TECHNICAL SUPPORT DOCUMENT (TSD)

1. INTRODUCTION

Luke Air Force Base (Luke AFB) is a military training installation, owned and operated by the United Sates Department of Defense, located within Maricopa County, Arizona approximately 9 miles west of downtown Glendale, Arizona on approximately 3,862 acres and employs approximately 8,200 military and non-military personnel. Luke AFB is the largest and only active duty F-16 pilots training base in the world and will soon train United States and Partner F-35A pilots. Luke AFB is a major source for two criteria pollutants, NOx and VOC emissions, but not for Hazardous Air Pollutants (HAP). It is classified as Standard Industrial Code (SIC) 9711, National Security.

The Phoenix metropolitan area has been designated as a serious non-attainment area for PM10 National Ambient Air Quality Standard and as a moderate non-attainment area for the 2008 8-hour Ozone National Ambient Air Quality Standard.

This Technical Support Document (TSD) is intended to provide additional information associated with the technical and regulatory evaluation of the Application 412754 for Renewal 2.0.0.0 of Permit V97017. This TSD is not a part of the Permit and is not legally enforceable.

2. FACILITY DESCRIPTION

Luke AFB is a large multi-faceted installation which is comparable in size and function to a small city. Operations at Luke AFB include training of military personnel, support activities for housing and feeding personnel, and maintenance and support of military equipment and operations. Specifically, the base has operations including, but not limited to: retail markets, hospital and dental clinics, public works, warehouse facilities, utilities, recreational facilities, an airfield, and maintenance operations. It is important to note that Luke AFB has several tenant operations. With the exception of the Army Air Force Exchange Service (AAFES) service station and the auto hobby paint booth and woodworking shop, emissions from tenant operations are regulated as a part of Luke AFB operations even though they are not under "common control". The AAFES service station and auto hobby paint booth are regulated separately and are not discussed further in this renewal application.

Sources of air pollutants include external combustion equipment used for heating base facilities; internal combustion equipment used for emergency power; use of volatile organic compounds VOC containing materials such as solvents, paints, and adhesives for maintenance of vehicles and aircraft, sign painting, woodworking facilities for construction of signs and furniture, surface coating operations, and gasoline, diesel, and Jet-A storage tanks used for fueling motor vehicles, aircraft and miscellaneous facility equipment.

3. RENEWAL DESCRIPTION

All prior revisions are incorporated in this renewal permit, which does not constitute a physical change or change in the method of operation of the facility.

4. APPLICABLE REQUIREMENTS

The application included a listing and discussion of all the regulatory requirements applicable to the source, which can be viewed in the following embedded icon:

Applicable Requirements.xlsx

5. EMISSIONS:

A. FACILITY WIDE EMISSION generating operations at the facility are conducted in many different buildings/locations on the base, all as identified in Appendix A and the Equipment List of the renewal application and include, (1) internal combustion sources such as; emergency and general purpose generators, and jet engine testing, (2) external combustion sources such as: boilers and water heaters, spray paint booth dryers, and a bake-off oven, (3) above ground storage tanks such as: Jet-A, diesel storage tanks, and gasoline storage tanks, (4) bulk fuel loading, (5) non-fuel evaporative emissions such as: solvent cleaning, surface coating, aerospace spray coating, vehicle spray coating and other spray coating, (6) fuel tank purging, (7) abrasive blasting, (8) woodworking and (9) water cooling towers.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List. A summary of emissions by process is presented in the icon below under the **SP Form** tab. For purposes of these calculations PM2.5 emissions are assumed to equal PM10 emissions.

Appendix A - Calculations 071516.x

Equipment List Updated Aug 2016 fo

Following in Tables A1 and A2 are Potential to Emit Summaries of criteria pollutants and hazardous air pollutants (HAP), which represent the total emissions from all the various sources of emissions facility wide. As the values in the following tables indicate the facility is a major source of NOx and VOC as criteria pollutants, but is not a major source of HAP either as a single HAP or as a combination of HAP.

Table A1 Facility Wide Emissions of Criteria Pollutants

	Pollutants					
Emissions	**CO**	**NOx**	**SOx**	**VOC**	**PM10**	**PM2.5**
tons/year **lbs/year**	**78.2** **156,365**	**163.2** **326,242**	**5.2** **10,420**	**114.5** **228,916**	**12.3** **24,641**	**12.3** **24,641**

Only total HAP are shown in the Table below but in the Appendix A Calculations the HAP are also speciated.

Table A2 Facility Wide Emissions of Hazardous Air Pollutants (HAP)

Total HAPs (tons/year)	**8.0**
Total HAPs (lbs/year)	**15,999**

In the following paragraphs are brief explanatory discussions and tabular illustrations of each of the various operations that contribute to the facility wide emissions. These are presented in the same order as they were presented in the application.

B. ABRASIVE BLASTING:

Emissions Source Description: Abrasive blasting operations involve the use of a hard material such as sand, plastic beads, or glass beads to remove old paint and/or corrosion from equipment. A high pressure gun is used to blast the abrasive material at the equipment being stripped/cleaned. Depending on the size of the equipment, blasting is performed in either a small enclosed cabinet (i.e., glove box), inside a booth, or outdoors. For indoor blasting, the exhausts from blasting operations are ventilated to a control system consisting of a fabric filter. The primary pollutants of interest are PM_{10}, $PM_{2.5}$, and HAP within the particulate.

Luke AFB has one walk-in abrasive blasting booth in Building 907 which vents to atmosphere. The remaining units are small glove-box blasters (modular, self-contained, abrasive blasting cabinets) that exhaust into the work space, and are considered an insignificant source in accordance with MCAPCR Appendix D ["Hand-held or manually operated equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of ceramic art work, precision parts, leather, metals, plastics, fiberboard, masonry, carbon, glass, or wood."].

Emissions Calculations: Maximum emissions from abrasive blasting have been estimated by multiplying the amount of blast media consumed by the appropriate emission factor, as shown in the equation below.

$E_{Pol} = Q \times 1/1{,}000 \times EF_{Pol}$

Where,

E_{POL} = Emissions of a particular pollutant (lb/yr);

Q = Annual blast media consumed (lb/yr); and

EF_{POL} = Emissions factor (lb/10^3 lb of blast media used).

Maximum particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) emissions were estimated based on the maximum blasting material which could be used and the emission factor for controlled garnet blasting obtained Table 2-1 of the Air Emissions Guide for Stationary Sources, AFCEC, October 2014 (AEI Guide)

(0.59 pounds (lb) per thousand pounds (10^3 lb) of PM_{10} of abrasive material used). PM and $PM_{2.5}$ emission were assumed to be equal to PM_{10} emissions.

HAP emissions were conservatively assumed to be 100% of particulate matter (PM) emissions. HAP emissions from abrasive blasting are a much smaller percentage of PM emissions and should a more accurate speciation be desired, a chemical analysis of the waste material collected would be required.

Maximum media usage for the unit were determined by taking the media usage in 2007, which Luke AFB has set as the baseline year based on knowledge of usual operations, and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that abrasive blasting at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table B 1 is a Potential to Emit Summary of criteria pollutants and HAP from abrasive blasting sources shown in full display in Appendix A of this TSD under the **ABCL** tab in the embedded icon cited above.

Table B 1

Emissions	**PM10/PM2.5**	**HAP**
tons/year	0	0
lbs/year	1.74	1.74

C. EXTERNAL COMBUSTION EMISSIONS:

Emissions Source Description: The majority of external combustion sources at Luke AFB include boilers, furnaces, and heaters used for comfort heating and potable water. Luke AFB also has three spray paint booth dryers which are used in association with the civilian and government vehicle paint booths to provide heated air to dry painted parts, and two bake-off ovens which are used for the removal of baked-on particulate matter from jet engine fuel spray rings.

Emissions from external combustion units occur as a result of the combustion of the fuel burned and include criteria pollutants and a variety of HAPs. Emissions depend on a variety of factors including the size/type of the combustor, firing configuration, fuel type, control devices used, operating capacity, and whether the system is properly operated/maintained.

The external combustion units at Luke AFB primarily utilize natural gas for fuel, although some units use either propane or LPG for fuel.

Emissions from the burn-off ovens are considered to be solely due to the combustion of natural gas used to fuel the oven, as the jet engine spray rings are pre-cleaned prior to placement in the burn off ovens and the combustion of any debris remaining can be considered negligible per MCAQD guidance (refer to Section 6 of this TSD for additional information on excluded sources and the guidance provided by MCAQD). See also County Rule 100 §200.63 for the definitions of insignificant activities.

Certain external combustion sources (e.g., water heaters <300,000 MMBTU/hr) at Luke AFB are considered an insignificant source in accordance with MCAPCR Appendix D ["All natural gas and/or liquefied petroleum gas-fired pieces of equipment over 300,000 BTU per hour, only if the input capacities added together are less than 2,000,000 BTU per hour, the emissions come from fuel burning, and the equipment is used solely for heating buildings for personal comfort or for producing hot water for personal use."]. Refer to Section 6 of this TSD and see also County Rule 100 §200.63 for additional information on insignificant sources. All external combustion units, including those that may be insignificant, have been included in maximum emissions calculations to allow for a conservative estimate.

Emissions Calculations: Emissions from external combustion units were estimated by multiplying the amount of fuel combusted by the appropriate emission factor, as shown in the equation below.

$E_{POL} = FC \times EF$

Where,

E_{POL} = Emissions of a particular pollutant (lb/yr);

FC = Quantity of fuel consumed per year (MMBtu/yr for natural gas); and
EF = Emission factor (lb/MMBtu for natural gas).

Calculations were completed using emission factors from AP-42, Section 1.4, Natural Gas Combustion (July 1998). Emission factors were converted from lb/10^6 ft3 to lb/MMBtu using a heating value of 1,020 Btu/ft^3, taken from AP-42, Section 1.4, Natural Gas Combustion (July 1998). Emissions for propane and LPG combustion were estimated using emission factors for natural gas combustion. Luke AFB is not taking credit for any boilers installed with Low NOx burners and has based all emissions on standard AP-42 emission factors.

The make, model, and heat input rating for each of the external combustion units was obtained from the boiler plate or specification sheet of each unit. Potential natural gas usage for each of the units was calculated using the maximum hours of operation per year (8,760 hr/yr).

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table C 1 is a Potential to Emit Summary of criteria pollutants from external combustion sources shown in full display in Appendix A of this TSD under the **ECOM** tab in the embedded icon cited above.

Table C 1

	Pollutants					
Emissions	CO	NOx	SOx	PM10	PM2.5	VOC
tons/year **lbs/year**	48.41 96,818.16	57.82 115,647.19	0.34 688.17	4.38 8,761.86	4.38 8,761.86	3.19 6,387.73

Table C 2 is a Potential to Emit Summary of hazardous air pollutants (HAP) emissions from external combustion sources described above. The HAP emitted are speciated in the references cited above with only total HAP shown in this table.

Table C 2

HAPs	**Emissions**
Total (tons/year)	0.086
Total (lbs/year)	172.99

D. FIRE FIGHTER TRAINING

Emissions Source Description: Luke AFB has a small scale fire fighter training facility used for periodic refresher training. The training is performed in a live fire training pit including a mock-up aircraft structure. The fire is simulated through the use of a controlled propane burner. Emissions from fire fighter training occur as a result of the combustion of the fuel burned and include criteria pollutants and a variety of HAPs (both organic and inorganic).

MCAPCR Rule 314 §303 defines fire fighter training as a trivial source ["Fire fighter training, training areas and training structures are exempt from needing a permit if the sole source of flame is a burner fueled by either liquefied petroleum gas or natural gas, with a British Thermal Unit (BTU) input per hour rating of less than 2,000,000 BTUs."] However, Luke AFB wishes to include these operations under Air Quality Operating Permit No. V97-017 so it will not be necessary to apply for separate open outdoor burning permits.

Emissions Calculations: Emissions from fire fighter training were estimated by multiplying the amount of fuel combusted by the appropriate emission factor, as shown in the equation below.

E_{POL} = Q x EF
Where,
E_{POL} = Emissions of a particular pollutant (lb/yr);
Q = Quantity of fuel consumed per year (10^3 gal/yr for propane); and
EF = Emission factor (lb/10^3 gal for propane).

Calculations were completed using emission factors from *Air Emissions Guide for Air Force Stationary Sources* (AFCEC, October 2014). Emissions from fire fighter training were determined by taking the average of the fuel consumed during 2012 to 2014 (used as the 3-year baseline average), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that fire fighter training at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table D 1 is a Potential to Emit Summary of criteria pollutants from fire fighter training sources shown in full display in Appendix A of this TSD under the **FIRE** tab in the embedded icon cited above.

Table D 1

	Pollutants					
Emissions	CO	NOx	SO2	VOC	PM10	PM2.5
tons/year	0.25	0.91	0.0033	0.39	0.16	0.16
lbs/year	505.71	1829.08	0.66	788.11	311.96	311.96

Table D 2 is a Potential to Emit Summary of hazardous air pollutants (HAP) from fire fighter training sources described above. Total HAP are shown in this table but the calculation sheet includes emissions for the HAP species formaldehyde as well.

Table D 2

HAPs	**Emissions**
Total (tons/year)	0.011
Total (lbs/year)	22.99

E. FUEL CELL MAINTENANCE

Emissions Source Description: Luke AFB performs maintenance, repair, and routine inspection of the F-16 fuel cells, which are the fuel storage tanks on the aircraft. Although fuel cell maintenance while the fuel cells remain on the aircraft is considered to be a mobile source of emissions by the Air Force, the F-16 has two external fuel cells which may be removed and maintained in a dedicated facility at Luke AFB. For this reason, fuel cell maintenance is included in these calculations.

Fuel remaining in the fuel cell and fuel foam are removed prior to inspection and maintenance of the fuel cell. Fuel cell maintenance is a source of VOC and HAP emissions from both the removal of fuel from the fuel cell into bowsers and from subsequently purging the fuel cell with clean air until the cell may be entered by maintenance personnel. Emissions from the evaporation of fuel from any explosion suppression foam removed from the cell is assumed to be negligible due to the strict Air Force Technical Order requirements that all removed foam must be immediately sealed to prevent fuel vaporization. Fuel cell defueling emissions are the result of vapors displaced from the bowser tank by fuel from the fuel cell (and back again). The emissions from the loading of fuel to and from the bowsers (during the defueling process) are addressed in Section G-Fuel Loading following. Refueling of the fuel cell occurs on the flight line once the cells have been put back on the aircraft and is considered a mobile source.

Emissions Calculations: Calculations were completed in accordance with the methodology shown in Section 13 of the *Air Emissions Guide for Air Force Stationary Sources* (AFCEC, October 2014). Emissions from the purging and ventilation of the fuel cell is related to the vapor concentration of the fuel in the fuel cell and the amount of residual fuel clinging to the interior surfaces of the cell that remains after removing the fuel from the fuel cell. However, these parameters can be difficult to determine, so emissions are conservatively estimated to be equal to the product of the saturation concentration of the vapor in the fuel cell and twice the fuel cell volume, as shown in the equation below.

$$E_{VOC} = C_{VOC} \times 0.13368 \times 2 \times \sum(V \times N)$$

Where,

E_{VOC} = Annual emissions of VOC (lb/yr);

2 = Factor used for the conservative estimate of emissions representing twice the fuel cell volume;

C_{VOC} = VOC concentration in the fuel cell (lb/ft^3);

0.13368 = Factor for converting cubic feet to gallons (ft^3/gal);

V = Fuel cell volume (gal/unit); and

N = Number of fuel cells purged/ventilated in a year (units/yr).

The vapor saturation concentration (CVOC) was first estimated using the vapor molecular weight, vapor pressure and temperature of JET-A, as shown in the equation below.

$C_{VOC} = (M_V \times P_{VA}) / (R \times T_{LA})$

Where,

M_V = Vapor molecular weight (lb/lb-mol);

P_{VA} = Vapor pressure at the daily average liquid surface temperature (psia);

R = Ideal gas constant (10.732 psia•ft^3/°R•lb-mol); and

T_{LA} = Daily average liquid surface temperature (°R).

The properties of JET-A were taken from Table 13-1 of the *Air Emissions Guide for Air Force Stationary Sources* (AFCEC, October 2014).

Speciated HAP emissions were calculated by multiplying the VOC emissions with the JET-A vapor-phase weight fraction of a particular HAP.

