[Note: some graphics & attachments are not available in this electronic version of document.]

September 29, 1995

MEMORANDUM

TO: Bill Albee, FAA
Rich Wilcox, EPA

FROM: Sandy Webb, EEA

SUBJECT: Technical Data to Support FAA's Advisory Circular on Reducing Emissions from Commercial Aviation

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Attached for your review is the draft document that presents technical data to support FAA's Advisory Circular on Reducing Emissions From Commercial Aviation. Data was collected and compiled in four main areas: commercial aircraft fleet emissions and strategies, conversion of GSE to alternative fuels (including electric), limiting the use of APUs, and fixed power and air conditioning systems at airport gates.

As discussed previously, many of the data elements are in draft form and would benefit from manufacturer and industry review. In particular, it would be advantageous to have industry representatives evaluate GSE use, brake horsepower, fuel consumption, and cost inputs. There are gaps in much of this data, which industry should be able to fill. For APUs, we appreciate FAA's assistance in contacting AlliedSignal to confirm the emission factors contained in ENSR's memorandum and to authorize inclusion of the data in the advisory circular. It would be useful to have AlliedSignal also review APU calculation procedures, and industry representatives review APU use and cost data.

Yesterday, EEA received average aircraft taxi data from FAA. These data were received too late to compile and review for incorporation into the attached draft document and airport database. Historical average taxi data was received from FAA's Office of Aviation Policy, Plans, and Management Analysis and includes airport location identification, OAG air carrier code, number of departures, number of arrivals, average taxi-in time, and average taxi-out time on a monthly basis. We do not have information on how the average taxi data was calculated. The file format and disk copy of the data file that FAA provided to EEA are included in Attachment 1. Because the data EEA requested of FAA on airports (Memorandum from S. Webb to B. Albee, FAA and R. Wilcox, EPA dated August 23, 1995) is coming from trade association surveys or hard copy reports filed with the FAA's Airports Division, data on only 50 airports is being provided for some data elements. As of today none of this information has been transmitted to EEA. Also, Airports Division was unable to provide other data elements, which we had originally hoped to compile. This includes the following data.

- Aircraft Gates
  - number of gates by airport
  - 400 Hz power/PCA status of gates by airport
  - 400 Hz power/PCA system installation, operating, and maintenance costs

- Helicopter Operations
  - number and type of helicopter operations by airport, county, or nonattainment area
- Enplanements
  - number of enplanements by airport for different aircraft categories (e.g., air carrier, air taxi, commuter, general aviation)
- Parking Spaces
  - the number of parking spaces by airport for employees and for passengers

In addition to the draft report, a diskette copy of the airport database covering 521 airports is attached. The information included in this database is discussed in the report. Please call me at (703) 528-1900 with any questions or comments.

Attachments:

Technical Data to Support FAA's Advisory Circular on Reducing Emissions from Commercial Aviation, draft report.

Airports Database Diskette

Average Aircraft Taxi Data Diskette and file format (Wilcox only)

cc: Annette Najjar, E.H. Pechan & Associates, Inc. (w/o attachments)

ATTACHMENT 1

FAA AVERAGE AIRCRAFT TAXI DATA

- **File Format**
- **Disk Copy of Data File**

ATTACHMENT 2

FAA AIRPORT GATE DATA

DRAFT

TECHNICAL DATA TO SUPPORT FAA'S ADVISORY CIRCULAR ON REDUCING EMISSIONS FROM COMMERCIAL AVIATION

Prepared for:

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September 29, 1995

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TECHNICAL DATA TO SUPPORT
FAA'S ADVISORY CIRCULAR
ON
REDUCING EMISSIONS FROM COMMERCIAL AVIATION

The U.S. Environmental Protection Agency (EPA) recently developed an interim final Federal Implementation Plan control strategy for aircraft operations in the Los Angeles, Sacramento, and Ventura areas of California. In its comments to the EPA on it's California FIP proposal, the Federal Aviation Administration (FAA) supported the reduction of emissions from commercial aviation through three methods: conversion of ground support equipment (GSE) to alternative fuels, reduced use of auxiliary power units (APUs), and installation of electric power and air conditioning at gates to reduce the need for operating APUs. FAA also agreed to encourage aircraft operators to operate the cleanest practical fleets into the FIP areas.

Although Congressional action deferred the proposed FIP for California, the EPA and FAA anticipate similar mandates in the forthcoming California State Implementation Plan (SIP) or a new EPA FIP if a conforming SIP is not produced before the scheduled deadline. Consequently, the EPA and FAA agree there is a need to continue the commercial aviation emission reduction initiative begun as part of the FIP. To this end, FAA plans to develop an advisory circular to encourage continuing progress in reducing emissions in the commercial aviation sector.

Under contract to EPA, EEA has collected and compiled technical data for use in developing the advisory circular. Data needed to evaluate the reduction of emissions through the conversion of GSE to alternative fuels is provided including GSE types, fuels, emissions, capital costs, and operating and maintenance costs. Emission reductions through limiting use of APUs is discussed and data needed to quantify this benefit is provided including APU models, emissions, and operating and maintenance costs. To allow limited APU use at airport gates, fixed power and air condition systems are necessary. Data is provided on system functions, operational and design parameters, emissions, and costs for existing and future fixed systems. Finally, an example fleet of U.S. commercial aircraft is ranked using several different measures of their relative emissions.

