = Actual VOC Emissions x $\frac{8{,}760}{2{,}272}$ (maximum potential hours/yr / standard operating hours/yr)

= **1,937.3** **lbs VOCs/yr**

3.0 Calculation of Actual and Potential HAP Emissions from Fuel Cell Maintenance of F-16

Table A-10
Emission Calculations for Fuel Cell Maintenance
162nd FW, Tucson, Arizona

HAP Emissions = Weight Fraction (lbs HAP/lbs Jet-A) x Total lbs Jet-A Emitted (Assuming that Jet-A is 100% VOCs)

Constituent	Vapor Weight Fraction [1]	Annual Pot. to Emit (lb/yr)
Benzene	0.007	12.592
Ethylbenzene	0.022	42.620
Hexane (-n)	0.128	247.970
Naphthalene	0.014	27.122
Toluene	0.065	125.922
Xylenes	0.045	87.177
Total		**543.4**

(1) Source: Tanks 4.0.9d output file.

Table A-11
Emission Calculations for Degreasers
162nd FW, Tucson, Arizona

1.0 Data Required to Estimate Emissions from Degreasers

Are degreasers present onsite, 1=Yes, 0 =No	1

2.0 Input Data for Parts Cleaning Stations (Stationary Only)

Location of Station	Solvent Type	Quantity Added (gal/yr)	Quantity Removed (gal/yr)	VOC Content (lb/gal)	VOC Emissions (lb)
Wheel/Tire Shop - 1	Safety-Kleen Gold	390	220	6.42	1091.7
Wheel/Tire Shop - 2	Safety-Kleen Gold	235	125	6.42	706.4
Engine Shop - 1	Safety-Kleen Gold	12	0	6.42	77.1
Engine Shop - 2	Safety-Kleen Gold	177	115	6.42	398.2
Hydraulics	Safety-Kleen Gold	0	0	6.42	0.0
Veh. Maintenance	Safety-Kleen Gold	11	0	6.42	70.6
Total		**825**	**460**		**2344.0**

3.0 Calculation of Criteria Pollutant Emissions

Actual VOC emissions (lb/yr)	2,344
Potential VOC emissions (lb/yr)	9,037

3.1 Calculation of Annual PTE

The potential emissions were calculated by the following equation:

Potential VOC emissions (lb/yr) = Quantity Added (gal/yr) x VOC Content (lb/gal) x (8760/2272)

Note: According to the Material Safety Data Sheet (MSDS), the material used in these degreasers does not contain HAPs.

Table A-11
Emission Calculations for Degreasers
162nd FW, Tucson, Arizona

Table A-12
Emission Calculations for Abrasive Blasting
162nd FW, Tucson, Arizona

1.0 Data Required to Calculate Emissions from Abrasive Blasting

Location (Building)	Quantity of Abrasive Material Used (lb/yr)	Quantity of Abrasive Material Disposed (lb/yr)	Control Equipment Efficiency (%)
Repair & Reclamation	249	293.0	85%
Total	249		

Note:
(1) Engine Shop abrasive blasting area has been removed since the previous permit renewal

2.0 Calculation of Criteria Pollutants

Annual Potential PM-10 Emissions (1) =	960	lb/yr
Annual Potential PM-2.5 Emissions (2) =	960	lb/yr

(1) Annual Uncontrolled PM-10 Potential Emissions (lb/yr) = Amount of beads used (lb/yr) x 8,760 (hr/yr)/2272 (hr/yr).
(2) PM-10 and PM-2.5 emissions are assumed to be equal to the total particulate emissions.

Note: There are no VOC emissions and minimal HAP emissions associated with abrasive blasting operations.
HAP emissions can only be quantified by performing a chemical analysis of the waste material collected by the fabric filter.