Maximum emissions from fuel cell maintenance were estimated using the maximum number of fuel cells purged in a year. The maximum number of fuel cells purged in a year was determined by taking the number of fuel cells purged in 2007 (used as baseline year), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that fuel cell maintenance at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table E 1 is a Potential to Emit Summary of criteria pollutants from fuel cell maintenance sources shown in full display in Appendix A of this TSD under the **CELL & DEFUEL** tabs in the embedded icon cited above.

Table E 1

Emissions	**VOC**
tons/year	0.955
lbs/year	1910.45

Table E 2 is a Potential to Emit Summary of hazardous air pollutants from fuel cell maintenance sources described above. Only total HAP are shown in this table but they are speciated in Appendix A.

Table E 2

HAPs	**Emissions**
Total (tons/year)	0.009
Total (lbs/year)	18.053

F. FUEL DISPENSING-GASOLINE

Emissions Source Description: Luke AFB has one gasoline dispensing location used primarily to refuel government vehicles (Building 335). Fuel dispensing is a source of VOC and HAP emissions. Vehicle refueling emissions are the result of vapors displaced from the vehicle tank by dispensed fuel, from spillage of fuels from pre-fill and post-fill nozzle drip, and from "spit-back" and overflow from the fuel tank filler neck on the vehicle during filling. Breathing and working emissions from the storage tanks are addressed with Fuel Storage.

At Luke AFB, gasoline dispensing currently involves the use of Stage II Vapor Recovery. However, in accordance with EPA policy, Luke AFB plans to phase out Stage II systems pending instruction from Maricopa County. For this reason, a control efficiency is not claimed for the use of Stage II Vapor Recovery in conjunction with emission calculations for gasoline dispensing.

At Building 335, gasoline is transferred into gasoline delivery vehicles for distribution to other gasoline storage tanks on base. These gasoline delivery vehicles are tested annually by an off-base contractor to ensure the vessels are vapor tight and leak free, in accordance with the requirements of MCAPCR Rule 352. Emissions from the transfer of fuel into these vessels are accounted for as a part of the fuel dispensing calculations; emissions from the transfer of fuel from these vessels to other storage tanks are considered a part of storage tank working losses.

Emissions Calculations: The VOC emission factors for gasoline are 11 lb/10^3 gal for uncontrolled displacement emissions per AP 42, Section 5.2, Table 5.2-7 (EPA, June 2008). VOC emissions were calculated using the equation shown below.

EVOC = Q x 1/1,000 x EF
Where,
EVOC = Emissions of VOC (lb/yr);
Q = Annual quantity of fuel transferred (gal/yr);
1/1,000 = Factor for converting gallons to 1,000-gallons (gal/10^3 gal); and
EF = Emission factor (lb/10^3 gal).

Speciated HAP emissions were calculated by multiplying the VOC displacement emissions with the vapor-phase weight fraction of a particular HAP.

Maximum VOC and HAP emissions from fuel dispensing operations were estimated using fuel usage quantities previously submitted to the MCAQD during the last renewal. The calculated emissions are lower than the applicability threshold for the Subpart CCCCCC, of the National Emission Standards for Hazardous Air Pollutants for Source Categories: Gasoline Dispensing Stations", codified at 40 CFR §63.11110 through §63.11132. Therefore, that federal regulation does not apply to the gasoline dispensing operations at Luke AFB.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table F 1 is a Potential to Emit Summary of criteria pollutants and HAP from fuel dispensing-gasoline sources shown in full display in Appendix A of this TSD under the **FDSP-Gas** tab in the embedded icon cited above.

Table F 1

Emissions	**VOC**
tons/year	6.6
lbs/year	13,199.87

Table F 2 is a Potential to Emit Summary of hazardous air pollutant emissions from fuel dispensing-gasoline sources described above. Only total HAP are shown in this table but they are speciated in Appendix A.

Table F 2

HAPs	**Emissions**
Total (tons/year)	0.197
Total (lbs/year)	394.68

G. FUEL LOADING-DIESEL & JET A

Emissions Source Description: Luke AFB has loading racks where diesel and JET-A are dispensed from large tanks into tank trucks (See the definition of delivery vessel in the regulations). Fuel loading is a source of VOC and HAP emissions. Loading losses are the result of vapors displaced from the fuel tank during loading of the fuel.

Fuel is transferred from Tanks 350 and 359 to five aboveground fuel loading racks through a pipeline within the base. Fuel can also be piped directly from Tanks 351 and 356 to the loading racks. From the loading racks, the fuel is loaded into base tank trucks and distributed to aircraft on the flight line or to the smaller storage tanks located throughout the base for use in equipment and vehicles. All loading is submerged, dedicated service.

Aircraft defueling (unloading of JET-A into a bowser) as a part of fuel cell maintenance activities (as described in Section 6.4) is also included under fuel loading. However, other aircraft defueling and refueling on the flight line is considered a mobile source and is not addressed in this renewal. Refer to Section 7.0 for additional information on excluded sources.

Emissions Calculations: VOC emissions from fuel loading operations are calculated in accordance with the loading loss equation provided in AP-42, Section 5.2 (EPA, June 2008). VOC emissions were calculated using the equation shown below.

$E_{VOC} = Q \times 1/1000 \times 12.46 \times S \times P \times M / T \times [1-(CAP_{eff}/100 \times CON_{eff}/100)]$

Where,

E_{VOC} = Annual emissions of VOCs (lb/yr);

Q = Annual quantity of fuel transferred into the tanks (gal/yr);

1/1000 = Factor for converting gallons to 1,000-gallons (gal/10^3 gal);

12.46 = Equation constant (°R lb-mol/psia 10^3 gal);

S = Saturation factor;

P = True vapor pressure of fuel (psia);

M = Vapor molecular weight of the fuel (lb/lb-mol);

T = Temperature of bulk liquid loaded (°R);

CAP_{eff} = Capture efficiency of the loading terminal (%);

CON_{eff} = Efficiency of the control device (%); and

100 = Factor for converting a percent to a fraction (%).

Speciated HAP emissions were calculated by multiplying the total VOC displacement emissions against the vapor phase weight fraction of each HAP in the fuel. Capture and control efficiency were set at 0% to allow for a conservative estimate of emissions.

The maximum amount of fuel loaded in a year was determined by taking the usage in 2007 (used as baseline year), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that fuel loading at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table G 1 is a Potential to Emit Summary of criteria pollutants from fuel loading-diesel and Jet A sources shown in full display in Appendix A of this TSD under the **FLD-DF2, JET A** tab in the embedded icon cited above.

Table G 1

Emissions	**VOC**
tons/year	28.54
lbs/year	57,083.3

Table G 2 is a Potential to Emit Summary of hazardous air pollutant from fuel loading-diesel and Jet A sources described above. Only total HAP are shown in this table but they are speciated in Appendix A.

Table G 2

HAPs	**Emissions**
Total (tons/year)	0.27
Total (lbs/year)	540.34

H. FUEL STORAGE

Emissions Source Description: Luke AFB stores fuel in multiple storage tanks. All fuel tanks contain one of three fuel types: jet fuel (JET-A), gasoline, or diesel/biodiesel. Evaporative regulated air pollutants from fuel storage tanks include VOC and organic HAP which occur as a result of working losses when the tanks are filled and breathing losses while the tanks are storing fuel.

JET-A Storage Tanks: JET-A fuel is received through an interstate pipeline that transfers fuel to Tanks 351 and 356. Tanks 351 and 356 are external floating roof tanks with capacities of 420,000 and 1,680,000 gallons, respectively. Fuel is then transferred from Tanks 351 and 356 into Tanks 350 and 359. Tanks 350 and 359 are fixed roof tanks, each with a capacity of 210,000 gallons. Fuel is transferred from Tanks 350 and 359 to five aboveground fuel loading racks through an internal pipeline. Loading rack operation is discussed in Section 6.4.

Tank 366 contains up to 25,000 gallons JET-A. Tank 366 receives JET-A from aircraft de-fueling or excess fuel when cleaning tanker trucks. Fuel from Tank 366 is then transferred into either Tank 351 or 356.

Gasoline and Diesel Storage Tanks: Tanks 367 and 368 contain up to 50,000 gallons diesel and 25,000 gallons gasoline, respectively. Tanks 367 and 368 receive fuel from an outside contractor.

Building 2201 has a 1,000-gallon gasoline convault AST. This tank receives gasoline from an outside contractor.

Building 335 is a service station, which provides gasoline and diesel fuel to military vehicles for base operations. Fuel is delivered to the government service station by a contractor, and fuel delivery pumps are essentially identical to retail gas station units, meeting weights and measure standards.

Insignificant Tanks: Smaller diesel and gasoline fuel storage tanks at Luke AFB (e.g., built in generator fuel storage tanks) are considered an insignificant source in accordance with MCAPCR Appendix D ["Chemical or petroleum storage tanks or containers that hold 250 gallons or less and would have emissions of a regulated air pollutant."]. See also County Rule 100 §200.63 for the definitions of insignificant activities.

Luke AFB also has tanks storing liquids considered to have a low vapor pressure (virgin oil, flush oil, hydraulic oil, antifreeze, etc.). These tanks are also considered an insignificant source in accordance with MCAPCR Appendix D ["Any emissions unit, operation, or activity that handles or stores no more than 12,000 gallons of a liquid with a vapor pressure less than 1.5 psia."]. See also County Rule 100 §200.63 for the definitions of insignificant activities.

Emissions Calculations: Maximum emissions from fuel storage tanks were estimated using previously permitted maximum fuel usage limits and individual tank characteristics (tank diameter, shell length/height, etc.). VOC emissions from fuel storage tanks were estimated using methods outlined in Section 7.1.4 of AP-42. Calculations were completed within the Air Program Information Management System (APIMS) by inputting the tank properties and fuel throughputs. HAP emissions were calculated by multiplying total VOC emissions by the vapor weight fraction of each HAP in the fuel.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table H 1 is a Potential to Emit Summary of criteria pollutants from abrasive blasting sources shown in full display in Appendix A of this TSD under the **STORAGE** tab in the embedded icon cited above.

Table H 1

Emissions	VOC
tons/year	8.77
lbs/year	17,545.44

Table H 2 is a Potential to Emit Summary of hazardous air pollutants from fuel storage sources described above. Only total HAP are shown in this table but they are speciated in Appendix A.

Table H 2

HAPs	Emissions
Total (tons/year)	0.246
Total (lbs/year)	493.19

I. JET ENGINE TEST CELLS

Emissions Source Description: Two F-16 aircraft engines are tested at Luke AFB: F100-PW-220 and F100-PW-229. This renewal addresses emissions from engines that have been removed from aircraft and are tested in dedicated test cells. These cells are permanent fixtures with noise-reducing enclosures, sometimes referred to as hush houses. Testing conducted on engines that are still attached to the aircraft are considered mobile and are not included in this application. Testing usually involves combustion of JET-A fuel in various simulated aircraft operating scenarios (such as idle or approach modes). Emissions from aircraft engine testing occur as a result of the combustion of the fuel burned and include criteria pollutants and a variety of HAPs (both organic and inorganic).

Emissions Calculations: Emissions from jet engine testing were estimated by multiplying the number of tests per year per mode by the appropriate emission factor, as shown in the equation below.

E_{Pol} = FFR x 1/1,000 x T_{Test} x EF_{Pol}
Where,
E_{Pol} = Emissions (lb/yr);
FFR = Fuel flow rate per mode (lb/hr);
1/1,000 = Factor for converting gallons to 1,000-gallons (gal/10^3 gal);
T_{Test} = Total annual time engine testing occurred while operating at the applicable fuel flow rate (hr/yr); and
EF_{Pol} = Emissions factor (lb/10^3 lb).

Maximum times in mode were taken from the test cell technical operating procedures. The maximum number of tests in a year was determined by taking the usage in 2007 (used as baseline year), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that jet engine testing at Luke AFB would increase proportionately to base operations.

Fuel flow rates and emission factors for each mode were taken from *Air Emissions Guide for Air Force Mobile Sources* (AFCEC, October 2014). Emission factors in units of lb/gal for sulfur dioxide (SO_2) were derived by assuming all the sulfur in the fuel is converted to sulfur oxides (SOx) during combustion. As described in the *Air Emissions Guide for Air Force Stationary Sources* (AFCEC, October 2014), the emission factor for SOx is obtained using the following equation: EFSOx = 20S; where S is the weight percent of sulfur in the fuel.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table I 1 is a Potential to Emit Summary of criteria pollutants from jet engine test cell sources shown in full display in Appendix A of this TSD under the **JET** tab in the embedded icon cited above.

Table I 1

	Pollutants					
Emissions	CO	NOx	SO2	VOC	PM10	PM2.5
tons/year **lbs/year**	13.17 26,338.62	31.52 63,052.69	0.90 1,893.23	4.25 8,498.11	2.25 4,506.91	2.25 4,506.91

Table I 2 is a Potential to Emit Summary of hazardous air pollutants from jet engine test cell sources described above. Only total HAP are shown in this table but they are speciated in Appendix A.

Table I 2

HAPs	**Emissions**
Total (tons/year)	0.41
Total (lbs/year)	825.15

J. MISCELLANEOUS CHEMICAL USE AND SURFACE COATING

Emissions Source Description for Miscellaneous Chemical Use at Luke AFB includes cleaners, solvents, light lubricants, oils, adhesives, sealants and other materials. These are chemicals which are used up in process and emissions are uncontrolled. The primary regulated air pollutants associated with miscellaneous chemical usage are VOC and organic HAP. Emissions of these pollutants are a result of product evaporation. A majority of the chemicals used contain no inorganic HAP or solids, and spray application is minimal. Therefore, PM emissions from general chemical use are considered to be negligible.

Emissions Calculations for Miscellaneous Chemical Use are calculated based on a material balance. The emissions of each pollutant are calculated by multiplying the volume of chemical product used by the density of the chemical product and then by the weight fraction (weight percent divided by 100) of the pollutant in the chemical product, as shown in the equation below.

E_{POL} = QC x D x (WP/100)
Where,
E_{POL} = Emissions of a particular pollutant (lb/yr);
QC = Quantity of chemical product used (gal/yr);

D = Density of the chemical product (lb/gal);
WP = Weight percent of the pollutant in the chemical product (%); and
100 = Factor for converting weight percent to weight fraction.

Luke AFB uses the Environmental Management Information System (EMIS); a comprehensive database tracking system for all material authorization and issues. When a material is authorized by base personnel, it is entered into the database, including health and safety information, physical and chemical properties and constituent breakdown from the material Safety Data Sheet (SDS). Many National Stock Numbers (NSN) are repeated since facilities are authorized to purchase any one specific cage (manufacturer) listed. Emissions are overstated by having duplicate NSN calculations, but each manufacturer usually has different constituents. In order to accurately report what is used, all possible products are accounted for.

Emissions from miscellaneous chemical use were determined by taking the emissions from 2007 EMIS data (used as the baseline average for this source), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that miscellaneous chemical use at Luke AFB would increase proportionately to base operations.

Emissions Source Description for Surface Coating operations are performed by a variety of shops on an Air Force installation, including corrosion control shops, structural maintenance shops, munitions maintenance shops, vehicle maintenance shops, hobby shops, etc. Surface coating operations involve the application of primers, paints (e.g., enamels, lacquers, polyurethanes), thinners, stains, varnishes, shellacs, glazes, etc., for decorative and protective purposes. The types of regulated air pollutants from surface coating include VOCs, organic HAPs, PM, and inorganic HAPs. The type and quantity of emissions are dependent on the composition of the surface coating material, the application technique, and whether or not a control device is used.

Surface coating operations at Luke AFB are categorized under Operating Permit No. V97-017 as: "Aerospace Manufacturing and Rework", "Vehicle and Mobile Equipment Coating", "Spray Coating Operations", "Architectural Coatings", and "Surface Coating Operations", as determined by MCAPCR Rules 348, 345, 315, 335, and 336, respectively. Aerospace coating operations at Luke AFB include coating of F-16 aircraft, aerospace ground equipment and rework at Buildings 922, 1018 and 1019. Vehicle refinishing operations at Luke AFB include coating of government vehicles operated by the federal government at Building 291. Spray Surface and spray coating operations at Luke AFB include coating of furniture, appliances, plastic products, and signs at Buildings 339 and 415. In addition, the booth in Bldg. 339 is occasionally used for architectural coatings.

All surface coating operations at Luke AFB except for those performed at Building 247 are enclosed coating operations utilizing high-volume low-pressure (HVLP) spray equipment to apply the coatings. Information on the types of controls used at each surface coating location is provided in Appendix A.