Data on U.S. airports having commercial air service has been compiled so that opportunities for reducing aviation emissions can be evaluated. This data includes information on each airport's local air quality (nonattainment status), the level of operational activity, and other indicators of the prospects for reducing aviation-related emissions. In addition, emissions from electric generation plants are discussed since these are important when considering electric GSE and fixed power and preconditioned air system emissions.

U.S. AIRPORTS WITH COMMERCIAL SERVICE

Using FAA Airport Master Records of U.S. and protectorate airports, EEA developed a preliminary database of 13,272 airports. The Airport Master Records are current as of 1990. Of the total, 521 airports in the lower-48 U.S. states had commercial service activity. Activity data (i.e., operations) from the Airport Master Records was supplemented with more current and detailed data using FAA fiscal year 1994 airport operations data for 435 airports (Reference 20). A list of the 521 commercial service airports and associated geographic and activity information is provided in Appendix 1.

The Clean Air Act and its various amendments established National Ambient Air Quality Standards (NAAQS) for several "criteria" pollutants, including ground-level ozone and carbon monoxide. Regions of the nation that fail to attain any of these standards are subject to a series of rigorous requirements designed to achieve attainment with the NAAQS. To identify those airports in nonattainment areas, baseline ozone and carbon monoxide nonattainment areas were identified and updated to include current redesignations. Boundaries of the Ozone Transport Region (OTR) also were defined. The Ozone Transport Region consists of the District of Columbia, Maryland, several northern Virginia counties, and all states north. Maps of the lower-48 states are included in Figures 1 and 2 that show the 521 commercial service airports and current ozone and carbon monoxide nonattainment designations, respectively. The ozone nonattainment area airport map in Figure 1 also includes the Ozone Transport Region boundary for the northeast states. A list of the 521 commercial service airports also is provided in Appendix 2 that identifies current ozone nonattainment status, current carbon monoxide nonattainment status, and whether it falls into the Ozone Transport Region.

EMISSIONS FROM ELECTRIC POWER PRODUCTION

Several options for reducing emissions from equipment operations at airports rely on the use of electric power. Use of electric GSE, electric air conditioners, or fixed power systems produces no emissions at the airport but generating the electricity needed to operate them does. Compared to APUs or GSE, power plants are very energy efficient and typically meet strict environmental standards through add-on controls and optimized operation. As a result, emissions from power production for use in electric equipment are much lower in total than emissions from equipment using internal combustion engines.

When electricity is used at an airport to power an aircraft on the ground or to recharge an electric vehicle, local or regional power plants are generating additional electricity to meet this demand. The emissions generated at the power plant depend on the power generation technology, fuel used, and emission controls. These factors vary from region to region throughout the US. Table 1 summarizes emissions factors for electric power