Table A-13
Emission Calculations for Paint Booths
162nd FW, Tucson, Arizona

1.0 Paint Booths Potential VOC Emissions

Product Used	Stock Number	VOC Content (lb/gal)	Potential Use (gal/yr)	VOC Emissions (lbs) (1)
Polyurethane Coating Red	8010-01-265-9154	4.77	1.58	8
Coating	6810-01-285-3038	3.5	0.50	2
Coating	8010-01-329-8709	3.405	2.00	7
Aircraft Thinner	8010-00-181-8080	7.43	20.61	153
Primer	8010-00-292-1127	3.51	1.06	4
Solvent blend	6850-01-481-1299	3.3	22.60	75
Isorpopyl, alcohol	6810-00-286-5435	32	6.55	210
Solvent	6850-00-527-2426	6.815	6.00	41
Polyurethane Coating Red	8010-01-339-7015	2.35	15.00	35
Gray Primer	8010-00-616-9181	4.69	2.00	9
Clear Gloss	8010-01-356-5171	3.5	3.00	11
Polyurethane coating	8010-01-285-3035	3.47	2.00	7
Polyurethane coating	8010-01-285-3048	3.64	2.00	7
Enamal Paint Blue	8010-01-331-6119	4.74	0.84	4
Eco Sure White	8010-01-331-6105	5	0.37	2
Eco Sure Black	8010-01-331-6107	4.61	1.77	8
Eco Sure Flat Black	8010-01-331-6108	3.08	1.1	3
Eco Sure Gloss Red	8010-01-331-6109	3.08	1.0	3
Eco Sure O.D	8010-01-331-6112	4.61	3.17	15
Eco Sure Yellow	8010-01-331-6115	4.67	0.22	1
Eco Sure Gray	8010-01-331-6116	4.69	1.00	5
Isopropanal	681-00-028-5435	6.65	3.00	20
Solvent	6850-01-481-1235	6.19	1.00	6
Polyurethanes	8010-01-344-3218	3.78	10.0	38
Adhesive	8010-01-441-6030	2.96	0.12	0
Poly Gloss Red	8010-01-354-0977	3.47	1.00	3
Poly DK Gray	8010-01-397-3978	3.11	4.00	12
Poly Flat Black	8010-01-397-3980	3.44	3.00	10
Activator	8010-01-441-6029	4.05	0.03	0
WD-40	8030-01-418-9008	3.44	1.75	6
Flat Clear	8010-01-441-5943	1.62	1.18	2
Elastomer Coating	8030-00-142-9899	6.07	1.00	6
Polyurethane Tape	8040-01-450-9187	6.23	0.25	2
Enamel Paint	8010-01-359-9246	4.73	0.22	1
Camouflage Grey	8010-01-441-6021	1.72	0.16	0
Poleyurethane Coating	8010-01-265-9154	2.61	0.75	2
Desothane Camo Coating	8010-01-441-6023	2.91	0.26	1
Besothane White Coating	8010-01-441-6029	3.60	0.16	1
Desothane Gray Coating	8010-01-441-6025	3.60	0.16	1
Camo Gray coating	8010-01-441-6025	2.90	0.13	0
Oil Based Orange	8010-PHM-0001-0297	5.00	0.50	3
Epoxy Primer	8010-01-416-6556	3.10	0.50	2
Total			**124**	**724**

(1) VOC Emissions (lbs/yr) = VOC content (lb/gal) x actual use (gals/yr)