Manual (touch-up) and aerosol can application of coatings inside the spray booth at Building 247 is considered insignificant ["Any equipment or activity using no more than one gallon per day of surface coating or any combination of surface coating and solvent, which contains either VOC or hazardous air pollutants (HAPs) or both."]. Additional general exemptions are specified by MCAPCR Rules 348, 345, 315, 335, and 336, and are not listed in this application (e.g., MCAPCR Rule 348 §§308.4: Cotton-tipped swabs used for very small cleaning operations and aqueous cleaning solvents are exempt from the requirements of Section 307 of this rule.).

Emissions Calculations for Surface Coating are performed using Safety Data Sheet (SDS) information and a material balance. VOC and organic HAP emissions from surface coating are estimated in the same manner as described above for Miscellaneous Chemical Use. Particulate matter emissions from surface coating operations are also calculated based on a material balance, and take into account the transfer efficiency of the application method and control efficiency of the control device. Emissions of particulate matter are calculated as shown in the equation below.

$$E_{POL} = QC \times D \times (WP/100) \times [1 - (TE/100)] \times [1 - (CE/100)] \times Cpol$$

Where,
E_{POL} = Emissions of a particular pollutant (lb/yr);
QC = Quantity of chemical product used (gal/yr);
D = Density of the chemical product (lb/gal);
WP = Weight percent of the pollutant in the chemical product (%);
TE = Transfer efficiency (%):

CE = Control efficiency (%);
C_{Pol} = Fractional percentage of PM_{10} or $PM_{2.5}$ to total PM; and
100 = Factor for converting weight percent to weight fraction.

Similar to miscellaneous chemical use, surface coating usage and SDS information is tracked using EMIS. To allow for a conservative estimate, it was assumed that 100% of particulate sprayed would not be transferred and either emitted directly to the atmosphere or to a filter system if conducted within a booth. Booth filter efficiency was conservatively set low at 95%.

Emissions from surface coating were determined by taking the emissions from 2007 (used as the baseline average for this source), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that surface coating at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table J 1 is a Potential to Emit Summary of criteria pollutants from miscellaneous chemical and surface coating sources shown in full display in Appendix A of this TSD under the **MISCSURF** tab in the embedded icon cited above.

Table J 1

	Pollutants					
Emissions	CO	NOx	SO2	VOC	PM10	PM2.5
tons/year **lbs/year**	NA	NA	NA	53.27 106,538.77	0.86 1,728.52	0.86 1,728.52

Table J 2 is a Potential to Emit Summary of hazardous air pollutants from miscellaneous chemical and surface coating sources described above. Only total HAP are shown in this table from Appendix A.

Table J 2

HAPs	**Emissions**
Total (tons/year)	6.7
Total (lbs/year)	13,412.16

K. SOLVENT CLEANING (DEGREASING)

Emissions Source Description : Luke AFB operates multiple degreasing units which are commonly used by maintenance shops to clean (or degrease) parts associated with a variety of vehicles and equipment.

In maintenance cleaners, dirty parts cleaned in remote reservoir tanks are manually sprayed with solvent, possibly brushed, and allowed to dry before being removed from the cleaner. The waste solvents are drained to a remote reservoir that captures drainage from the sink and acts as a pump sump for the spray. The cover is closed whenever parts are not being processed or allowed to drip dry in the cleaner.

The regulated air pollutants from solvent cleaning machines include VOCs and HAPs from product evaporation; however, the solvents used at Luke AFB do not contain HAPs. Therefore, only VOC emissions are being authorized from solvent cleaning units operated at Luke AFB.

Some facilities use aqueous parts washers where the detergent used does not contain VOC's. These units are considered a trivial source in accordance with MCAPCR Appendix E ["Storage tanks, vessels, containers holding or storing liquid substances that will not emit any VOC or HAPs. Exemptions for storage tanks containing petroleum liquids or other VOCs should be based on size limits and vapor pressure of liquids stored and are not appropriate for this list."].

Emissions Calculations: Maximum VOC emissions were calculated using the equation shown below.

$E_{VOC} = Q \times D \times (1-R/100)$
Where,
E_{VOC} = Emissions of VOC (lb/yr);
Q = Solvent Used (gal/yr);

D = Solvent Density (lb/gal); and
R = Percent Recovered (%).

The maximum amount of each type of solve used determined by taking the usage in 2007 (used as baseline year for this source), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year), which conservatively assumes that solvent cleaning at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table K 1 is a Potential to Emit Summary of criteria pollutants from solvent cleaning sources shown in full display in Appendix A of this TSD under the **DEGR** tab in the embedded icon cited above.

Table K 1

Emissions	**VOC**
tons/year	3.46
lbs/year	6,930.44

L. INTERNAL COMBUSTION EMISSIONS:

Emissions Source Description: Luke AFB has two types of stationary internal combustion engines. The majority of the engines are emergency generators which are used to provide emergency backup power to facilities/systems when the primary electrical power is not available; however, Luke AFB also has two general purpose generators (located in buildings 1034 and 1074)which are used to provide electricity for the base as required. While some of these older engines may otherwise be subject to 40 CFR 63, Subpart ZZZZ requirements, the facility has a National Security exemption from those requirements under 40 CFR 1068 C.

Emissions from internal combustion occur as a result of the combustion of the fuel burned and include criteria pollutants and a variety of HAPs. The emissions from internal combustion units depend on a variety of factors including the size/type of the combustor, firing configuration, fuel type, control devices used, and operating capacity.

Smaller stationary internal combustion engines at Luke AFB with a maximum equipment rating of less than 50hp are considered an insignificant source in accordance with MCAPCR Appendix D ["Any piston-type IC engine with a manufacturer's maximum continuous rating of no more than 50 brake horsepower (bhp)."]. See also County Rule 100 §200.63 for the definitions of insignificant activities.

Emissions Calculations: Emissions from stationary internal combustion sources were calculated using the equation below:

E_{POL} = OT x PO X LF/100 X EF_{POL}
Where,
E_{POL} = Emissions of a particular pollutant (lb/yr);
OT = Operating time (hr/yr);
PO = Rated power output of engine (hp);
LF = Engine load factor (%); 74% per AEI Guide, Table 28-2; and
EF_{POL} = Emissions factor (lb/hp-hr).

Power rating for each of the generators was obtained from base records and by visiting as many generators as possible to verify the information. The maximum hours of operation for each of the engines was set based on the EPA memorandum "Calculating Potential to Emit (PTE) for Emergency Generators", which states that an engine cannot operate for more than 500 hours per year and be considered an emergency generator (EPA, September 1995). Emissions factors were taken from Table 28-3 and 28-4 of the AEI Guide.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table L 1 is a Potential to Emit Summary of criteria pollutants from internal combustion sources shown in full display in Appendix A of this TSD under the **ICOM** tab in the embedded icon cited above.

Table L 1

	Pollutants					
Emissions	CO	NOx	SO2	VOC	PM10	PM2.5
tons/year **lbs/year**	16.35 32,702.08	72.8 145,713.4	3.92 7,838.24	5.02 10,032.48	4.59 9,196.42	4.59 9,196.42

Table L 2 is a Potential to Emit Summary of hazardous air pollutant from internal combustion sources as described above. The hazardous air pollutants emitted from these sources are shown only in total in the table below but are also speciated in the referenced documents.

Table L 2

HAPs	Emissions
Total (tons/year)	0.059
Total (lbs/year)	117.88

M. WOODWORKING

Emissions Source Description : Most Air Force installations have a few organizations that operate woodworking equipment (e.g., saws, sanders, etc.). The use of woodworking equipment generates airborne PM in the form of small wood waste particles (shavings, sander dust, sawdust, etc.). In most cases, the airborne particulate is captured by a ventilation system and control device. The control device used is either a cyclone, a baghouse (fabric filter), or both in series. The sawdust captured by the control device is then collected in a bin or other container that is emptied when full. All processes at Luke AFB are manually operated.

Luke AFB currently operates a baghouse to control air emissions at Building 247, two cyclones to control air emissions at Buildings 339 and 415, and a Roto Clone Hopper to control air emissions at Building 339. For the purposes of emission estimations, the Roto Clone Hopper is treated as equivalent to a cyclone. All other woodworking activities utilize hand held or manually operated equipment that exhaust into the work space and are considered an insignificant source in accordance with MCAPCR Appendix D ["Hand-held or manually operated equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of ceramic art work, precision parts, leather, metals, plastics, fiberboard, masonry, carbon, glass, or wood."]. See also County Rule 100 §200.63 for the definitions of insignificant activities.

Emissions Calculations: Emissions from woodworking were calculated by multiplying the amount of waste collected time the appropriate emissions factor per the equation below:

$E_{POL} = Q \times EF_{Pol} \times 1 - (CAP_{eff}/100 \times CON_{eff}/100)$

Where,

E_{POL} = Emissions of a particular pollutant (lb/yr);

Q = Annual quantity of wood waste hauled away (ton/yr);

EF_{Pol} = Emissions factor (lb/ton wood waste hauled away);

CAP_{eff} = Capture efficiency (%);

CON_{eff} = Control efficiency (%); and

100 = Factor for converting percent to fraction.

Emission factors for PM_{10} were taken from the Maricopa County Emissions Inventory Help Sheet for the Woodworking Industry (2014). The capture and control efficiencies for the cyclones and baghouses were assumed to be 100% and 85%, respectively, in accordance with the Maricopa County Emissions Inventory Help Sheet for the Woodworking Industry (2014) for cyclones.

The maximum amount of sawdust collected at each location was determined by taking the usage in 2007 (used as baseline year for this source), and scaling this number up by 4.21. The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five days per week, 52 weeks per year (2,080 hours per year) which it is conservatively assumes that woodworking operations at Luke AFB would increase proportionately to base operations.

Detailed emissions calculations and equipment information for all operations and equipment of the facility are shown in the embedded icons Appendix A Emissions Calculations and Equipment List above.

Table M 1 is a Potential to Emit Summary of criteria pollutants from woodworking sources shown in full display in Appendix A of this TSD under the **WOOD** tab in the embedded icon cited above.

Table M 1

Emissions	PM10/PM2.5
tons/year	0.083
lbs/year	165.3

N. MISCELLANEOUS DISCUSSION ITEMS

Cooling Towers:
LAFB operates a central plant for heating and cooling that contains four cooling towers with a total maximum circulation rate of 3,900 gallons per minute. There are additional small cooling towers scattered throughout the facility but they are all of smaller capacity than the central plant towers. Appendix D of County Rules states that cooling towers with a circulation rate of less than 10, 000 gallons per minute are considered insignificant activities. Therefore, no permit conditions are being included in this permit for the operation of these cooling towers.

Waste Water Treatment Plant (WWTP):
The WWTP accepts municipal waste water discharges from facilities on the base. No industrial waste from Luke AFB is sent to the WWTP for treatment. The WWTP is designed to treat a maximum of 1.2 million gallons/day. The current throughput is approximately 425,000 gallons/day. A complete description of the WWTP was included in the application documents.

Fully treated effluent is sent to a storage pond where it is used as irrigation on the base. It can also be discharged to the Agua Fria River through an effluent metering flume to record the volume so discharged.

Emissions from the WWTP may include by-products of aerobic digestion such as carbon dioxide, methane, and trace amounts of hydrogen sulphide. No criteria or HAP emissions are expected from this process. These by-products may be odor producing and odor is regulated under this permit; however, there have been no odor complaints in the last five year permit period.

Open Outdoor Burning
LAFB occasionally conducts open outdoor burning and has applied for such burn permits as are required by County Rule 314 some of which have varying periods of expiration. It was decided to include open outdoor burning in this permit so that it will not be necessary to apply for separate open outdoor burning permits. Permission for burning must still be obtained for each burn conducted.

6. INSIGNIFICANT AND TRIVIAL ACTIVITIES

Per MCAPCR Rule 100 §§200.58 and Appendix D, emissions do not need to be calculated for insignificant activities, however, the sources must be listed or generally grouped in the application. The table below summarizes the sources at Luke AFB that meet the definition of insignificant.

Source Type	EPN	Description	Exclusion Rationale
Boilers/Heaters/ Water Heaters	Multiple – See Source List	Boilers/Heaters/ Water heaters <300,000 Btu/hr	Appendix D: General Combustion Activities establishes a threshold for these sources as greater than 300,000 Btu/hr. All natural gas and/or liquefied petroleum gas-fired pieces of equipment over 300,000 BTU per hour, only if the input capacities added together are less than 2,000,000 BTU per hour, the

Source Type	EPN	Description	Exclusion Rationale
			emissions come from fuel burning, and the equipment is used solely for heating buildings for personal comfort or for producing hot water for personal use. It is implied that water heaters <300,000 Btu/hr are insignificant.
Cooling Towers	Multiple – See Source List	Cooling Towers with circulation rate of 3,900 gallons per minute or less	Appendix D: Miscellaneous Activities. Cooling towers: Any water cooling tower which: (1) has a circulation rate of less than 10,000 gallons per minute; and (2) is not used to cool process water, water from barometric jets, or water from barometric condensers.
Stationary Internal Combustion	Multiple – See Source List	Emergency generators <50hp	Appendix D: Internal Combustion (IC) Equipment. Any piston-type IC engine with a manufacturer's maximum continuous rating of no more than 50 brake horsepower (bhp).
Woodworking	Multiple – See Source List	Hand held or manually operated equipment that exhaust into the work space	Appendix D: Miscellaneous Activities. Hand-held or manually operated equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of ceramic art work, precision parts, leather, metals, plastics, fiberboard, masonry, carbon, glass, or wood.
Abrasive Blasting	Multiple – See Source List	Small Glove Box Blaster	
Storage Tanks	Multiple – See Source List	Gasoline, Diesel and JET-A Storage Tanks <250 gal cap.	Appendix D: Storage And Distribution. Chemical or petroleum storage tanks or containers that hold 250 gallons or less and would have emissions of a regulated air pollutant. Any emissions unit, operation, or activity that handles or stores no more than 12,000 gallons of a liquid with a vapor pressure less than 1.5 psia.
	Multiple – See Source List	Generator fuel storage tanks (Diesel) - various capacities	
	Multiple – See Source List	Tanks storing liquids considered to have a low vapor pressure (virgin oil, flush oil, hydraulic oil, antifreeze, etc.)	
Surface Coating	Multiple	Paint booth [in a designated (clean) shop area] in which manual application of materials is the sole method of application.	Appendix D: Surface Coating And Printing Equipment. Any equipment or activity using no more than one gallon per day of surface coating or any combination of surface coating and solvent, which contains either VOC or hazardous air pollutants (HAPs) or

Source Type	EPN	Description	Exclusion Rationale
			both.

Per MCAPCR Rule 100 §§200.111 and Appendix E, "Trivial activities" means activities, process, or emissions units, such as the following, that may be omitted from a Title V permit application. The table below summarizes the sources at Luke AFB that meet the definition of trivial.

Description	Exclusion Rationale
Welding	Appendix E: Repair And Maintenance. Plant maintenance and upkeep activities (e.g., grounds keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots), provided these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and not otherwise triggering a permit modification. Cleaning and painting activities qualify, if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners and/or operators must still get a permit, if otherwise required.
Miscellaneous Chemical Use[1]	Appendix E: Repair and Maintenance. Plant maintenance and upkeep activities (e.g., grounds keeping, general repairs, cleaning, painting, welding, plumbing, re-tarring roofs, installing insulation, and paving parking lots), provided these activities are not conducted as part of a manufacturing process, are not related to the source's primary business activity, and not otherwise triggering a permit modification. Cleaning and painting activities qualify, if they are not subject to VOC or HAP control requirements. Asphalt batch plant owners and/or operators must still get a permit, if otherwise required. And Repair or maintenance shop activities not related to the source's primary business activity (excluding emissions from surface coating or degreasing (solvent metal cleaning) activities) and not otherwise triggering a permit modification.
Solvent Cleaning (Degreasing) Using Aqueous Solvents	Appendix E: Storage And Distribution. Storage tanks, vessels, containers holding or storing liquid substances that will not emit any VOC or HAPs. Exemptions for storage tanks containing petroleum liquids or other VOCs should be based on size limits and vapor pressure of liquids stored and are not appropriate for this list.
Fire Suppression Systems (e.g., AFFF)	Appendix E: Emergency Equipment. Fire suppression systems.

[1]Miscellaneous chemical emissions estimates may include emissions from activities that would be considered insignificant to allow for a conservative estimate.