FIGURE 1

U.S. Commercial Service Airports

— In Relation To U.S. Ozone Nonattainment Areas —

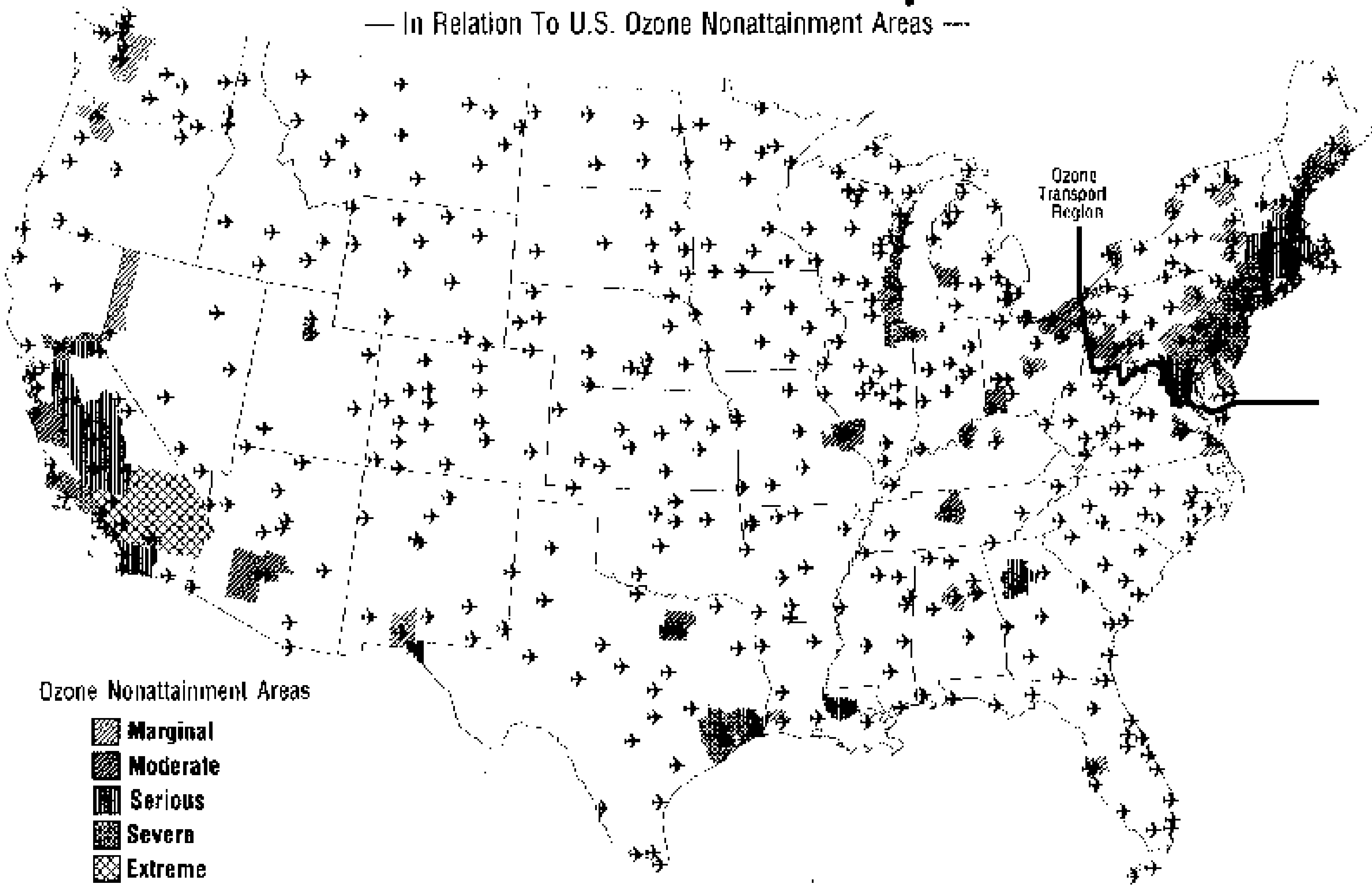
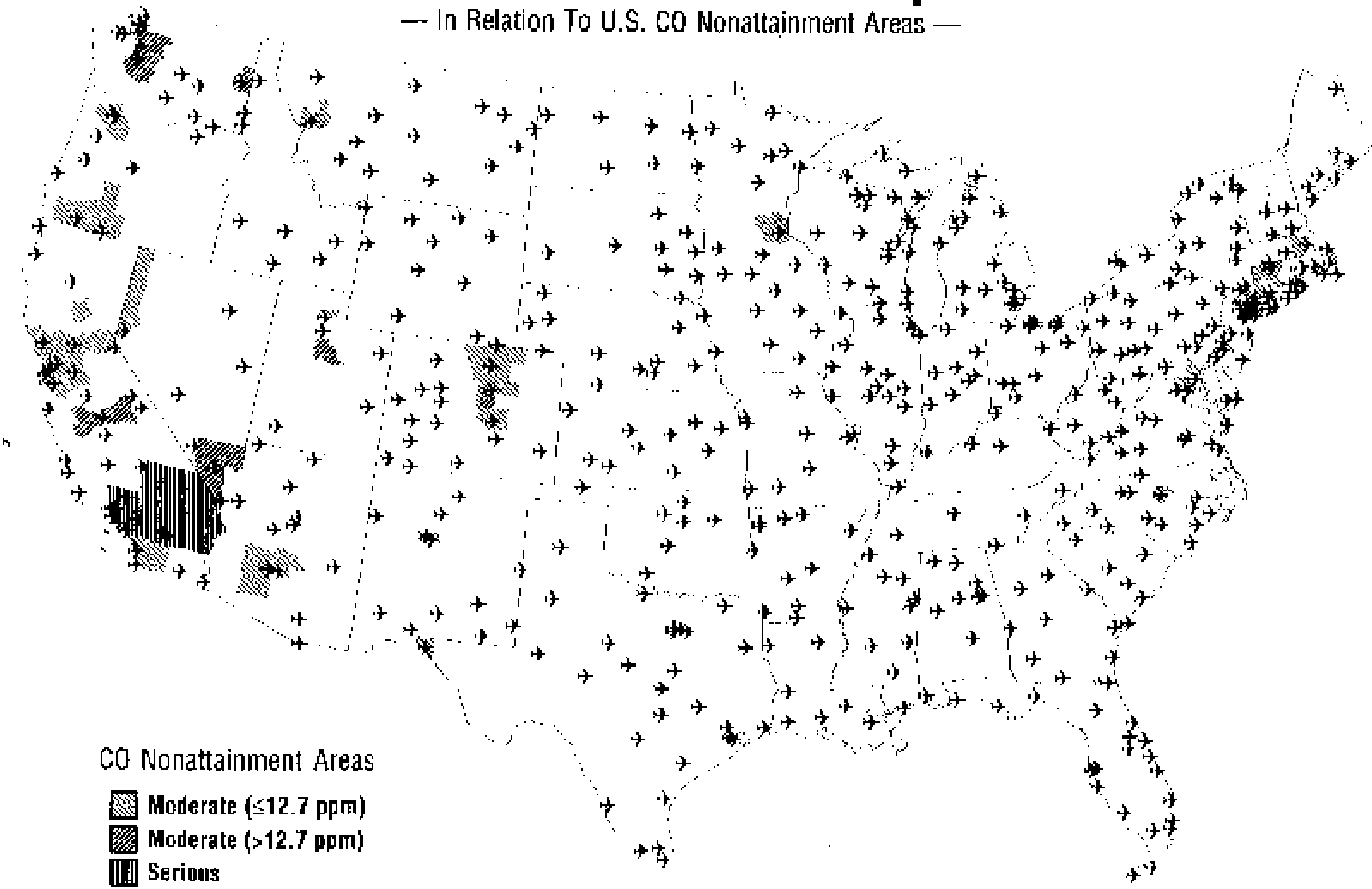


FIGURE 2

U.S. Commercial Service Airports

— In Relation To U.S. CO Nonattainment Areas —



production for the total US as well as for the OTR, California, and all areas of the US except the OTR and California. These factors relate emissions at a power plant to electricity use at an airport or other location connected to the power distribution system. They are based on the regional mix of electricity generation technology and assume an 8% power loss in the transmission and distribution system.