Table A-13
Emission Calculations for Paint Booths
162nd FW, Tucson, Arizona

2.0 Paint Booths Potential Particulate Emissions

Product Used (1)	Stock Number	Potential Use (gal/yr)	Overspray (2)	Control Device	Control Efficiency	PM Emissions (lbs) (3)
Polyurethane Coating Red	8010-01-265-9154	1.58	25%	Dry Filter	85.00%	0.444
Coating	6810-01-285-3038	0.50	25%	Dry Filter	85.00%	0.141
Coating	8010-01-329-8709	2.00	25%	Dry Filter	85.00%	0.563
Aircraft Thinner	8010-00-181-8080	20.61	25%	Dry Filter	85.00%	5.797
Primer	8010-00-292-1127	1.06	25%	Dry Filter	85.00%	0.298
Solvent blend	6850-01-481-1299	22.60	25%	Dry Filter	85.00%	6.356
Isorpopyl, alcohol	6810-00-286-5435	6.55	25%	Dry Filter	85.00%	1.842
Solvent	6850-00-527-2426	6.00	25%	Dry Filter	85.00%	1.688
Polyurethane Coating Red	8010-01-339-7015	15.00	25%	Dry Filter	85.00%	4.219
Gray Primer	8010-00-616-9181	2.00	25%	Dry Filter	85.00%	0.563
Clear Gloss	8010-01-356-5171	3.00	25%	Dry Filter	85.00%	0.844
Polyurethane coating	8010-01-285-3035	2.00	25%	Dry Filter	85.00%	0.563
Polyurethane coating	8010-01-285-3048	2.00	25%	Dry Filter	85.00%	0.563
Enamal Paint Blue	8010-01-331-6119	0.84	25%	Dry Filter	85.00%	0.236
Eco Sure White	8010-01-331-6105	0.37	25%	Dry Filter	85.00%	0.104
Eco Sure Black	8010-01-331-6107	1.77	25%	Dry Filter	85.00%	0.498
Eco Sure Flat Black	8010-01-331-6108	1.09	25%	Dry Filter	85.00%	0.307
Eco Sure Gloss Red	8010-01-331-6109	1.02	25%	Dry Filter	85.00%	0.287
Eco Sure O.D	8010-01-331-6112	3.17	25%	Dry Filter	85.00%	0.892
Eco Sure Yellow	8010-01-331-6115	0.22	25%	Dry Filter	85.00%	0.062
Eco Sure Gray	8010-01-331-6116	1.00	25%	Dry Filter	85.00%	0.281
Isopropanal	681-00-028-5435	3.00	25%	Dry Filter	85.00%	0.844
Solvent	6850-01-481-1235	1.00	25%	Dry Filter	85.00%	0.281
Polyurethanes	8010-01-344-3218	10.00	25%	Dry Filter	85.00%	2.813
Adhesive	8010-01-441-6030	0.12	25%	Dry Filter	85.00%	0.034
Poly Gloss Red	8010-01-354-0977	1.00	25%	Dry Filter	85.00%	0.281
Poly DK Gray	8010-01-397-3978	4.00	25%	Dry Filter	85.00%	1.125
Poly Flat Black	8010-01-397-3980	3.00	25%	Dry Filter	85.00%	0.844
Activator	8010-01-441-6029	0.03	25%	Dry Filter	85.00%	0.009
WD-40	8030-01-418-9008	1.75	25%	Dry Filter	85.00%	0.492
Flat Clear	8010-01-441-5943	1.18	25%	Dry Filter	85.00%	0.332
Elastomer Coating	8030-00-142-9899	1.00	25%	Dry Filter	85.00%	0.281
Polyurethane Tape	8040-01-450-9187	0.25	25%	Dry Filter	85.00%	0.070
Enamel Paint	8010-01-359-9246	0.22	25%	Dry Filter	85.00%	0.062
Camouflage Grey	8010-01-441-6021	0.16	25%	Dry Filter	85.00%	0.045
Poleyurethane Coating	8010-01-265-9154	0.75	25%	Dry Filter	85.00%	0.211
Desothane Camo Coating	8010-01-441-6023	0.26	25%	Dry Filter	85.00%	0.072
Besothane White Coating	8010-01-441-6029	0.16	25%	Dry Filter	85.00%	0.045
Desothane Gray Coating	8010-01-441-6025	0.16	25%	Dry Filter	85.00%	0.045
Camo Gray coating	8010-01-441-6025	0.13	25%	Dry Filter	85.00%	0.036
Oil Based Orange	8010-PHM-0001-0297	0.50	25%	Dry Filter	85.00%	0.141
Epoxy Primer	8010-01-416-6556	0.50	25%	Dry Filter	85.00%	0.141
Total		123.54				**34.7**

(1) Assumed MEK and thinner do not significantly contribute to PM emissions.