Additionally, the table below summarizes sources that are not defined insignificant or trivial per MCAPCR, but can be justifiably excluded from permitting.

Description	Exclusion Rationale
Aircraft Defueling	Both pieces of equipment are mobile; not a stationary source.
Jet Engine Spray Ring Matter Burn Off	Jet engine spray rings are pre-cleaned prior to placement in burn off ovens. Any debris remaining is invisible to the naked eye. The burn-off ovens are exempted from the requirements of MCAPCR Rule 313 per email "RE: Rule 313" from Patty Nelson – ENVX (PNelson@mail.maricopa.gov) to Newell Yvonne I Civilian 56 CES/CEVC, Thursday May 06, 2004 1:55 PM.
Oil water separators	Generally used only for JET-A, oils, and other heavy materials mixed with water. Units are constant level, underground units (i.e., no working or

	breathing losses) and assumed to have no evaporative emissions.
Portable Jet Engine Test Stand	Considered a mobile source.
Portable Fuel Storage Tanks	Not a stationary source.
Outdoor Firing Range	Shooters are mobile; not a stationary source.

APPENDIX A

Source Type: Abrasive Blasting

Process ID: 515

Source List and Usage

Process ID	Facility ID	Description	Make	Media Type	Control	Media Usage (lb/yr)	
						2007[1]	Max[2]
515	907	Walk-In Abrasive Blasting Booth	Pauli-Griffin	Garnet	Baghouse (Control ID 522)	700	2,947

1. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

Pollutant	Emissions Factor[1, 2] ($lb/10^3 lb$)
PM	0.59
PM_{10}	0.59
$PM_{2.5}$	0.55

1. Emission factors taken from Air Emissions Guide for Air Force Stationary Sources, Table 2-1, AFCEC, October 2014.
2. PM emission factor not available. PM emissions conservatively assumed to equal PM_{10} emissions.

Emissions

Pollutant	Emissions[1]		
	(lb/hr)	(lb/yr)	(tpy)
PM	0.0008	1.74	0.0009
PM_{10}	0.0008	1.74	0.0009
$PM_{2.5}$	0.0008	1.62	0.0008
Total HAPs[2]	0.0008	1.74	0.0009

1. Calculation Methodology:

$E_{Pol} = Q \times 1/1{,}000 \times EF_{Pol}$

E_{Pol} = Emissions (lb/yr)

Q = Annual blast media consumed (lb/yr)

1,000 = Factor for converting pounds to 10^3 pounds ($lb/10^3$ lb)

EF_{Pol} = Emissions factor ($lb/10^3$ lb of blast media used)

Emission calculation methodology from Section 2 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014, for uncontrolled abrasive blasting.

Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

2. Speciation data not available. Total HAP emissions conservatively assumed to equal PM emissions.

APPENDIX A

Source Type: External Combustion

Process ID: 001, 002

Source List and Usage

Process ID	Equipment Size	Fuel Type	Total Heat Input[1] (MMBTU/hr)	Maximum Operation (hr/yr)	Maximum Fuel Use	Throughput Units
001	<10 MMBtu/hr	Nat. Gas	134	8,760	1,144	MMscf/yr
002	<10 MMBtu/hr	Propane	1	8,760	95	Mgal/yr

1. Total MMBtu/hr includes all external combustion units at Luke AFB. The total number was rounded up to the nearest MMBTU/hr.
2. The following heating values were used for unit conversion (MMBtu to gal):

For Natural Gas:	1,026	MMBtu/MMscf
For Propane:	92	MMBtu/10^3 gal

from Air Emissions Guide for Air Force Stationary Sources, Table 11-2, AFCEC, October 2014.

Emissions Factors

Pollutant	CAS #	Natural Gas (lb/MMscf)[1]	Propane (lb/Mgal)[2]
CO	-	84	7.5
NOx	-	100	13
SOx	-	0.6	0.018
PM	-	7.6	0.7
PM_{10}	-	7.6	0.7
$PM_{2.5}$	-	7.6	0.7
VOC	-	5.5	1
Acenaphthene	83-32-9	1.80E-06	1.65E-07
Acenaphthylene	208-96-8	1.80E-06	1.65E-07
Acetaldehyde	75-07-0	4.30E-03	2.84E-04
Acrolein	107-02-8	2.70E-03	2.47E-04
Anthracene	120-12-7	2.40E-06	2.20E-07
Arsenic	7440-38-2	2.00E-04	1.83E-05
Benz(a)anthracene	56-55-3	1.80E-06	1.65E-07
Benzene	71-43-2	8.00E-03	5.31E-04
Benzo(b)fluoranthene	205-99-2	1.80E-06	1.65E-07
Benzo(k)fluoranthene	207-08-9	1.80E-06	1.65E-07
Benzo(g,h,i)perylene	191-24-2	1.20E-06	1.46E-07
Benzo(a)pyrene	50-32-8	1.20E-06	1.46E-07
Beryllium	7440-41-7	1.20E-05	1.10E-06
Cadmium	7440-43-9	1.10E-03	1.01E-04
Chromium	7440-47-3	1.40E-03	1.28E-04
Chrysene	218-01-9	1.80E-06	1.65E-07
Cobalt Compounds	7440-48-4	8.40E-05	7.69E-06
Dibenzo(a,h)anthracene	53-70-3	1.20E-06	1.46E-07
Dichlorobenzene	25321-22-6	1.20E-03	1.10E-04
7,12-Dimethylbenz(a)anthracene	57-97-6	1.60E-05	1.46E-06
Ethyl Benzene	100-41-4	9.50E-03	6.31E-04
Fluoranthene	206-44-0	3.00E-06	2.75E-07
Fluorene	86-73-7	2.80E-06	2.56E-07
Formaldehyde	50-00-0	7.50E-02	6.86E-03
Hexane	110-54-3	6.30E-03	4.21E-04
Indeno(1,2,3-cd)pyrene	193-39-5	1.80E-06	1.65E-07
Lead	7439-92-1	5.00E-04	4.58E-05
Manganese	7439-96-5	3.80E-04	3.48E-05
Mercury	7439-97-6	2.60E-04	2.38E-05
3-Methylchloranthrene	56-49-5	1.80E-06	1.65E-07
2-Methylnaphthalene	91-57-6	2.40E-05	2.16E-06
Naphthalene	91-20-3	3.00E-04	2.75E-05
Nickel	7440-02-0	2.10E-03	1.92E-04
Phenanathrene	85-01-8	1.70E-05	1.56E-06
Pyrene	129-00-0	5.00E-06	4.58E-07
Selenium Compounds	7782-49-2	2.40E-05	2.20E-06
Toluene	108-88-3	3.66E-02	2.42E-03
Xylenes	1330-20-7	-	1.80E-03

1. Air Emissions Guide for Air Force Stationary Sources, Tables 11-3, 11-4, AFCEC, October 2014. Emission factors are derived from AP-42 and Mohave Desert Air Quality Management District.
2. Air Emissions Guide for Air Force Stationary Sources, Tables 11-13, 11-14, AFCEC, October 2014. Emission factors are derived from AP-42 and Mohave Desert Air Quality Management District.

APPENDIX A EXTERNAL COMBUSTION

Emissions

Pollutant	CAS #	Emissions[1]					
		001			002		
		(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)
CO	-	10.97	96,103.86	48.05	0.08	714.13	0.36
NOx	-	13.06	114,409.36	57.20	0.14	1,237.83	0.62
SOx	-	0.08	686.46	0.34	1.96E-04	1.71	0.00
PM	-	0.99	8,695.11	4.35	0.01	66.65	0.03
PM_{10}	-	0.99	8,695.11	4.35	0.01	66.65	0.03
$PM_{2.5}$	-	0.99	8,695.11	4.35	0.01	66.65	0.03
VOC	-	0.72	6,292.51	3.15	0.01	95.22	0.05
Total HAPs	-	0.02	171.67	0.09	1.51E-04	1.32	6.61E-04
Acenaphthene	83-32-9	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Acenaphthylene	208-96-8	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Acetaldehyde	75-07-0	5.62E-04	4.92	2.46E-03	3.09E-06	0.03	1.35E-05
Acrolein	107-02-8	3.53E-04	3.09	1.54E-03	2.68E-06	0.02	1.18E-05
Anthracene	120-12-7	3.13E-07	2.75E-03	1.37E-06	2.39E-09	2.09E-05	1.05E-08
Arsenic	7440-38-2	2.61E-05	0.23	1.14E-04	1.99E-07	1.74E-03	8.71E-07
Benz(a)anthracene	56-55-3	2.35E-07	0.00	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Benzene	71-43-2	1.04E-03	9.15	4.58E-03	5.77E-06	0.05	2.53E-05
Benzo(b)fluoranthene	205-99-2	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Benzo(k)fluoranthene	207-08-9	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Benzo(g,h,i)perylene	191-24-2	1.57E-07	1.37E-03	6.86E-07	1.59E-09	1.39E-05	6.95E-09
Benzo(a)pyrene	50-32-8	1.57E-07	1.37E-03	6.86E-07	1.59E-09	1.39E-05	6.95E-09
Beryllium	7440-41-7	1.57E-06	0.01	6.86E-06	1.20E-08	1.05E-04	5.24E-08
Cadmium	7440-43-9	1.44E-04	1.26	6.29E-04	1.10E-06	0.01	4.81E-06
Chromium	7440-47-3	1.83E-04	1.60	8.01E-04	1.39E-06	0.01	6.09E-06
Chrysene	218-01-9	2.35E-07	0.00	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Cobalt Compounds	7440-48-4	1.10E-05	0.10	4.81E-05	8.36E-08	7.32E-04	3.66E-07
Dibenzo(a,h)anthracene	53-70-3	1.57E-07	1.37E-03	6.86E-07	1.59E-09	1.39E-05	6.95E-09
Dichlorobenzene	25321-22-6	1.57E-04	1.37	6.86E-04	1.20E-06	0.01	5.24E-06
7,12-Dimethylbenz(a)anthracene	57-97-6	2.09E-06	0.02	9.15E-06	1.59E-08	1.39E-04	6.95E-08
Ethyl Benzene	100-41-4	1.24E-03	10.87	5.43E-03	6.86E-06	0.06	3.00E-05
Fluoranthene	206-44-0	3.92E-07	3.43E-03	1.72E-06	2.99E-09	2.62E-05	1.31E-08
Fluorene	86-73-7	3.66E-07	3.20E-03	1.60E-06	2.78E-09	2.44E-05	1.22E-08
Formaldehyde	50-00-0	9.80E-03	85.81	4.29E-02	7.46E-05	0.65	3.27E-04
Hexane	110-54-3	8.23E-04	7.21	3.60E-03	4.58E-06	0.04	2.00E-05
Indeno(1,2,3-cd)pyrene	193-39-5	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
Lead	7439-92-1	6.53E-05	0.57	2.86E-04	4.98E-07	4.36E-03	2.18E-06
Manganese	7439-96-5	4.96E-05	0.43	2.17E-04	3.78E-07	3.31E-03	1.66E-06
Mercury	7439-97-6	3.40E-05	0.30	1.49E-04	2.59E-07	2.27E-03	1.13E-06
3-Methylchloranthrene	56-49-5	2.35E-07	2.06E-03	1.03E-06	1.79E-09	1.57E-05	7.86E-09
2-Methylnaphthalene	91-57-6	3.13E-06	0.03	1.37E-05	2.35E-08	2.06E-04	1.03E-07
Naphthalene	91-20-3	3.92E-05	0.34	1.72E-04	2.99E-07	2.62E-03	1.31E-06
Nickel	7440-02-0	2.74E-04	2.40	1.20E-03	2.09E-06	0.02	9.14E-06
Phenanathrene	85-01-8	2.22E-06	0.02	9.72E-06	1.70E-08	1.49E-04	7.43E-08
Pyrene	129-00-0	6.53E-07	0.01	2.86E-06	4.98E-09	4.36E-05	2.18E-08
Selenium Compounds	7782-49-2	3.13E-06	0.03	1.37E-05	2.39E-08	2.09E-04	1.05E-07
Toluene	108-88-3	4.78E-03	41.87	2.09E-02	2.63E-05	0.23	1.15E-04
Xylenes	1330-20-7	-	-	-	1.96E-05	0.17	8.57E-05

2. Calculation Methodology:

E_{POL} = FC * EF

E_{POL} = Emissions of a particular pollutant (lb/yr);

FC = Quantity of fuel consumed per year (units/yr); and

EF = Emission factor (lb/units).

Emission calculation methodology from Section 11 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.

APPENDIX A

Source Type: Fire Fighter Training

Process ID: 003

Source List and Usage

Process ID	Facility ID	Fuel Type	Fuel Usage (gal)	
			3-Yr Average [1]	Max[2]
003	7213	Propane	7,800	32,838

1. 3-Yr Average includes usage from 2012-2014 to obtain a baseline actual usage.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

Pollutant	CAS #	Propane ($lb/10^3$ gal)[1]
CO	-	15.4
NOx	-	55.7
SOx	-	0.02
PM	-	9.5
PM_{10}	-	9.5
$PM_{2.5}$	-	9.5
VOC	-	24.0
Formaldehyde	50-00-0	0.7

1. Emission factors taken rom Air Emissions Guide for Air Force Stationary Sources, AFCEC, Table 12-1, October 2014.

Emissions

Pollutant	CAS #	Emissions[1]		
		(lb/hr)	(lb/yr)	(tpy)
CO	-	0.24	505.71	0.25
NOx	-	0.88	1,829.08	0.91
SOx	-	3.16E-04	0.66	3.28E-04
PM	-	0.15	311.96	0.16
PM_{10}	-	0.15	311.96	0.16
$PM_{2.5}$	-	0.15	311.96	0.16
VOC	-	0.38	788.11	0.39
Total HAPs	-	0.01	22.99	0.01
Formaldehyde	50-00-0	0.01	22.99	0.01

1. Calculation Methodology:

$E_{POL} = Q * EF$

E_{POL} = Emissions of a particular pollutant (lb/yr);

Q = Quantity of fuel consumed per year (10^3 gal/yr for propane); and

EF = Emission factor (lb/10^3 gal for propane).

Emission calculation methodology from Section 12 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, Oct

Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

APPENDIX A

Source Type: Fuel Cell Maintenance
Process IDs: 520, 521, 522

Source List and Usage

Process ID	Facility ID	Tank Description	Fuel Tank Volume (gal)	Numer of Cells Purged	
				2007 [1]	Max [2]
520	968	Internal Tank	1,050	532	2,240
521		External Tank	370	467	1,966
522		External Tank	300	279	1,175

1. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

JET-A Physical Properties[1]

Property	Description	Value	Units
M_V	Vapor Molecular Weight	130	lb/lb-mol
P_{VA} [2]	Vapor Pressure	9.54E-02	psia
R	Ideal Gas Law	10.732	psia•ft3/°R•lb-mol
T_{LA}	Daily Liquid Average Surface Temperature	560	R
C_{VOC} [3]	Vapor Saturation Concentration	0.00206	lb/ft^3

1.Values taken from Air Emissions Guide for Air Force Stationary Sources, Table 13-1, AFCEC, October 2014.
2. Vapor pressure at daily average liquid surface temperature, conservatively assumed to equal 100 ◦F.
3. Calculation Methodology:
$C_{VOC} = (M_V \times P_{VA}) / (R \times T_{LA})$
M_V = Vapor molecular weight (lb/lb-mol);
P_{VA} = Vapor pressure at the daily average liquid surface temperature (psia);
R = Ideal gas constant (10.732 psia•ft^3/°R•lb-mol); and
T_{LA} = Daily average liquid surface temperature (°R).

Hazardous Air Pollutant Vapor Speciation (Weight %)

Hazardous Air Pollutant	CAS #	JET-A
Benzene	71-43-2	3.38E-02
Cumene	98-82-8	1.81E-01
Ethyl Benzene	100-41-4	1.59E-01
Fluorene	86-73-7	3.44E-03
Isooctane	540-84-1	1.23E-03
Naphthalene	91-20-3	2.68E-01
Phenylbenzene	92-52-4	6.78E-02
Pyrene	129-00-0	1.00E-05
Toluene	108-88-3	2.19E-01
Xylenes	1330-20-7	1.19E-02

1. Speciation taken from Values taken from Air Emissions Guide for Air Force Stationary Sources, Table 13-2, AFCEC, October 2014.