TABLE 1: EMISSIONS FROM ELECTRIC POWER CONSUMPTION[1]

Region	**Emission Factor (lbs/MWh)[2]**		
	HC	**CO**	**NO_x**
Ozone Transport Region[3]	0.03	0.33	0.88
California	0.04	0.44	0.31
Other U.S.	0.03	0.34	3.97
Total U.S.:	0.03	0.36	3.52

[1] Source: EEA unless otherwise noted. Data has been adjusted to account for 8% transmission and distribution losses.

[2] Represents pounds of pollutant emitted at the point of power generation per megawatt hour of electricity consumed in 2000.

[3] Source: *Impact of Battery-Powered Electric Vehicles on Air Quality in the Northeast States* (Reference 19)

COMMERCIAL AIRCRAFT

Several options exist for reducing aircraft emissions through operational control strategies. These include scheduling lower-emitting aircraft to operate in areas with air quality problems, minimizing the number of engines in operation during taxi-in and taxi-out (single engine taxi), derated-power takeoffs, and reducing use of reverse thrust upon landing, among others. Several of these options were analyzed as possible components of the FIP. For the present report, the only operational control analysis was evaluating different ways to rank aircraft according to their relative emissions.

The objective in scheduling lower-emitting aircraft to operate in areas with air quality problems is to move the maximum number of passengers and cargo (i.e., payload) with minimum emissions. For the purpose of this analysis, the minimum emissions per unit of payload moved is the figure of merit for "environmental efficiency" or "emissions productivity." Ranking aircraft simply according to their emissions per operation is not an appropriate measure since large aircraft generally have higher emissions than smaller aircraft because they have larger and/or more engines. Large aircraft are moving more payload since they (potentially) are transporting more passengers and cargo with each operation. A measure that more closely reflects emissions per unit of payload would be emissions per seat, however, this does not address cargo and airlines periodically change the configuration of their aircraft cabins, adding or removing seats, which would change value of this measure. Directly measuring emissions per unit of payload would be a better way to compare different aircraft. Consistently and accurately measuring payload is a problem, however, since it requires knowing the passenger and cargo load factors. This implies that a surrogate for emissions per unit of payload is needed. The best surrogate measure that EEA considered was emissions per unit of engine thrust. Conceptually, one ton of payload requires a similar amount of thrust for a single LTO regardless of the aircraft model or number or size of engines. Undoubtedly this measure does vary by aircraft model since the ratio of payload to gross weight varies somewhat between aircraft models. The benefit to this measure is that its value reflects the actual performance of the engines; engines with low emissions factors produce low emissions per unit of thrust . Another benefit is that engine manufacturers already calculate this value, based on default LTO times-in-mode, as part of the engine certification process. It is reported as Dp/Foo; where Dp is the mass of any gaseous pollutant emitted during the reference emissions landing and takeoff cycle and Foo is rated output, which is the maximum power/thrust available for take-off under normal operating conditions at sea level static conditions (without water injection). It is typically reported in grams/kiloNewton thrust.

An example fleet of U.S. commercial aircraft, listed in Table 2, was used to evaluate alternative means of defining lower-emitting aircraft. The aircraft were ranked from lowest- to highest-emitting based on total emissions per LTO, emissions per seat per LTO, emissions per engine per LTO, and Dp/Foo (expressed as pounds of emissions per 1000 pounds of thrust). Only the last measure appears to rank the aircraft where large and small aircraft appear throughout the ranking and newer aircraft are generally at the top of the list as one would expect since many have engines designed for low emissions. Other measures tend to distribute the aircraft poorly, biasing the ranking in favor of smaller aircraft. The aircraft rankings by different evaluation measure are shown in Appendix 3.

GROUND SUPPORT EQUIPMENT

A wide variety of equipment services large commercial aircraft while they are unloading and loading passengers and freight at an airport. Air taxi and smaller aircraft, unlike larger commercial aircraft, typically do not require this service equipment. As a group, the ground support equipment (GSE) for large commercial aircraft include primarily the following types of equipment.

- **Air Start Units -** Provide large volumes of compressed air to an aircraft's main engines for starting.
- **Air-Conditioning Units -** Provide conditioned air to ventilate and cool parked aircraft.
- **Aircraft Tugs -** Tow aircraft in the terminal gate area. They also tow aircraft to and from hangers for maintenance. These were broken into two categories: tugs for narrow body aircraft and tugs for wide body aircraft.