(2) Overspray estimated at 25% according to HVLP application method.

(3) All particulate matter assumed to be PM-10 and PM-2.5.

Table A-13
Emission Calculations for Paint Booths
162nd FW, Tucson, Arizona

Average paint density assumed to be = 7.5 lb/gal

3.0 Paint Booths Potential Emissions

	Potential PM-10 Emissions (lbs/yr)	Potential PM-2.5 Emissions (lbs/yr)	Potential VOC Emissions (lbs/yr)	Potential PM-10 Emissions (tpy)	Potential PM-2.5 Emissions (lbs/yr)	Potential VOC Emissions (tpy)
Paint Booths	893	893	2,791	0.45	0.45	1.40

Potential PM emissions (lb/yr) = potential paint use (gal) x density (lb/gal) x overspray (lb/lb used) x (8760/2272); Based on uncontrolled emissior
Potential VOC emissions (lb/yr) = potential paint use (gal) x density (lb/gal) x (8760/2272); Based on uncontrolled emissions.

Table A-13
Emission Calculations for Paint Booths
162nd FW, Tucson, Arizona

4.0 Paint Booths HAP Emissions

Pollutant	Actual Emissions (lb/yr)	Potential Emissions (lb/yr)	Potential Emissions (tpy)
Chromium	1.7	6.7	0.003
Ethylbenzene	8.74	33.7	0.017
Cobalt	0.07	0.3	0.000
Methyl Isobutyl Ketone	35.81	138.1	0.069
Toluene	86.7	334.3	0.167
Xylenes	58.21	224.4	0.112
TOTAL	**191.3**	**737**	**0.37**

4.1 Calculation of Actual Annual Emissions

Quantities of paint and thinner used in 2011 were obtained from shop personnel, and actual HAP emissions were estimated using AF-EMIS.

4.2 Calculation of Annual PTE

Potential HAP Emissions (lb/yr) = Actual Emissions (lb/yr) x 8760 hours/ 2272 hours

Table A-14
Emission Calculations for Welding
162nd FW, Tucson, Arizona

1.0 Initial data needed to calculate emissions from welding operations.

Building No.	Type of welding process being performed[1]	Type of electrode used	Quantity of electrode used [2] (lbs/yr)	Fume Emission Factor (lbs/1000 lbs) [3]	Control System Efficiency (%)	PM_{10} Emissions (lbs/yr)
10	Metallic Inert Gas	ER 70S-6	30	5.2	0%	0.156
10	Tungsten Inert	4043 Al	10	38.4	0%	0.384
10	Gas Welding	4130	1	38.4	0%	0.0384
10	Gas Welding	5356	2	38.4	0%	0.0768
10	Tungsten Inert	347 SS	10	38.4	0%	0.384
10	Gas Welding	Cobalt (Haynes 188)	10	38.4	0%	0.384
10	Tungsten Inert	Inconel	3	38.4	0%	0.1152
10	Gas Welding	5786	10	38.4	0%	0.384
10	Gas Welding	17-4 PH SS	2	38.4	0%	0.0768
10	Welding	Nickel Brazing Rod	1	0.05	0%	0.00005
TOTALS			79			1.999

Notes:

(1) Examples include Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), etc.

(2) Quantity Net of Waste. If waste information is not available, estimate or assume waste is between 10 and 30%.

(3) Emission factors are generally from Tables 33-1 in Chapter 33 of the USAF AEI Guidance Document, December 2003.

(4) The highest emission factor of E-type electrodes for SMAW is used for Tungsten Inert welding.

2.0 Emission rate calculations for criteria pollutants

Emissions	PM_{10} Emissions (lbs/yr)	$PM_{2.5}$ Emissions (lbs/yr)
Total Actual Emissions (lbs/yr)	1.999	1.999
Total Potential Emissions (lbs/yr)	7.71	7.71