Emissions

Fuel Type	CAS #	Emissions[1]											
		520 Internal Tank - 1050 gal			521 External Tank - 370 gal			522 External Tank - 300 gal			Total		
		(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)
VOC	--	0.62	1,297.49	0.65	0.19	401.35	0.20	0.09	194.41	0.10	**0.91**	**1,893.25**	**0.95**
Total HAPs	--	0.01	12.26	0.01	0.00	3.79	1.90E-03	0.00	1.84	9.19E-04	**0.01**	**17.89**	**0.01**
Benzene	71-43-2	0.00	0.44	2.19E-04	0.00	0.14	6.78E-05	0.00	0.07	3.29E-05	**0.00**	**0.64**	**3.20E-04**
Cumene	98-82-8	0.00	2.35	1.17E-03	0.00	0.73	3.63E-04	0.00	0.35	1.76E-04	**0.00**	**3.43**	**1.71E-03**
Ethyl Benzene	100-41-4	0.00	2.06	1.03E-03	0.00	0.64	3.19E-04	0.00	0.31	1.55E-04	**0.00**	**3.01**	**1.51E-03**
Fluorene	86-73-7	2.15E-05	0.04	2.23E-05	6.64E-06	0.01	6.90E-06	3.22E-06	0.01	3.34E-06	**3.13E-05**	**0.07**	**3.26E-05**
Isooctane	540-84-1	7.67E-06	0.02	7.98E-06	2.37E-06	4.94E-03	2.47E-06	1.15E-06	2.39E-03	1.20E-06	**1.12E-05**	**0.02**	**1.16E-05**
Naphthalene	91-20-3	0.00	3.48	1.74E-03	0.00	1.08	5.38E-04	0.00	0.52	2.61E-04	**0.00**	**5.07**	**2.54E-03**
Phenylbenzene	92-52-4	0.00	0.88	4.40E-04	0.00	0.27	1.36E-04	0.00	0.13	6.59E-05	**0.00**	**1.28**	**6.42E-04**
Pyrene	129-00-0	6.24E-08	1.30E-04	6.49E-08	1.93E-08	4.01E-05	2.01E-08	9.35E-09	1.94E-05	9.72E-09	**9.10E-08**	**1.89E-04**	**9.47E-08**
Toluene	108-88-3	0.00	2.84	1.42E-03	0.00	0.88	4.39E-04	0.00	0.43	2.13E-04	**0.00**	**4.15**	**2.07E-03**
Xylenes	1330-20-7	0.00	0.15	7.72E-05	0.00	0.05	2.39E-05	0.00	0.02	1.16E-05	**0.00**	**0.23**	**1.13E-04**

1. Calculation Methodology:
$E_{VOC} = 2 \times C_{VOC} \times 0.13368 \times \sum(V \times N)$
E_{VOC} = Annual emissions of VOC (lb/yr);
2 = Factor used for the conservative estimate of emissions representing twice the fuel cell volume;
C_{VOC} = VOC concentration in the fuel cell (lb/ft^3);
0.13368 = Factor for converting cubic feet to gallons (ft^3/gal);
V = Fuel cell volume (gal/unit); and
N = Number of fuel cells purged/ventilated in a year (units/yr).
Emission calculation methodology from Section 13 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.
Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

Source Type: Fuel Cell Maintenance - Aircraft Defueling
Process ID: 523

Source List and Maximum Throughput

Process ID	Facility ID	Description	Fuel Type	Throughout (gal/yr)	
				2007 [1]	Max[2]
523	968	Aircraft Defueling Prior to Fuel Cell Maintenance	JET-A	106,400	447,944

1. Luke AFB determined that 2007 is representative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

Loading Loss Calculation

Loading Loss Equation Parameter		Value
		JET-A
Saturation (S) Factor	S	1.45
True Vapor Pressure (psi)	P	0.0085
Molecular Weight of Vapor (lb/lb-mole)	M	130
Temperature of Bulk Liquid Loaded (˚R)	T	520
Capture Efficiency (%)	CAPeff	0
Control Efficiency (%)	CONeff	0
Loading Loss (lb/1000 gal)	L_L	0.0384

1. Loading loss calculated in accordance with Section 5.2-"Transportation and Marketing of Petroleum Liquids," Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources, Fifth Edition, U.S. Environmental Protection Agency, July 2008. The equation used is shown below:

L_L = 12.46*SPM/T*(1-(CAPeff/100 - CONeff/100))

12.46 = Equation constant (°R lb-mol/psia 10^3 gal);
S = Saturation factor;
P = True vapor pressure of fuel (psia);
M = Vapor molecular weight of the fuel (lb/lb-mol);
T = Temperature of bulk liquid loaded (°R);
Cap = Capture efficiency of the loading terminal (%);
CE = Efficiency of the control device (%); and
100 = Factor for converting a percent to a fraction (%)

Saturation factor, true vapor pressure, and vapor molecular weight taken from Air Emissions Guide for Air Force Stationary Sources, AFCEC, Table 16-1 and 16-2, October 2014.

Hazardous Air Pollutant Vapor Speciation (Weight %)

Hazardous Air Pollutant	CAS #	JET-A
Benzene	71-43-2	3.38E-02
Cumene	98-82-8	1.81E-01
Ethyl Benzene	100-41-4	1.59E-01
Fluorene	86-73-7	3.44E-03
Isooctane	540-84-1	1.23E-03
Naphthalene	91-20-3	2.68E-01
Phenylbenzene	92-52-4	6.78E-02
Pyrene	129-00-0	1.00E-05
Toluene	108-88-3	2.19E-01
Xylenes	1330-20-7	1.19E-02

1. Speciation taken from Values taken from Air Emissions Guide for Air Force Stationary Sources, Table 13-2, AFCEC, October 2014.

Emissions

Pollutant	CAS #	Emissions[1]		
		523		
		(lb/hr)	(lb/yr)	(ton/yr)
VOCs	-	8.27E-03	17.20	8.60E-03
Total HAPs	-	7.81E-05	1.63E-01	8.13E-05
Benzene	71-43-2	2.79E-06	5.81E-03	2.91E-06
Cumene	98-82-8	1.50E-05	3.11E-02	1.56E-05
Ethyl Benzene	100-41-4	1.31E-05	2.73E-02	1.37E-05
Fluorene	86-73-7	2.84E-07	5.92E-04	2.96E-07
Isooctane	540-84-1	1.02E-07	2.12E-04	1.06E-07
Naphthalene	91-20-3	2.22E-05	4.61E-02	2.30E-05
Phenylbenzene	92-52-4	5.61E-06	1.17E-02	5.83E-06
Pyrene	129-00-0	8.27E-10	1.72E-06	8.60E-10
Toluene	108-88-3	1.81E-05	3.77E-02	1.88E-05
Xylenes	1330-20-7	9.84E-07	2.05E-03	1.02E-06

1. Calculation Methodology:

$E_{HAP} = E_{VOC}$ x (WP_{HAP}/100)
E_{HAP} = HAP Emissions (lb/yr)
E_{VOC} = VOC Emissions (lb/yr)
WP_{HAP} = Weight percent HAP in the fuel (%)
100 = Factor for converting weight percent to weight fraction (%)

Emission calculation methodology from Air Emissions Guide for Air Force Stationary Sources, Section 16, AFCEC, October 2014.
Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

Source Type: Fuel Dispensing - Gasoline
Process ID: 653

Source List and Maximum Throughput

Process ID	Facility ID	Description	Fuel Type	Fuel Usage (gal)
				Max[2]
653	368	Military Service Station	Gasoline	1,199,988

1. Limited to 99,999 gallons per month to remain below NESHAP CCCCCC requirements.

Emissions Factors

Emission Source	Emission Factor (lb/1000 gal)[1]
	Gasoline
Displacement	11

1. Gasoline emission factors from EPA document AP 42, Section 5.2, Table 5.2-7, dated June 2008.

Hazardous Air Pollutant Vapor Speciation (Weight %)

HAP	CAS #	Gasoline
Benzene	71-43-2	0.65
Cumene	98-82-8	0.01
Ethyl Benzene	100-41-4	0.05
Hexane	110-54-3	0.59
Toluene	108-88-3	0.73
2,2,4-Trimethylpentane	540-84-1	0.75
Xylenes (mixed isomers)	1330-20-7	0.21

1. Calculated using USEPA Tanks 4.09d from liquid weight percents.

Emissions

Fuel Type	CAS #	Emissions[1, 2]		
		653		
		(lb/yr)	(lb/yr)	(tpy)
VOC	--	6.35	13,199.87	6.60
Total HAPs	--	0.19	394.68	0.20
Benzene	71-43-2	4.12E-02	85.80	0.04
Cumene	98-82-8	6.35E-04	1.32	6.60E-04
Ethyl Benzene	100-41-4	3.17E-03	6.60	3.30E-03
Hexane	110-54-3	3.74E-02	77.88	0.04
Toluene	108-88-3	4.63E-02	96.36	0.05
2,2,4-Trimethylpentane	540-84-1	4.76E-02	99.00	0.05
Xylenes (mixed isomers)	1330-20-7	1.33E-02	27.72	0.01

1. Emissions for displacement and spillage are calculated separately, using the methodology below:

$E_{VOC} = Q \times 1/1{,}000 \times EF$

E_{VOC} = Emissions (lb/yr)

Q = Annual quantity of fuel transferred (gal/yr)

1,000 = Factor for converting gal to 10^3 gal (gal/10^3gal)

EF = Emissions factor (lb/10^3 gal).

Emission calculation methodology from Section 16 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014, for uncontrolled fuel tran

2. Calculation Methodology:

$E_{HAP} = E_{VOC} \times (WP_{HAP}/100)$

E_{HAP} = HAP Emissions (lb/yr)

E_{VOC} = VOC Emissions (lb/yr)

WP_{HAP} = Weight percent HAP in the fuel (%)

100 = Factor for converting weight percent to weight fraction (%)

Emission calculation methodology from Section 16 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.

Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

APPENDIX A

Source Type: Loading - Diesel, JET-A
Process IDs: 642, 643, 644

Source List and Maximum Throughput

Process ID	Description	Fuel Type	Throughout (gal/yr)[1]	
			2007 [1]	Max[2]
642	JET-A to Trucks, Tank 351, 356	JET-A	40,918,465	172,266,738
643	JET-A to Aircraft, Tank 351, 356	JET-A	40,918,466	172,266,742
644	Diesel to Trucks, Bldg 405	Diesel/ Bio-Diesel	39,862	167,819

1. Luke AFB determined that 2007 is representative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

Loading Loss Calculation

Loading Loss Equation Parameter		Value	
		JET-A	Diesel
Saturation (S) Factor	S	0.6	0.6
True Vapor Pressure (psi)	P	0.0954	0.022
Molecular Weight of Vapor (lb/lb-mole)	M	130	130
Temperature of Bulk Liquid Loaded (˚R)	T	559.67	559.67
Capture Efficiency (%)	CAPeff	0	0
Control Efficiency (%)	CONeff	0	0
Loading Loss (lb/1000 gal)	L_L	0.1657	0.0382

1. Loading loss calculated in accordance with Section 5.2-"Transportation and Marketing of Petroleum Liquids," Compilation of Air Pollutant Emission Factors - Volume I: Stationary Point and Area Sources, Fifth Edition, U.S. Environmental Protection Agency, July 2008. The equation used is shown below:

L_L = 12.46*SPM/T*(1-(CAPeff/100 - CONeff/100))

12.46 = Equation constant (°R lb-mol/psia 10^3 gal);
S = Saturation factor;
P = True vapor pressure of fuel (psia);
M = Vapor molecular weight of the fuel (lb/lb-mol);
T = Temperature of bulk liquid loaded (°R);
Cap = Capture efficiency of the loading terminal (%);
CE = Efficiency of the control device (%); and
100 = Factor for converting a percent to a fraction (%)

Saturation factor, true vapor pressure, and vapor molecular weight taken from Air Emissions Guide for Air Force Stationary Sources, AFCEC, Table 16-1 and 16-2, October 2014 at 100 F.

APPENDIX A FUEL LOADING-DIESEL & JET A

Hazardous Air Pollutant Vapor Speciation (Weight %)

Hazardous Air Pollutant	CAS #	JET-A[1]	Diesel[2]
Benzene	71-43-2	3.38E-02	0.20
Cumene	98-82-8	1.81E-01	-
Ethyl Benzene	100-41-4	1.59E-01	0.31
Fluorene	86-73-7	3.44E-03	-
Hexane	110-54-3	-	0.04
Isooctane	540-84-1	1.23E-03	-
Naphthalene	91-20-3	2.68E-01	-
Phenylbenzene	92-52-4	6.78E-02	-
Pyrene	129-00-0	1.00E-05	-
Toluene	108-88-3	2.19E-01	2.30
1,2,4-Trimethylbenzene	95-63-6	-	4.67
Xylenes	1330-20-7	1.19E-02	5.83

1. JP-8 speciation taken from Values taken from Air Emissions Guide for Air Force Stationary Sources, Table 13-2, AFCEC, October 2014.

2. Diesel calculated using USEPA Tanks 4.09d from liquid weight percents.

Emissions

Pollutant	CAS #	JET-A			JET-A			Diesel		
		642			643			644		
		(lb/hr)	(lb/yr)	(ton/yr)	(lb/hr)	(lb/yr)	(ton/yr)	(lb/hr)	(lb/yr)	(ton/yr)
VOCs	-	13.72	28,538.45	14.27	13.72	28,538.45	14.27	3.08E-03	6.41	3.21E-03
Total HAPs	-	0.13	269.74	0.13	0.13	269.74	0.13	4.11E-04	0.86	4.28E-04
Benzene	71-43-2	4.64E-03	9.65	4.82E-03	4.64E-03	9.65	4.82E-03	6.16E-06	0.01	6.41E-06
Cumene	98-82-8	0.02	51.65	0.03	0.02	51.65	0.03	-	-	-
Ethyl Benzene	100-41-4	0.02	45.38	0.02	0.02	45.38	0.02	9.56E-06	0.02	9.94E-06
Fluorene	86-73-7	4.72E-04	0.98	4.91E-04	4.72E-04	0.98	4.91E-04	-	-	-
Hexane	110-54-3	-	-	-	-	-	-	1.23E-06	2.56E-03	1.28E-06
Isooctane	540-84-1	1.69E-04	0.35	1.76E-04	1.69E-04	0.35	1.76E-04	-	-	-
Naphthalene	91-20-3	0.04	76.48	0.04	0.04	76.48	0.04	-	-	-
Phenylbenzene	92-52-4	0.01	19.35	0.01	0.01	19.35	0.01	-	-	-
Pyrene	129-00-0	1.37E-06	2.85E-03	1.43E-06	1.37E-06	2.85E-03	1.43E-06	-	-	-
Toluene	108-88-3	0.03	62.50	0.03	0.03	62.50	0.03	7.09E-05	0.15	7.37E-05
1,2,4-Trimethylbenzene	95-63-6	-	-	-	-	-	-	1.44E-04	0.30	1.50E-04
Xylenes	1330-20-7	1.63E-03	3.40	1.70E-03	1.63E-03	3.40	1.70E-03	1.80E-04	0.37	1.87E-04

1. Calculation Methodology:

$E_{HAP} = E_{VOC} \times (WP_{HAP}/100)$

E_{HAP} = HAP Emissions (lb/yr)

E_{VOC} = VOC Emissions (lb/yr)

WP_{HAP} = Weight percent HAP in the fuel (%)

100 = Factor for converting weight percent to weight fraction (%)

Emission calculation methodology from Section 16 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.

Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

APPENDIX A

Source Type: Fuel Storage

Process IDs: Multiple (See Below)

Source List and Maximum Usage

Process ID	Facility ID	Description	Tank Type[1]	Fuel Type	Diameter (ft)	Shell Length (ft)	Shell Color	Capacity (gal)	Maximum Throughput[2] (gal)
620	351	B351, STANDING	EFR	JET-A	45.0	n/a	White	413,779	16,704,220
621	351	B351, WORKING	EFR	JET-A	45.0	n/a	White	413,779	16,704,220
622	356	B356, STANDING	EFR	JET-A		n/a			22,700,454
623	356	B356, WORKING	EFR	JET-A		n/a			22,700,454
624	350	B350, STANDING	VFR	JET-A	30.0	44.0	White	206,219	371,858
625	350	B350, WORKING	VFR	JET-A	30.0	44.0	White	206,219	371,858
626	359	B359, STANDING	VFR	JET-A	30.0	44.0	White	206,219	697,907
627	359	B359, WORKING	VFR	JET-A	30.0	44.0	White	206,219	697,907
632	366	B366, STANDING	VFR	JET-A	21.0	20.0	White	38,864	78,833
633	366	B366, WORKING	VFR	JET-A	21.0	20.0	White	38,864	78,833
666	368	B368, STANDING	VFR	Gasoline	15.0	30.0	White	35,000	16,147
669	368	B368, WORKING	VFR	Gasoline	15.0	30.0	White	35,000	16,147
662	2201	B2201, STANDING	HFR	Gasoline	4.7	11.0	White	1,000	4,392
663	2201	B2201, WORKING	HFR	Gasoline	4.7	11.0	White	1,000	4,392

1. EFR = External Floating Roof, VFR = Vertical Fixed Roof, HFR = Horizontal Fixed Roof
2. Maximum throughput based on previously permitted limits.