TABLE 2: U.S. COMMERCIAL AIRCRAFT EXAMPLE FLEET

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO* CO	NOx	HC	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	2	267	267
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	2	262	262
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	2	218	280
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	1	150	150
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	1	150	150
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	2	186	200
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	3	335	335
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	3	335	335
A-330	AIRBUS	PW4158	32.62	57.00	2.75	3	335	335
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	3	262	440
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	1	136	160
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	1	136	160
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	1	136	160
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	1	136	160
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	1	102	122
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	1	102	122
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	1	102	122
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	1	102	122
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	1	128	137
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	1	128	137
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	1	146	146
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	1	146	146
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	1	108	122
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	3	410	431
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	3	410	410
B-747-400	BOEING	PW4056	31.55	115.02	2.54	3	412	412
B-757-200	BOEING	PW2037	23.78	35.75	2.34	2	187	194
B-757-200	BOEING	PW2040	26.75	49.87	2.65	2	187	194
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	2	187	194
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	2	184	210
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	2	184	210
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	2	184	210
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	2	184	210
B-767-300	BOEING	PW4460	31.88	62.16	2.62	3	204	254
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	3	204	254
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	3	204	254
B-777-200	BOEING	PW4056	15.78	57.51	1.27	3	350	400
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	1	95	110
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	1	98	108
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	3	284	296
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	3	284	296
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	3	258	298
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	3	298	298
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	2	189	259
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	2	189	259
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	1	98	108
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	1	107	107
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	1	122	122
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	1	135	146
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	1	63	68
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	1	97	103
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	1	97	103
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	3	275	296
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	3	226	226
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	3	314	314
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	3	314	314

* LTO - Landing/Take-Off cycle

- **Baggage Tractors -** Haul baggage between the aircraft and the terminal.
- **Belt Loaders -** Mobile conveyor belts used to move baggage between the ground and the aircraft hold.
- **Buses -** Shuttle personnel between airport locations.
- **Cargo Moving Equipment -** Various types of equipment employed to move baggage and other cargo around the airport and to and from aircraft. This category includes forklifts, lifts, and cargo loaders.
- **Cars** - Move personnel around the airport.
- **Deicers -** Vehicles used to transport, heat, and spray deicing fluid.
- **Ground Power Unit (GPU) -** Mobile ground-based generator units that supply aircraft with electricity while they are parked at the airport.
- **Other -** Small miscellaneous types of equipment commonly found on airports such as compressors, scrubbers, sweepers, and specialized units.
- **Pickups -** Move personnel and equipment around the airport.
- **Service Vehicles -** Specially modified vehicles to service aircraft at airports. This category includes fuel trucks, maintenance trucks, service trucks, lavatory trucks, and bobtail tractors (a truck body that has been modified to tow trailers and equipment).
- **Vans -** Move personnel and equipment around the airport.

GSE OPPORTUNITY FOR EMISSION REDUCTIONS

While GSE are commonly fueled by gasoline or diesel, it is possible to use other fuels that result in lower emission operation. Alternatives to gasoline and diesel include compressed natural gas, liquefied natural gas, liquefied petroleum gas (commonly propane), and electricity. This discussion refers to these fuels excluding electricity as alternative fuels.

Many different types of GSE are commercially available that operate on alternative fuels or electricity. From an emissions perspective, equipment originally designed to use these fuels gives much better environmental performance than equipment that is converted from a conventional fuel to use an alternative fuel or electricity. This report describes the benefit of using GSE designed to use alternative fuels or electricity.

The following sections discuss how to determine emission reductions achieved and the cost (or savings) incurred through purchasing, operating, and maintaining equipment that operates on alternative fuels or electricity. First, GSE emissions and operating cost discussions address calculation methodologies, sample calculations, and data inputs. Then the methodology for calculating emission reductions, costs (or savings), and cost effectiveness are discussed.

GSE EMISSIONS

This section discusses the calculation methodology and data inputs for determining the pollutant emissions from GSE. In the case of electric GSE, emissions attributable to the generation of electricity for use by the equipment are taken into account. GSE emissions of significance are hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NO_x), particulates (PM), and sulfur dioxide (SO_2). For conventional and alternative fuel GSE, the factors that determine the quantity of pollutant emitted are the emission factor, average rated brake horsepower, load factor, and usage. For electric GSE, the quantity of pollutant emitted due to the generation of electricity for recharging the equipment is determined by the emission factor of the electric power plant and the amount of electricity consumed as described earlier.

GSE Emissions - Calculation Methodology (Conventional and Alternative Fuel GSE)

The following equation calculates the pollutant emissions from an individual unit of equipment.

$$E_{it} = (BHP_t \times LF_t \times U_t \times EI_{it}) \times CF$$

Where:
- E_{it} - emissions per year of pollutant i, in pounds, produced by GSE type t
- BHP_t - average rated brake horsepower (BHP) of the engine for equipment type t
- LF_t - load factor utilized in ground support operations for equipment type t
- U_t - annual hours of use for equipment type t
- EI_{it} - emission index (or emission factor) for pollutant i, in grams per BHP-hr, which is specific to a given engine size (and engine vintage for diesel engines) and fuel type
- i - pollutant type (HC, CO, NO_x, PM, SO_2)

t - equipment type (e.g., diesel baggage tug)
CF - 0.0022046 unit conversion factor from grams to pounds

GSE Emissions - Calculation Methodology (Electric GSE)

The following equation calculates the pollutant emissions attributable to the generation of electricity used by a particular piece of electric GSE. The emissions are determined based on usage and emission indices of the electric power plant. Since emissions associated with electric GSE occur at the power plant rather than at the point where the equipment is used, the equation defined above is modified somewhat.

$$E_{it} = U_t \text{ X } EI_{it}$$

Where: E_{it} - emissions of pollutant i, in pounds, attributable to the use of GSE type t (e.g., electric baggage tug) for a given time period
U_t - megawatt hours of electricity used by equipment type t
EI_{it} - emission index (or emission factor) for pollutant i, in pounds per megawatt hour of electricity consumed
i - pollutant type (HC, CO, NO_x, CO_2)
t - equipment type (e.g., electric baggage tug)

GSE Emissions - Example Calculation (Conventional and Alternative Fuel GSE)

This sample calculation illustrates the procedure for determining the pollutant emissions from a particular GSE type. For this example, emissions will be calculated for a diesel baggage tug with a 78 horsepower engine, which is used for 1,021 hours per year.