Fuel Type	Permit Limit Throughput (gal/yr)[1]
JET-A	40,553,272
Gasoline	20,539

1. Total combined fuel usage for all fuel storage tanks above will not exceed this throughput limit.

APPENDIX A FUEL STORAGE

Emissions Factors

Hazardous Air Pollutant Vapor Speciation (Weight %)

Compound	CAS #	Weight %		
		Diesel	Gasoline	JP-8/Jet A
Benzene	71-43-2	0.20	0.65	3.38E-02
1,2,4-Trimethylbenzene	95-63-6	4.67	--	--
Cumene (Isopropylbenzene)	98-82-8	--	0.01	1.81E-01
Ethylbenzene	100-41-4	0.31	0.05	1.59E-01
Fluorene	86-73-7	--	--	3.44E-03
Hexane	110-54-3	0.04	0.59	--
Isooctane (2,2,4-Trimethyl Pentane)	540-84-1	--	0.75	1.23E-03
Naphthalene	91-20-3	--	--	2.68E-01
Phenylbenzene (1,1'-biphenyl)	92-52-4	--	--	6.78E-02
Pyrene	129-00-0	--	--	1.00E-05
Toluene	108-88-3	2.30	0.73	2.19E-01
Xylenes (mixed isomers)	1330-20-7	5.83	0.21	1.19E-02

1. Calculated Using Raoult's Law and Values from Table 16-5, Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.

Emissions

External Floating Roof Tanks - Fuel Storage Maximum Emission Rates

Pollutant	CAS #	Emissions[1, 2, 3]									
		620		621		622		623		Total	
		JET-A, B351, STANDING		JET-A, B351, WORKING		JET-A, B356, STANDING		JET-A, B356, WORKING			
		(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(tpy)
VOCs	-	201.62	0.10	368.42	0.18	244.90	0.12	265.06	0.13	**1,079.99**	**0.54**
Total HAPs	-	1.91	9.53E-04	3.48	1.74E-03	2.31	1.16E-03	2.51	1.25E-03	**10.21**	**0.01**
Benzene	71-43-2	0.07	3.41E-05	0.12	6.23E-05	0.08	4.14E-05	0.09	4.48E-05	**0.37**	**1.83E-04**
1,2,4-Trimethylbenzene	95-63-6	--	--	--	--	--	--	--	--	**--**	**--**
Cumene (Isopropylbenzene)	98-82-8	0.36	1.82E-04	0.67	3.33E-04	0.44	2.22E-04	0.48	2.40E-04	**1.95**	**9.77E-04**
Ethylbenzene	100-41-4	0.32	1.60E-04	0.59	2.93E-04	0.39	1.95E-04	0.42	2.11E-04	**1.72**	**8.59E-04**
Fluorene	86-73-7	0.01	3.47E-06	0.01	6.34E-06	0.01	4.21E-06	0.01	4.56E-06	**0.04**	**1.86E-05**
Hexane	110-54-3	--	--	--	--	--	--	--	--	**--**	**--**
Isooctane (2,2,4-Trimethylpentane)	540-84-1	2.48E-03	1.24E-06	4.53E-03	2.27E-06	3.01E-03	1.51E-06	3.26E-03	1.63E-06	**0.01**	**6.64E-06**
Naphthalene	91-20-3	0.54	2.70E-04	0.99	4.94E-04	0.66	3.28E-04	0.71	3.55E-04	**2.89**	**1.45E-03**
Phenylbenzene (1,1'-biphenyl)	92-52-4	0.14	6.83E-05	0.25	1.25E-04	0.17	8.30E-05	0.18	8.99E-05	**0.73**	**3.66E-04**
Pyrene	129-00-0	2.02E-05	1.01E-08	3.68E-05	1.84E-08	2.45E-05	1.22E-08	2.65E-05	1.33E-08	**1.08E-04**	**5.40E-08**
Toluene	108-88-3	0.44	2.21E-04	0.81	4.03E-04	0.54	2.68E-04	0.58	2.90E-04	**2.37**	**1.18E-03**
Xylenes (mixed isomers)	1330-20-7	0.02	1.20E-05	0.04	2.19E-05	0.03	1.46E-05	0.03	1.58E-05	**0.13**	**6.43E-05**

APPENDIX A FUEL STORAGE EMISSIONS

Vertical Fixed Roof Tanks - Fuel Storage Maximum Emission Rates

Pollutant	CAS #	Emissions[1, 2, 3]													
		624		625		626		627		632		633		Total	
		JET-A, B350, STANDING		JET-A, B350, WORKING		JET-A, B359, STANDING		JET-A, B359, WORKING		JET-A, B366, STANDING		JET-A, B366, WORKING			
		(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(tpy)
VOCs	-	81.67	0.04	63.07	0.03	81.67	0.04	118.39	0.06	98.60	0.05	13.39	0.01	**456.79**	**0.23**
Total HAPs	-	0.77	3.86E-04	0.60	2.98E-04	0.77	3.86E-04	1.12	5.59E-04	0.93	4.66E-04	0.13	6.33E-05	**4.32**	**2.16E-03**
Benzene	71-43-2	0.03	1.38E-05	0.02	1.07E-05	0.03	1.38E-05	0.04	2.00E-05	0.03	1.67E-05	4.53E-03	2.26E-06	**0.15**	**7.72E-05**
1,3-Butadiene	106-99-0	--	--	--	--	--	--	--	--	--	--	--	--	**--**	**--**
Cumene (Isopropylbenzene)	98-82-8	0.15	7.39E-05	0.11	5.71E-05	0.15	7.39E-05	0.21	1.07E-04	0.18	8.92E-05	0.02	1.21E-05	**0.83**	**4.13E-04**
Ethylbenzene	100-41-4	0.13	6.49E-05	0.10	5.01E-05	0.13	6.49E-05	0.19	9.41E-05	0.16	7.84E-05	0.02	1.06E-05	**0.73**	**3.63E-04**
Fluorene	86-73-7	2.81E-03	1.40E-06	2.17E-03	1.08E-06	2.81E-03	1.40E-06	4.07E-03	2.04E-06	3.39E-03	1.70E-06	4.61E-04	2.30E-07	**0.02**	**7.86E-06**
Hexane	110-54-3	--	--	--	--	--	--	--	--	--	--	--	--	**--**	**--**
Isooctane (2,2,4-Trimethylpentane)	540-84-1	1.00E-03	5.02E-07	7.76E-04	3.88E-07	1.00E-03	5.02E-07	1.46E-03	7.28E-07	1.21E-03	6.06E-07	1.65E-04	8.23E-08	**0.01**	**2.81E-06**
Naphthalene	91-20-3	0.22	1.09E-04	0.17	8.45E-05	0.22	1.09E-04	0.32	1.59E-04	0.26	1.32E-04	0.04	1.79E-05	**1.22**	**6.12E-04**
Phenylbenzene (1,1'-biphenyl)	92-52-4	0.06	2.77E-05	0.04	2.14E-05	0.06	2.77E-05	0.08	4.01E-05	0.07	3.34E-05	0.01	4.54E-06	**0.31**	**1.55E-04**
Pyrene	129-00-0	8.17E-06	4.08E-09	6.31E-06	3.15E-09	8.17E-06	4.08E-09	1.18E-05	5.92E-09	9.86E-06	4.93E-09	1.34E-06	6.69E-10	**4.57E-05**	**2.28E-08**
Toluene	108-88-3	0.18	8.94E-05	0.14	6.91E-05	0.18	8.94E-05	0.26	1.30E-04	0.22	1.08E-04	0.03	1.47E-05	**1.00**	**5.00E-04**
Xylenes (mixed isomers)	1330-20-7	0.01	4.86E-06	0.01	3.75E-06	0.01	4.86E-06	0.01	7.04E-06	0.01	5.87E-06	1.59E-03	7.97E-07	**0.05**	**2.72E-05**

Horizontal Fixed Roof Tanks - Fuel Storage Maximum Emission Rates

Pollutant	CAS #	Emissions[1, 2, 3]									
		666		669		662		663		Total	
		GASOLINE, B368, STANDING		GASOLINE, B368, WORKING		GASOLINE, B2201, STANDING		GASOLINE, B2201, WORKING			
		(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(ton/yr)	(lb/yr)	(tpy)
VOCs	-	13,958.84	6.98	735.49	0.37	1,173.83	0.59	140.49	0.07	**16,008.65**	**8.00**
Total HAPs	-	417.37	0.21	21.99	0.01	35.10	0.02	4.20	2.10E-03	**478.66**	**0.24**
Benzene	71-43-2	90.73	0.05	4.78	2.39E-03	7.63	3.81E-03	0.91	4.57E-04	**104.06**	**0.05**
1,3-Butadiene	106-99-0	--	--	--	--	--	--	--	--	**--**	**--**
Cumene (Isopropylbenzene)	98-82-8	1.40	6.98E-04	0.07	3.68E-05	0.12	5.87E-05	0.01	7.02E-06	**1.60**	**8.00E-04**
Ethylbenzene	100-41-4	6.98	3.49E-03	0.37	1.84E-04	0.59	2.93E-04	0.07	3.51E-05	**8.00**	**4.00E-03**
Fluorene	86-73-7	--	--	--	--	--	--	--	--	**--**	**--**
Hexane	110-54-3	82.36	0.04	4.34	2.17E-03	6.93	3.46E-03	0.83	4.14E-04	**94.45**	**0.05**
Isooctane (2,2,4-Trimethylpentane)	540-84-1	104.69	0.05	5.52	2.76E-03	8.80	4.40E-03	1.05	5.27E-04	**120.06**	**0.06**
Naphthalene	91-20-3	--	--	--	--	--	--	--	--	**--**	**--**
Phenylbenzene (1,1'-biphenyl)	92-52-4	--	--	--	--	--	--	--	--	**--**	**--**
Pyrene	129-00-0	--	--	--	--	--	--	--	--	**--**	**--**
Toluene	108-88-3	101.90	0.05	5.37	2.68E-03	8.57	4.28E-03	1.03	5.13E-04	**116.86**	**0.06**
Xylenes (mixed isomers)	1330-20-7	29.31	0.01	1.54	7.72E-04	2.47	1.23E-03	0.30	1.48E-04	**33.62**	**0.02**

1. VOC emissions previously calculated using AP-42 approved methods and the Air Program Information Management System (APIMS).

2. Calculation Methodology:

$E_{Max} = E_{Historic} \times 4.21$

E_{Max} = Max VOC Emissions

$E_{Historic}$ = Max Historic VOC Emissions

The factor of 4.21 is the ratio of the maximum number of hours per year (8,760) to current average actual site operating hours of eight hours per day, five

3. HAP Calculation Methodology:

$E_{HAP} = E_{VOC} \times (WP_{HAP}/100)$

E_{HAP} = HAP Emissions (lb/yr)

E_{VOC} = VOC Emissions (lb/yr)

WP_{HAP} = Weight percent HAP in the fuel (%)

100 = Factor for converting weight percent to weight fraction (%)

Emission calculation methodology from Section 16 of Air Emissions Guide for Air Force Stationary Sources, AFCEC, October 2014.

APPENDIX A

Source Type: Jet Engine Testing

Process ID: 330, 332

Source List and Usage

Process ID	Facility ID	Aircraft	Engine	Numer of Engine Tests	
				2007 [1]	Max[2]
330	1006, 1012, 1016	F-16	F100-PW-220	228	960
332	1006, 1016	F-16	F100-PW-229	17	72

1. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum limits are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage limit (i.e., 8,760 hrs / 2,080 hrs).

EPN	Maximum Time-In-Mode (mins/test)[1]				
	Idle	Approach	Intermediate	Military	Afterburner
330	30.0	N/A[2]	2.6	10.1	0.7
332	30.0	N/A[2]	2.6	10.1	0.7

1. Maximum Time-In-Modes obtained from interviewing base personnel on operating procedures.
2. Not applicable; engine is not tested in this mode.

Emissions Factors

Fuel Flowrates

Aircraft	Engine	Fuel Flowrate per Mode (lb/hr)[1]				
		Idle	Approach	Intermediate	Military	Afterburner
F-16	F100-PW-220	1,084	3,837	5,770	9,679	41,682
F-16	F100-PW-229	1,087	3,098	5,838	11,490	20,793

1. Fuel flowrates taken from Air Emissions Guide for Air Force Mobile Sources, AFCEC, Table 2-8, October 2014.

APPENDIX A JET ENGINE TESTING

F100-PW-220 Engine Emissions Factors

Pollutant	CAS	Emissions Factors per Mode (lb/1000lb)[1,2]				
		Idle	Approach	Intermediate	Military	Afterburner
CO	-	35.30	1.92	0.86	0.86	11.99
NO_X	-	4.61	12.53	22.18	29.32	8.37
SO_X[3]	-	0.60	0.60	0.60	0.60	0.60
PM	-	2.06	2.63	2.06	1.33	1.15
PM_{10}	-	2.06	2.63	2.06	1.33	1.15
$PM_{2.5}$	-	1.85	2.37	1.85	1.20	1.04
VOC	-	7.94	5.12	2.89	1.79	1.53
Total HAPs	-	1.31E+00	8.80E-03	3.11E-02	3.45E-02	5.16E-02
Acenaphthylene	208-96-8	5.38E-04	--	--	--	--
Acetaldehyde	75-07-0	2.41E-01	--	7.00E-03	1.30E-02	1.60E-02
Acrolein	107-02-8	8.40E-02	--	--	--	--
Benzene	71-43-2	4.70E-02	3.87E-04	1.89E-04	4.90E-04	1.82E-04
Carbon Tetrachloride	56-23-5	2.31E-04	3.02E-04	3.09E-04	1.85E-04	2.23E-05
Dibenzofuran	132-64-9	6.49E-04	--	--	--	--
Dibutyl Phthalate	84-74-2	2.23E-04	2.14E-04	1.77E-04	1.47E-04	8.33E-04
1,4-Dichlorobenzene	106-46-7	--	4.90E-05	3.90E-04	1.77E-04	3.16E-06
Di(2-Ethylhexyl) Phthalate (DEHP	117-81-7	1.35E-03	2.83E-03	2.04E-03	2.35E-03	3.93E-03
Ethylbenzene	100-41-4	2.99E-03	1.93E-04	2.70E-04	3.44E-04	4.01E-05
Fluorene	86-73-7	3.35E-04	--	--	--	8.76E-05
Formaldehyde	50-00-0	7.77E-01	--	--	2.00E-03	2.00E-02
Hexachlorobutadiene	87-68-3	--	4.06E-04	1.40E-03	5.74E-04	--
Methylene Chloride	75-09-2	6.94E-04	1.35E-03	3.06E-03	3.16E-03	1.07E-03
2-Methylnaphthalene	91-57-6	2.59E-02	3.30E-04	2.60E-04	3.53E-04	4.51E-04
Naphthalene	91-20-3	3.42E-02	2.13E-04	3.96E-04	4.01E-04	4.12E-04
2-Nitrophenol	88-75-5	5.91E-03	--	--	--	--
4-Nitrophenol	100-02-7	5.57E-03	--	--	--	--
Phenanthrene	85-01-8	4.48E-04	--	--	--	1.33E-04
Phenol	108-95-2	1.35E-02	--	--	2.68E-04	1.04E-03
Propanal	123-38-6	4.90E-02	--	8.00E-03	6.00E-03	7.00E-03
Pyrene	129-00-0	1.79E-04	--	--	--	--
Styrene	100-42-5	5.02E-04	--	2.78E-04	--	--
1,1,2,2-Tetrachloroethane	79-34-5	--	--	6.96E-04	2.52E-04	--
Tetrachloroethene	127-18-4	--	--	2.40E-03	8.96E-04	--
1,2,4-Trichlorobenzene	120-82-1	--	3.43E-04	2.04E-03	7.29E-04	3.22E-05
1,1,1-Trichloroethane	71-55-6	1.38E-03	5.02E-04	3.36E-04	5.61E-04	7.21E-05
Trichloroethene	79-01-6	--	--	9.17E-05	--	--
m,p-Xylene	1330-20-7	1.47E-02	1.40E-03	1.43E-03	2.11E-03	2.59E-04
o-Xylene	95-47-6	3.61E-03	2.81E-04	3.51E-04	4.73E-04	5.80E-05

1. Emissions factors taken from Air Emissions Guide for Air Force Mobile Sources, AFCEC, Table 2-8 and 2-9, October 2014.

2. HAP emissions factors for engine F100-PW-220 were not available. HAP emission factors for engine F100-PW-200 were used as a surrogate as emissions from this eng

3. SO_X emission factor calculated as follows:

EF_{SOx} = SO_X emission factor (lb/10^3 lb)

S = Weight percent sulfur content of the fuel (%)

20 = Factor for converting units from weight percent to lb/10^3 lb (lb/% 10^3 lb)

Note: JET-A maximum sulfur content = 0.03%

APPENDIX A JET ENGINE TESTING

F100-PW-229 Emissions Factors

Parameter	CAS	Emissions Factors per Mode (lb/1000lb)[1,2]				
		Idle	Approach	Intermediate	Military	Afterburner
CO	-	10.17	1.17	0.15	0.33	21.51
NO_X	-	3.80	15.08	17.54	29.29	14.30
SO_X[3]	-	0.60	0.60	0.60	0.60	0.60
PM	-	2.06	2.63	2.06	1.33	1.15
PM_{10}	-	2.06	2.63	2.06	1.33	1.15
$PM_{2.5}$	-	1.85	2.37	1.85	1.20	1.04
VOC	-	0.45	0.24	0.35	0.31	5.26
Total HAPs	-	1.31E+00	8.80E-03	3.11E-02	3.45E-02	5.16E-02
Acenaphthylene	208-96-8	5.38E-04	--	--	--	--
Acetaldehyde	75-07-0	2.41E-01	--	7.00E-03	1.30E-02	1.60E-02
Acrolein	107-02-8	8.40E-02	--	--	--	--
Benzene	71-43-2	4.70E-02	3.87E-04	1.89E-04	4.90E-04	1.82E-04
Carbon Tetrachloride	56-23-5	2.31E-04	3.02E-04	3.09E-04	1.85E-04	2.23E-05
Dibenzofuran	132-64-9	6.49E-04	--	--	--	--
Dibutyl Phthalate	84-74-2	2.23E-04	2.14E-04	1.77E-04	1.47E-04	8.33E-04
1,4-Dichlorobenzene	106-46-7	--	4.90E-05	3.90E-04	1.77E-04	3.16E-06
Di(2-Ethylhexyl) Phthalate (DEHP	117-81-7	1.35E-03	2.83E-03	2.04E-03	2.35E-03	3.93E-03
Ethylbenzene	100-41-4	2.99E-03	1.93E-04	2.70E-04	3.44E-04	4.01E-05
Fluorene	86-73-7	3.35E-04	--	--	--	8.76E-05
Formaldehyde	50-00-0	7.77E-01	--	--	2.00E-03	2.00E-02
Hexachlorobutadiene	87-68-3	--	4.06E-04	1.40E-03	5.74E-04	--
Methylene Chloride	75-09-2	6.94E-04	1.35E-03	3.06E-03	3.16E-03	1.07E-03
2-Methylnaphthalene	91-57-6	2.59E-02	3.30E-04	2.60E-04	3.53E-04	4.51E-04
Naphthalene	91-20-3	3.42E-02	2.13E-04	3.96E-04	4.01E-04	4.12E-04
2-Nitrophenol	88-75-5	5.91E-03	--	--	--	--
4-Nitrophenol	100-02-7	5.57E-03	--	--	--	--
Phenanthrene	85-01-8	4.48E-04	--	--	--	1.33E-04
Phenol	108-95-2	1.35E-02	--	--	2.68E-04	1.04E-03
Propanal	123-38-6	4.90E-02	--	8.00E-03	6.00E-03	7.00E-03
Pyrene	129-00-0	1.79E-04	--	--	--	--
Styrene	100-42-5	5.02E-04	--	2.78E-04	--	--
1,1,2,2-Tetrachloroethane	79-34-5	--	--	6.96E-04	2.52E-04	--
Tetrachloroethene	127-18-4	--	--	2.40E-03	8.96E-04	--
1,2,4-Trichlorobenzene	120-82-1	--	3.43E-04	2.04E-03	7.29E-04	3.22E-05
1,1,1-Trichloroethane	71-55-6	1.38E-03	5.02E-04	3.36E-04	5.61E-04	7.21E-05
Trichloroethene	79-01-6	--	--	9.17E-05	--	--
m,p-Xylene	1330-20-7	1.47E-02	1.40E-03	1.43E-03	2.11E-03	2.59E-04
o-Xylene	95-47-6	3.61E-03	2.81E-04	3.51E-04	4.73E-04	5.80E-05

1. Emissions factors taken from Air Emissions Guide for Air Force Mobile Sources, AFCEC, Table 2-8 and 2-9, October 2014.

2. HAP emissions factors for engine F100-PW-220 were not available. HAP emission factors for engine F100-PW-200 were used as a surrogate as emissions from this eng

3. SO_X emission factor calculated as follows:

EF_{SOx} = SO_X emission factor (lb/10^3 lb)

S = Weight percent sulfur content of the fuel (%)

20 = Factor for converting units from weight percent to lb/10^3 lb (lb/% 10^3 lb)

Note: JET-A maximum sulfur content = 0.03%

APPENDIX A JET ENGINE TESTING

Emissions

Process ID: 330

F100-PW-220 Emissions

Pollutant	CAS	Emissions per Mode (lb/yr)[1]					Total Emissions		
		Idle	Approach[2]	Intermediate	Military	Afterburner	(lb/hr)	(lb/yr)	(tpy)
CO	-	18,367.30	N/A	206.43	1,345.15	5,597.39	551.32	25,516.26	12.76
NO_X	-	2,398.68	N/A	5,323.91	45,860.19	3,907.44	765.64	58,255.85	29.13
SO_X	-	312.19	N/A	144.02	938.48	280.10	34.93	1,674.79	0.84
PM	-	1,071.86	N/A	494.47	2,080.29	536.86	74.93	4,183.48	2.09
PM_{10}	-	1,071.86	N/A	494.47	2,080.29	536.86	74.93	4,183.48	2.09
$PM_{2.5}$	-	962.59	N/A	444.06	1,876.95	485.51	67.64	3,769.11	1.88
VOC	-	4,131.34	N/A	693.69	2,799.79	714.26	106.38	8,339.08	4.17
Total HAPs	-	682.09	N/A	7.47	53.92	24.10	4.09	767.58	0.38
Acenaphthylene	208-96-8	0.28	N/A	0.0000	0.0000	0.0000	0.0006	0.2799	0.0001
Acetaldehyde	75-07-0	125.40	N/A	1.6802	20.3336	7.4694	1.0944	154.8804	0.0774
Acrolein	107-02-8	43.71	N/A	0.0000	0.0000	0.0000	0.0911	43.7069	0.0219
Benzene	71-43-2	24.46	N/A	0.0454	0.7664	0.0850	0.0644	25.3518	0.0127
Carbon Tetrachloride	56-23-5	0.12	N/A	0.0742	0.2894	0.0104	0.0048	0.4941	0.0002
Dibenzofuran	132-64-9	0.34	N/A	0.0000	0.0000	0.0000	0.0007	0.3377	0.0002
Dibutyl Phthalate	84-74-2	0.12	N/A	0.0425	0.2299	0.3889	0.0374	0.7773	0.0004
1,4-Dichlorobenzene	106-46-7	0.00	N/A	0.0936	0.2769	0.0015	0.0041	0.3719	0.0002
Di(2-Ethylhexyl) Phthalate (DEHP	117-81-7	0.70	N/A	0.4897	3.6757	1.8347	0.1998	6.7025	0.0034
Ethylbenzene	100-41-4	1.56	N/A	0.0648	0.5381	0.0187	0.0098	2.1773	0.0011
Fluorene	86-73-7	0.17	N/A	0.0000	0.0000	0.0409	0.0040	0.2152	0.0001
Formaldehyde	50-00-0	404.29	N/A	0.0000	3.1283	9.3368	1.6953	416.7537	0.2084
Hexachlorobutadiene	87-68-3	0.00	N/A	0.3360	0.8978	0.0000	0.0136	1.2339	0.0006
Methylene Chloride	75-09-2	0.36	N/A	0.7345	4.9426	0.4995	0.0936	6.5378	0.0033
2-Methylnaphthalene	91-57-6	13.48	N/A	0.0624	0.5521	0.2105	0.0518	14.3014	0.0072
Naphthalene	91-20-3	17.79	N/A	0.0951	0.6272	0.1923	0.0604	18.7095	0.0094
2-Nitrophenol	88-75-5	3.08	N/A	0.0000	0.0000	0.0000	0.0064	3.0751	0.0015
4-Nitrophenol	100-02-7	2.90	N/A	0.0000	0.0000	0.0000	0.0060	2.8982	0.0014
Phenanthrene	85-01-8	0.23	N/A	0.0000	0.0000	0.0621	0.0060	0.2952	0.0001
Phenol	108-95-2	7.02	N/A	0.0000	0.4192	0.4855	0.0606	7.9290	0.0040
Propanal	123-38-6	25.50	N/A	1.9203	9.3848	3.2679	0.4491	40.0686	0.0200
Pyrene	129-00-0	0.09	N/A	0.0000	0.0000	0.0000	0.0002	0.0931	0.0000
Styrene	100-42-5	0.26	N/A	0.0667	0.0000	0.0000	0.0021	0.3279	0.0002
1,1,2,2-Tetrachloroethane	79-34-5	0.00	N/A	0.1671	0.3942	0.0000	0.0065	0.5612	0.0003
Tetrachloroethene	127-18-4	0.00	N/A	0.5761	1.4015	0.0000	0.0225	1.9775	0.0010
1,2,4-Trichlorobenzene	120-82-1	0.00	N/A	0.4897	1.1402	0.0150	0.0202	1.6449	0.0008
1,1,1-Trichloroethane	71-55-6	0.72	N/A	0.0807	0.8775	0.0337	0.0119	1.7098	0.0009
Trichloroethene	79-01-6	0.00	N/A	0.0220	0.0000	0.0000	0.0005	0.0220	0.0000
m,p-Xylene	1330-20-7	7.65	N/A	0.3432	3.3003	0.1209	0.0554	11.4132	0.0057
o-Xylene	95-47-6	1.88	N/A	0.0843	0.7398	0.0271	0.0129	2.7295	0.0014

1. Calculation Methodology:

E_{Pol} = FFR x 1/1,000 x T_{Test} x EF_{Pol}

E_{Pol} = Emissions (lb/yr)

FFR = Fuel flow rate (lb/hr)

1,000 = Factor for converting pounds to 10^3 pounds (lb/10^3 lb)

T_{Test} = Total annual time engine testing occurred while operating at the applicable fuel flow rate (hr/yr)

EF_{Pol} = Emissions factor (lb/10^3 lb)

2. Not applicable; engine is not tested in this mode.

APPENDIX A JET ENGINE TESTING

Process ID: 332

F100-PW-229 Emissions

Pollutant	CAS	Emissions per Mode (lb/yr)[1]					Total Emissions		
		Idle	Approach[2]	Intermediate	Military	Afterburner	(lb/hr)	(lb/yr)	(tpy)
CO	-	397.97	N/A	2.73	45.96	375.70	462.98	822.36	0.41
NO_X	-	148.70	N/A	319.48	4,078.89	249.77	740.41	4,796.84	2.40
SO_X	-	23.48	N/A	10.93	83.56	10.48	23.52	128.44	0.06
PM	-	80.61	N/A	37.52	185.21	20.09	53.46	323.43	0.16
PM_{10}	-	80.61	N/A	37.52	185.21	20.09	53.46	323.43	0.16
$PM_{2.5}$	-	72.39	N/A	33.70	167.11	18.16	48.22	291.37	0.15
VOC	-	17.61	N/A	6.38	43.17	91.87	115.47	159.03	0.08
Total HAPs	-	51.30	N/A	0.57	4.80	0.90	3.08	57.57	0.03
Acenaphthylene	208-96-8	0.0211	N/A	0.0000	0.0000	0.0000	0.0006	0.0211	0.0000
Acetaldehyde	75-07-0	9.4308	N/A	0.1275	1.8104	0.2795	0.7849	11.6481	0.0058
Acrolein	107-02-8	3.2871	N/A	0.0000	0.0000	0.0000	0.0913	3.2871	0.0016
Benzene	71-43-2	1.8392	N/A	0.0034	0.0682	0.0032	0.0616	1.9141	0.0010
Carbon Tetrachloride	56-23-5	0.0090	N/A	0.0056	0.0258	0.0004	0.0046	0.0408	0.0000
Dibenzofuran	132-64-9	0.0254	N/A	0.0000	0.0000	0.0000	0.0007	0.0254	0.0000
Dibutyl Phthalate	84-74-2	0.0087	N/A	0.0032	0.0205	0.0145	0.0203	0.0470	0.0000
1,4-Dichlorobenzene	106-46-7	0.0000	N/A	0.0071	0.0246	0.0001	0.0044	0.0318	0.0000
Di(2-Ethylhexyl) Phthalate (DEHF	117-81-7	0.0528	N/A	0.0372	0.3273	0.0686	0.1221	0.4859	0.0002
Ethylbenzene	100-41-4	0.1170	N/A	0.0049	0.0479	0.0007	0.0096	0.1705	0.0001
Fluorene	86-73-7	0.0131	N/A	0.0000	0.0000	0.0015	0.0022	0.0146	0.0000
Formaldehyde	50-00-0	30.4056	N/A	0.0000	0.2785	0.3493	1.2834	31.0334	0.0155
Hexachlorobutadiene	87-68-3	0.0000	N/A	0.0255	0.0799	0.0000	0.0148	0.1054	0.0001
Methylene Chloride	75-09-2	0.0272	N/A	0.0557	0.4401	0.0187	0.0772	0.5416	0.0003
2-Methylnaphthalene	91-57-6	1.0135	N/A	0.0047	0.0492	0.0079	0.0431	1.0753	0.0005
Naphthalene	91-20-3	1.3383	N/A	0.0072	0.0558	0.0072	0.0527	1.4086	0.0007
2-Nitrophenol	88-75-5	0.2313	N/A	0.0000	0.0000	0.0000	0.0064	0.2313	0.0001
4-Nitrophenol	100-02-7	0.2180	N/A	0.0000	0.0000	0.0000	0.0061	0.2180	0.0001
Phenanthrene	85-01-8	0.0175	N/A	0.0000	0.0000	0.0023	0.0033	0.0199	0.0000
Phenol	108-95-2	0.5283	N/A	0.0000	0.0373	0.0182	0.0394	0.5838	0.0003
Propanal	123-38-6	1.9175	N/A	0.1457	0.8356	0.1223	0.3145	3.0210	0.0015
Pyrene	129-00-0	0.0070	N/A	0.0000	0.0000	0.0000	0.0002	0.0070	0.0000
Styrene	100-42-5	0.0196	N/A	0.0051	0.0000	0.0000	0.0022	0.0247	0.0000
1,1,2,2-Tetrachloroethane	79-34-5	0.0000	N/A	0.0127	0.0351	0.0000	0.0070	0.0478	0.0000
Tetrachloroethene	127-18-4	0.0000	N/A	0.0437	0.1248	0.0000	0.0243	0.1685	0.0001
1,2,4-Trichlorobenzene	120-82-1	0.0000	N/A	0.0372	0.1015	0.0006	0.0210	0.1392	0.0001
1,1,1-Trichloroethane	71-55-6	0.0540	N/A	0.0061	0.0781	0.0013	0.0114	0.1395	0.0001
Trichloroethene	79-01-6	0.0000	N/A	0.0017	0.0000	0.0000	0.0005	0.0017	0.0000
m,p-Xylene	1330-20-7	0.5752	N/A	0.0260	0.2938	0.0045	0.0540	0.8996	0.0004
o-Xylene	95-47-6	0.1413	N/A	0.0064	0.0659	0.0010	0.0126	0.2145	0.0001