Pollutant	BHP	Load Factor	Usage (hr/yr)	Emission Index (grams/BHP-hr)	Emissions (lbs)
HC	78 x	55% x	1,021 x	1.2 x 0.0022046 =	115.88
CO	78 x	55% x	1,021 x	4.0 x 0.0022046 =	386.25
NO_x	78 x	55% x	1,021 x	11.0 x 0.0022046 =	1,062.20
PM	78 x	55% x	1,021 x	0.5 x 0.0022046 =	48.28
SO_2	78 x	55% x	1,021 x	0.25 x 0.0022046 =	24.14

GSE Emissions - Example Calculation (Electric GSE)

This example calculation illustrates the procedure for determining the pollutant emissions attributable to the generation of electricity used by a particular GSE type. This example assumes a baggage tug consumed 60,000 kilowatt-hours (or 60 Mwh) of power during the year at an airport in California.

Pollutant	Power Consumption (Mwh)		Emission Index (lbs/Mwh)		Emissions (lbs)
HC	60	x	0.04	=	2.4
CO	60	x	0.44	=	26.4
NO_x	60	x	0.31	=	18.6

GSE Emissions - Data Inputs

The data needed for calculating pollutant emissions from GSE include GSE type, engine BHP, engine load factor, GSE usage, engine emission factors, population, and electric generation emission factors; emission factors from electric power generation were presented above in Table 3. These data inputs, as well as GSE economic life, are discussed below.

- **GSE Type -** GSE type refers to the equipment (e.g., baggage tug) and fuel (e.g. diesel) type. A list of GSE types is included in Table 3.

- **Brake Horsepower (BHP) -** Brake horsepower refers to the average rated brake horsepower of an equipment type's engine. Typical brake horsepower data by GSE type is included in Table 3.

- **Load Factor -** The load factor is the average operational horsepower output of the engine divided by its rated BHP. Load factors by equipment type are included in Table 3.

TABLE 3: GSE EQUIPMENT AND ENGINE DATA

Equipment Type	Economic Life[1]	Load Factor	Use Per Year[2]	Fuel Type	Coolant	BHP	Fuel Consumption[3]
Aircraft Tug (Narrow Body Aircraft)	10	80%	1,721	Diesel	Water	175	0.061
				Electric	Water		
				Gasoline	Water	130	0.089
				LPG	Water	130	
				CNG	Water	130	
Aircraft Tug (Wide Body Aircraft)	10	80%	1,721	Diesel	Water	500	0.053
				Gasoline	Water	500	0.089
				CNG	Water	500	
Air-Conditioning Unit	8	75%	271	Diesel	Water	300	0.053
				Electric[4]			
				Gasoline	Water	130	0.089
				CNG	Water	130	
Air Start Unit	8	90%	181	Diesel	Water	600	0.053
				Electric	Air		
				Gasoline	Water	130	0.089
				Jet Turbine	Air	140	0.156[5]
				CNG	Water	130	
Baggage Tug	8	55%	1,021	Diesel	Water	78	0.064
				Electric	Air		
				Gasoline	Water	100	0.089
				LPG	Water	100	
				CNG	Water	100	
Belt Loader	8	50%	887	Diesel	Water	45	0.076
				Gasoline	Water	60	0.089
				LPG	Water	60	
				CNG	Water	60	

TABLE 3: GSE EQUIPMENT AND ENGINE DATA
(Continued)

Equipment Type	Economic Life[1]	Load Factor	Use Per Year[2]	Fuel Type	Coolant	BHP	Fuel Consumption[3]
Bobtail	8	55%	434	Gasoline	Water	100	0.089
				CNG	Water	100	
Bus	8	25%	1,678	Diesel Truck	Water	180	0.095
				Gasoline Truck	Water	130	0.123
				CNG Truck	Water	130	
Car	8	25%	486	Gasoline Car	Water	130	0.123
				LPG Car	Water	130	
				CNG Car	Water	130	
Cargo Loader[6]	10	50%	1,250	Diesel	Water	76	0.064
				Gasoline	Water	70	0.089
				LPG	Water	70	
				CNG	Water	70	
Cart	8	50%	340	Electric	Air		
				Gasoline	Air	12	0.162
				LPG	Air	12	
				CNG	Water	12	
Deicer	8	95%	156	Diesel	Water	93	0.064
				Gasoline	Water	93	0.089
				CNG	Water	93	
Forklift	8	30%	1,028	Diesel	Water	52	0.064
				Electric	Water		
				Gasoline	Water	50	0.089
				LPG	Water	52	
				CNG	Water	52	

TABLE 3: GSE EQUIPMENT AND ENGINE DATA
(Continued)

Equipment Type	Economic Life[1]	Load Factor	Use Per Year[2]	Fuel Type	Coolant	BHP	Fuel Consumption[3]
Fuel Truck	8	25%	1,117	Diesel Truck	Water	180	0.095
				Gasoline Truck	Water	130	0.123
				LPG Truck	Water	130	
				CNG Truck	Water	130	
GPU	8	75%	2,240	Diesel	Water	145	0.061
				Electric	Air		
				Gasoline	Water	150	0.089
				CNG	Water	150	
Lav Cart	8	50%	725	Gasoline	Air	12	0.162
				CNG	Water	12	
Lav Truck	8	25%	735	Gasoline	Water	130	0.089
				CNG	Water	130	
Lift	8	50%	1,357	Electric	Air		
				Gasoline	Water	100	0.089
				LPG	Water	100	
				CNG	Water	100	
Maintenance Truck	8	50%	563	Diesel	Water	130	0.061
				Gasoline	Water	130	0.089
				LPG	Water	130	
				CNG	Water	130	
Other[7]	8	50%	771	Diesel	Water	50	0.064
				Gasoline	Water	50	0.089
				LPG	Water	50	
				CNG	Water	50	
Pickup	8	25%	1,722	Gasoline Truck	Water	130	0.123
				LPG Truck	Water	130	
				CNG Truck	Water	130	

TABLE 3: GSE EQUIPMENT AND ENGINE DATA
(Concluded)

Equipment Type	Economic Life[1]	Load Factor	Use Per Year[2]	Fuel Type	Coolant	BHP	Fuel Consumption[3]
Service Truck	8	20%	563	Diesel	Water	170	0.061
				Gasoline	Water	180	0.089
				LPG	Water	180	
				CNG	Water	180	
Van	8	25%	1,987	Gasoline Truck	Water	130	0.123
				CNG Truck	Water	130	
Water Trucks	8	20%	567	Gasoline	Water	150	0.089
				CNG	Water	150	

SOURCES:

Economic Life - American Airlines, Inc.

Load Factor - TWA *South Coast & Sacramento Federal Implementation Plans* correspondence (see Appendix GSE 1), supplemented with information from GSE and engine manufacturers and the ground service operations supervisors of United and Alaska Airlines

Use Per Year - *Comments of the Air Transport Association on EPA's Proposed FIP: Measures for Commercial Aviation* (Reference 1)

Fuel Type - American Airlines, Delta Airlines, Federal Express, Northwest Airlines, Southwest Airlines, Trans World Airlines, and United Airlines

BHP - Delta Airlines, Trans World Airlines, and United Air Lines, supplemented with data from *Jane's Airport and ATC Equipment, 1992 - 1993* (Reference 18) and discussions with equipment manufacturers

Fuel Consumption - On-road vehicle fuel consumption is based on the national average fleet mix of on-road vehicles; off-road vehicle fuel consumption was estimated using data from *Documentation of Input Factors for the New Off-Road Mobile Source Emissions Inventory Model* (Reference 6)

1 Economic Life in years

2 Average Use Per Year in hours

3 Fuel Consumption in gallons per BHP-hour

4 Add on to an existing gate

5 Fuel consumption is for APU model GTC85-72 with 200 HP and 210 lb/hr fuel flow.

6 Lower Lob Cargo Loader (15,000 lbs)

7 Includes compressors, scrubbers, sweepers, and specialized units

- **Usage -** The specific hours of operations for a particular piece of equipment should be used where available. If the specific usage is not known, an average operation, as shown in Table 3, can be used.

- **Off-Road GSE Emission Factors -** There is no single, acknowledged source of emission factors for the specific engines found on most conventional and alternative fuel GSE that is endorsed by EPA. Table 4 summarizes emission factors compiled from various sources and represent a typical GSE fleet mix.

- **On-Road GSE Emission Factors -** On-road emission factors are based on the national average fleet mix of on-road vehicles. On-road emission factors in grams per BHP-hour are provided in Table 5.

- **Population -** When calculating an emissions inventory, the specific population of the inventory should be used.

- **Economic Life -** The economic life, or planning life, refers to the average number of years a new piece of equipment is projected to be used. In reality, the useful life of a piece of equipment is much longer than its initial economic life due to rebuilding and remanufacture options. The economic life of equipment used for the cost benefit calculations in this report, in years, is listed by equipment type in Table 3.

GSE OPERATING COSTS

This section discusses the calculation methodology and data inputs for calculating the cost of purchasing, operating, and maintaining a piece of GSE. The factors that determine the cost of purchasing, operating, and maintaining a piece of equipment are the capital cost(s), usage, hourly operating cost, and hourly maintenance cost.

GSE Operating Costs - Calculation Methodology

The following discusses the calculation methodology for determining the cost of purchasing and operating and maintaining a piece of GSE. The cost of purchasing a piece of equipment is simply the sum of all capital costs. For most types of GSE, the only capital cost is the actual cost of the piece of GSE. For electric GSE, the cost of purchasing a piece of GSE also includes the cost of purchasing an electric recharger station. Calculating the cost of operating and maintaining a piece of GSE is more