1. Calculation Methodology:

E_{Pol} = FFR x 1/1,000 x T_{Test} x EF_{Pol}

E_{Pol} = Emissions (lb/yr)

FFR = Fuel flow rate (lb/hr)

1,000 = Factor for converting pounds to 10^3 pounds (lb/10^3 lb)

T_{Test} = Total annual time engine testing occurred while operating at the applicable fuel flow rate (hr/yr)

$EF_{Pol =}$ Emissions factor (lb/10^3 lb)

2. The greater of the Intermediate or Military fuel flow rates and emissions factors were used for each pollutant.

APPENDIX A MISCELLANEOUS CHEMICAL USE AND SURFACE COATING

Source Type: Miscellaneous Chemical Use and Surface Coating
Process IDs: Multiple (See Below)

Source List and Usage

Process ID	Process Type/Description	Material Type	2007 Usage[1] (gal/yr)	Max Usage[2] (gal/yr)
751	General Maintenance Materials: Multiple Buildings	Paint	142.56	600.18
752		Primer	101.82	428.66
753		Thinner	10.00	42.10
757		Adhesive	133.40	561.61
760		Sealer	614.74	2,588.06
762		Alcohol	232.63	979.37
770		Miscellaneous Cleaners, Corrosion Prevention, Hardeners, Etc.	4,871.67	20,509.73
775	Corrosion Control: Building 922 (with Two 3-Stage PM and Carbon Filters; Control ID 520; Stack ID 801)	Paint	1,635.65	6,886.09
776		Primer	827.74	3,484.79
777		Thinner	508.00	2,138.68
779		Alcohol	21.00	88.41
780		Adhesive	21.90	92.20
781		Sealant	27.58	116.11

1. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions - GENERAL MAINTENANCE MATERIALS, MULTIPLE BLDGS

Compound	CAS	751				752				753				757			
		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions	
		(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	--	--	0.46	957.29	0.48	--	0.30	627.32	0.31	--	--	--	--	--	--	--	--
VOC	--	568.46	1.15	2,393.22	1.20	372.52	0.75	1,568.31	0.78	53.30	0.11	224.39	0.11	361.65	0.73	1,522.55	0.76
Total HAPS	--	--	0.12	239.32	0.12	--	0.08	156.83	0.08	--	0.11	224.39	0.11	--	0.07	152.25	0.08

Compound	760				762				770				TOTAL			
	2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions	
	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	--	--	--	--	--	--	--	--	--	--	--	--	**--**	**0.76**	**1,584.61**	**0.79**
VOC	2,440.71	4.94	10,275.39	5.14	1,533.11	3.10	6,454.39	3.23	17,542.25	35.51	73,852.87	36.93	**22,872.00**	**46.29**	**96,291.12**	**48.15**
Total HAPS	--	0.49	1,027.54	0.51	--	0.31	645.44	0.32	--	3.55	7,385.29	3.69	**--**	**4.73**	**9,831.07**	**4.92**

Emissions - CORROSION CONTROL BLD 922, CONTROLLED BY CARBON FILTERS & FLAME TEST MONITORING

Compound	CAS	775				776				777				779			
		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions	
		(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	--	--	0.05	100.74	0.05	--	0.02	43.17	0.02	--	--	--	--	--	--	--	--
VOC	--	1,196.48	2.42	5,037.18	2.52	512.70	1.04	2,158.47	1.08	674.67	1.37	2,840.36	1.42	26.25	0.05	110.51	0.06
Total HAPS	--	--	0.24	503.72	0.25	--	0.10	215.85	0.11	--	1.37	2,840.36	1.42	--	0.01	11.05	0.01

Compound	780				781				TOTAL			
	2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions		2007 Emissions	Hourly Emissions	Max Emissions	
	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)	(lb/yr)	(lb/hr)	(lb/yr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	--	--	--	--	--	--	--	--	**--**	**0.07**	**143.91**	**0.07**
VOC	9.82	0.02	41.34	0.02	14.20	0.03	59.78	0.03	**2,434.12**	**4.93**	**10,247.65**	**5.12**
Total HAPS	--	1.99E-03	4.13	2.07E-03	--	2.87E-03	5.98	2.99E-03	**--**	**1.72**	**3,581.09**	**1.79**

Note: Based on knowledge of typical operations, PM emissions from paint and primer application were assumed to be 40% of VOC emissions and a filter efficiency of 90% was assumed for Building 922. All other solvents were assumed to be hand applied, therefore, PM emission were set to be negligble. HAP emissions were assumed to be 10% of VOC emissions, except for thinners, HAP emissions were set to be 100% of VOC emissions.
Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

APPENDIX A

Source Type: Solvent Cleaning Equipment (Degreasers)
Process ID: Multiple (See Below)

Source List

Process ID[1]	Solvent Type	VOC Content (lb/gal)	HAP Content (lb/gal)	Solvent Used (gal/yr)		Percent Recovered/ Disposed
				2007 [2]	Max[3]	
701	Safety Kleen	6.8	0	293	1,233.53	70%
706	ZEP Dyna 680, Type II	6.39	0	20	84.20	0%
707	Formula 724	6.5	0	N/A	100	0%
708	Penetone 724	6.5	0	N/A	100	0%
709	Penetone 725	6.58	0	N/A	100	0%
710	PD 680, TYPE III	6.39	0	N/A	100	0%
711	Calla 296	1.01	0	N/A	100	0%
712	Super Agitene 141	6.67	0	N/A	100	0%
713	Tectyl 275 (Finger F	5.11	0	N/A	100	0%

1. Process ID's are seperated by solvent type rather than units. For a listing of specific units and Facility ID's, refer to the equipment list included with this application.
2. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum operations are determined from this baseline year.
3. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs). For solvents that do not have 2007 usage, maximum was set to 100 gal/yr based on knowledge of operations.

Emissions

Pollutant	Process ID	Emissions[1,2]		
		(lb/yr)	(lb/yr)	(tpy)
VOC	701	1.21	2,516.40	1.26
	706	0.26	538.04	0.27
	707	0.31	650.00	0.33
	708	0.31	650.00	0.33
	709	0.32	658.00	0.33
	710	0.31	639.00	0.32
	711	0.05	101.00	0.05
	712	0.32	667.00	0.33
	713	0.25	511.00	0.26
	Total	3.33	6,930.44	3.47

1. Calculation Methodology:
E_{VOC} = Q*D*(1-R/100)
E_{VOC} = Emissions (lb/yr)
Q = Solvent Used (gal/yr)
D = Solvent Density (lb/gal)
R = Percent Recovered (%)
Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).

APPENDIX A

Source Type: Stationary Internal Combustion
Process IDs: 300, 360

Source List and Usage

Process ID	Power Rating[1] (hp)	Maximum Run Time[2] (hr/yr/unit)
Diesel Fired Generators ≤450 kW or 600 hp		
300	9,000	500
Diesel Fired Generators >450 kW or 600 hp		
360	2,800	500

1. Total power rating includes all generators at Luke AFB for that particular rating category. The total number was rounded up to the nearest 100 hp.
2. 500 hours per unit is based on guidance provided in Calculating Potential to Emit for Emergency Generators, EPA, September 1995.

Emissions Factors

Pollutant	CAS #	Diesel[1]	
		Engines < 600 HP	Engines 600 < hp ≤ 3000
		(lb/hp-hr)	(lb/hp-hr)
CO	-	7.68E-03	6.88E-03
NOx	-	3.57E-02	2.59E-02
SOx	-	2.35E-03	1.23E-05
PM	-	2.56E-03	8.09E-04
PM_{10}	-	2.51E-03	8.09E-04
$PM_{2.5}$	-	2.51E-03	8.09E-04
VOC	-	2.79E-03	7.16E-04
1,3-Butadiene	106-99-0	3.16E-07	3.16E-07
Acenaphthene	83-32-9	1.15E-08	3.79E-08
Acenaphthylene	208-96-8	4.09E-08	7.47E-08
Acetaldehyde	75-07-0	6.20E-06	2.04E-07
Acrolein	107-02-8	7.48E-07	6.37E-08
Anthracene	120-12-7	1.51E-08	9.95E-09
Benz(a)anthracene	56-55-3	1.36E-08	5.03E-09
Benzene	71-43-2	7.55E-06	6.28E-06
Benzo(a)pyrene1.52E-	50-32-8	1.52E-09	2.08E-09
Benzo(b)fluoranthene	205-99-2	8.02E-10	8.98E-09
Benzo(g,h,i)perylene	191-24-2	3.96E-09	4.50E-09
Benzo(k)fluoranthene	207-08-9	1.25E-09	1.76E-09
Chrysene	218-01-9	2.86E-09	1.24E-08
Dibenz(a,h)anthracene	53-70-3	4.72E-09	2.80E-09
Fluoranthene	206-44-0	6.16E-08	3.26E-08
Fluorene	86-73-7	2.36E-07	1.04E-07
Formaldehyde	50-00-0	9.55E-06	6.38E-07
Indeno(1,2,3-c,d)pyrene	193-39-5	3.03E-09	3.35E-09
Naphthalene	91-20-3	6.86E-07	1.05E-06
Phenanthrene	85-01-8	2.38E-07	3.30E-07
Pyrene	129-00-0	3.87E-08	3.00E-08
Toluene	108-88-3	3.31E-06	2.27E-06
Xylenes	1330-20-7	2.31E-06	1.56E-06

1. Emissions factors taken from Air Emissions Guide for Air Force Stationary Sources, AFCEC, Tables 28-3 and 28-4, October 2014. Pre-2007 factors were used to provide a conservative

APPENDIX A INTERNAL COMBUSTION

Emissions

Pollutant[1]	CAS #	300			360		
		<600hp			600 < hp ≤ 3000		
		(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)
CO	-	51.15	25,574.40	12.79	14.26	7,127.68	3.56
NOx	-	237.76	118,881.00	59.44	53.66	26,832.40	13.42
SOx	-	15.65	7,825.50	3.91	0.03	12.74	0.01
PM	-	17.06	8,528.13	4.26	1.68	838.12	0.42
PM_{10}	-	16.72	8,358.30	4.18	1.68	838.12	0.42
$PM_{2.5}$	-	16.72	8,358.30	4.18	1.68	838.12	0.42
VOC	-	18.58	9,290.70	4.65	1.48	741.78	0.37
Total HAPs	-	0.21	104.37	0.05	0.03	13.51	0.01
1,3-Butadiene	106-99-0	2.10E-03	1.05	5.26E-04	6.55E-04	0.33	1.64E-04
Acenaphthene	83-32-9	7.66E-05	0.04	1.91E-05	7.85E-05	0.04	1.96E-05
Acenaphthylene	208-96-8	2.72E-04	0.14	6.81E-05	1.55E-04	0.08	3.87E-05
Acetaldehyde	75-07-0	4.13E-02	20.65	0.01	4.23E-04	0.21	1.06E-04
Acrolein	107-02-8	4.98E-03	2.49	1.25E-03	1.32E-04	0.07	3.30E-05
Anthracene	120-12-7	1.01E-04	0.05	2.51E-05	2.06E-05	0.01	5.15E-06
Benz(a)anthracene	56-55-3	9.06E-05	0.05	2.26E-05	1.04E-05	0.01	2.61E-06
Benzene	71-43-2	5.03E-02	25.14	0.01	1.30E-02	6.51	3.25E-03
Benzo(a)pyrene1.52E-	50-32-8	1.01E-05	0.01	2.53E-06	4.31E-06	2.15E-03	1.08E-06
Benzo(b)fluoranthene	205-99-2	5.34E-06	2.67E-03	1.34E-06	1.86E-05	0.01	4.65E-06
Benzo(g,h,i)perylene	191-24-2	2.64E-05	0.01	6.59E-06	9.32E-06	4.66E-03	2.33E-06
Benzo(k)fluoranthene	207-08-9	8.33E-06	4.16E-03	2.08E-06	3.65E-06	1.82E-03	9.12E-07
Chrysene	218-01-9	1.90E-05	0.01	4.76E-06	2.57E-05	0.01	6.42E-06
Dibenz(a,h)anthracene	53-70-3	3.14E-05	0.02	7.86E-06	5.80E-06	2.90E-03	1.45E-06
Fluoranthene	206-44-0	4.10E-04	0.21	1.03E-04	6.75E-05	0.03	1.69E-05
Fluorene	86-73-7	1.57E-03	0.79	3.93E-04	2.15E-04	0.11	5.39E-05
Formaldehyde	50-00-0	6.36E-02	31.80	0.02	1.32E-03	0.66	3.30E-04
Indeno(1,2,3-c,d)pyrene	193-39-5	2.02E-05	0.01	5.04E-06	6.94E-06	3.47E-03	1.74E-06
Naphthalene	91-20-3	4.57E-03	2.28	1.14E-03	2.18E-03	1.09	5.44E-04
Phenanthrene	85-01-8	1.59E-03	0.79	3.96E-04	6.84E-04	0.34	1.71E-04
Pyrene	129-00-0	2.58E-04	0.13	6.44E-05	6.22E-05	0.03	1.55E-05
Toluene	108-88-3	2.20E-02	11.02	0.01	4.70E-03	2.35	1.18E-03
Xylenes	1330-20-7	1.54E-02	7.69	3.85E-03	3.23E-03	1.62	8.08E-04

1. Calculation Methodology:

E_{Pol} = OT x PO x LF/100 x EF_{Pol}

E_{Pol} = Emissions (lb/yr)

OT = Operating Time (hr/yr)

PO = Rated power output of engines (hp)

LF = Engine load factor (%); 74% per Air Emissions Guide for Air Force Stationary Sources, Table 28-8, AFCEC, October 2014.

EF_{Pol} = Emissions factor (lb/hp-hr)

Emission calculation methodology from Air Emissions Guide for Air Force Stationary Sources, Section 28, AFCEC, October 2014.

APPENDIX A

Source Type: Woodworking

Process ID: 502, 503, 516

Source List and Usage

Process ID	Facility ID	Description	Dust Collection System	Capture Effeciency (%)[1]	Control Effeciency (%)[1]
502	247, 339, 415, 948	Waste Bin Emptying	N/A	0	0
503	247, 339, 415, 948	Cyclone Bin Vents	N/A	0	0
516	247	Hobby Shop	Baghouse (Control ID 500)	100	85
	339	Construction/Refurbishing of Base Signs	Cyclone (Control ID 506)		
	415	Mock-up/model Fabrication	Cyclone (Control ID 502)		

1. Control efficiencies taken from Maricopa County Emissions Inventory Help Sheet for the Woodworking Industry (2014) for cyclones. The cyclone control efficiency of 85% was used rather than the baghouse control efficiency of 99% for Building 247 to allow for a conservative estimate.

Process ID	Wood Waste Collected (ton/yr)	
	2007 [1]	Max[2]
502	2.34	10
503	2.34	10
516	2.34	10

1. Luke AFB determined that 2007 is respresentative of a typical operations year; therefore maximum operations are determined from this baseline year.
2. Baseline usage has been scaled up by a factor of 4.21 to arrive at a maximum usage (i.e., 8,760 hrs / 2,080 hrs).

Emissions Factors

Pollutant	Emissions Factor (lb/ton wood waste hauled away)[1]		
	Baghouse or Cyclone Operations	Wood Waste Storage Bin Vent	Wood Waste Storage Bin Loadout
$PM/PM_{10}/PM_{2.5}$	100.00	0.58	1.2

1. Emission factors taken from Emission Inventory Help Sheet for the Woodworking Industry, Maricopa County Air Quality Department, 2014.

Emissions

Pollutant	Emissions								
	502			503			516		
	(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)	(lb/hr)	(lb/yr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	0.01	11.82	0.01	2.75E-03	5.71	2.86E-03	0.07	147.77	0.07

1. Calculation Methodology:

E_{Pol} = Q x EF_{Pol} x 1 - (CAP_{eff}/100 x CON_{eff}/100)

E_{Pol} = Emissions (lb/yr)

Q = Annual quantity of wood waste hauled away (ton/yr)

EF_{Pol} = Emissions factor (lb/ton wood waste hauled away)

CAP_{eff} = Capture Efficiency (%)

CON_{eff} = Control Efficiency (%)

Emission calculation methodology from Emission Inventory Help Sheet for the Woodworking Industry, Maricopa County Air Quality Department, 2014.

Hourly emissions were estimated as annual emissions divided by actual operating hours (2,080 hr/yr).