TABLE 4: OFF-ROAD GSE EMISSION FACTORS

Engine Type	Coolant Type	Horsepower Range	EMISSION FACTORS (grams per BHP-hr)				
			HC	NO_x	CO	PM	SO_2
Gasoline	Air Cooled	1 to 24	10.0	2.0	360.0	0.2	0.21
		25 to 50	7.0	3.0	400.0	0.0	0.21
	Water Cooled	25 to 50	4.0	4.0	240.0	0.0	0.21
		≥ 51	4.0	4.0	240.0	0.0	0.26
Diesel	Water Cooled	1 to 50	1.0	11.0	4.0	0.7	0.29
		≥ 51	1.2	11.0	4.0	0.5	0.25
OEM Optimized CNG	Water Cooled	1 to 24	5.0	4.0	180.0	0.0	0.00
		25 to 50	2.0	6.0	120.0	0.0	0.00
		≥ 51	1.0	3.5	2.1	0.0	0.00
Existing CNG or LPG	Air Cooled	1 to 24	5.0	4.0	180.0	0.0	0.00
		25 to 50	4.0	6.0	200.0	0.0	0.00
	Water Cooled	1 to 24	5.0	4.0	180.0	0.0	0.00
		25 to 50	2.0	6.0	120.0	0.0	0.00
		≥ 51	2.0	6.0	120.0	0.0	0.00

SOURCE: *Regulatory Strategies for Off-Highway Equipment* (Reference 8) and *Feasibility of Controlling Emissions from Off-Road, Heavy-Duty Construction Equipment* (Reference 7)

TABLE 5: ON-ROAD GSE EMISSION FACTORS

Vehicle Type	Engine Type	EMISSION FACTORS (grams per BHP-hr)				
		HC	NO_x	CO	PM	SO_2
Light Duty Vehicle	Gasoline	4.18	1.57	8.98	0.03	0.21
Light Duty Truck	Gasoline	4.10	1.87	13.05	0.04	0.26
	Diesel	0.88	2.02	2.60	0.43	0.25

SOURCE: MOBILE5a and PART5 model runs at GSE-equivalent mileage accumulation and age distribution involved. The following equation calculates the cost to operate and maintain a particular piece of GSE and fuel type. If the hourly operating cost is not known, it can be estimated using the equipment's fuel consumption and a fuel cost.

$$C_t = U_t \text{ x } (OC_t + MC_t)$$

Or

$$C_t = U_t \text{ x } [(FF_t \text{ x } BHP_t \text{ x } LF_t \text{ x } FC_t) + MC_t]$$

Where:

- C_t - total operating and maintenance cost per year of GSE type t
- U_t - annual hours of use for equipment type t
- OC_t - cost, in dollars per hour, of operating equipment type t
- MC_t - cost, in dollars per hour, of maintaining equipment type t
- FF_t - fuel flow (or fuel consumption), in gallons per brake horsepower-hour, of equipment type t; for electricity the fuel consumption is in megawatt hours
- BHP_t - average rated brake horsepower (BHP) of the engine for equipment type t
- LF_t - load factor utilized in ground support operations for equipment type t
- FC_t - cost, in dollars per gallon, of fuel type (e.g., diesel) of equipment type t (e.g., diesel baggage tug); for electricity the cost is in dollars per megawatt hour
- t - equipment type t (e.g., diesel baggage tug)

GSE Cost Sample Calculation

This sample calculation illustrates the procedure for determining the cost of purchasing, operating, and maintaining a particular GSE type and usage. For this sample, costs are calculated for a new diesel baggage tug. The cost of purchasing the equipment is assumed to be $28,000. To calculate an annual O&M cost for the baggage tug, the equation identified above is used. The hourly operating cost is estimated using the equipment's fuel consumption and an average fuel cost of $0.53, based on an average cost of jet fuel (assumed to be representative of the cost an air carrier would pay for diesel fuel).

Usage (hr/yr)	Fuel Flow (gal/BHP-hr)	BHP	Load Factor	Fuel Cost ($/gal)	Maintenance Cost ($/hr)	Annual O&M Cost ($)
1,021 x [(		0.064	x	78 x	55% x	0.53) +8.06] =9,715

GSE Cost Data Inputs

The data needed for calculating the cost of purchasing, operating, and maintaining a piece of GSE include GSE type, BHP, usage, capital cost(s), operating cost, maintenance cost, and population. If the operating cost is not known, it can be estimated using the equipment's fuel flow (or fuel consumption), usage, and a given fuel cost. The GSE type, BHP, usage, fuel flow (under the GSE emission data inputs' emission factor discussion), and population are addressed under the GSE emission data inputs section. The remaining GSE cost data inputs are discussed below.

- **Capital Cost(s) -** Capital costs are a one-time expenditure, incurred when a new piece of equipment is purchased. If the capital costs are fully realized in the first year of the equipment's life, then for subsequent years of the equipment's operation the capital costs would be zero and the only cost is for operating and maintenance. For the purposes of these calculations, capital costs will be realized over the life of a piece of equipment (annualized) as is discussed in further detail in the following GSE cost/benefit section. Capital costs for replacement, converted, and modified GSE were compiled from industry sources. Capital costs per unit for conventional, alternative fuel, and electric GSE are provided in Tables 6 and 7.

  For electric GSE, total capital costs include the cost of purchasing electric recharger stations. If the number of recharger stations needed per piece of electric equipment is not known, it can be assumed that one recharger station is installed for each new piece of electric GSE. The recharger capital cost is assumed to be an additional cost of $2,500 and includes a minimum for additional wiring from the terminal to each recharger station. In general, an electric GSE and recharger cost more to purchase than a conventional GSE, although for most GSE types it costs less to operate and maintain an electric GSE and recharger than a conventional GSE. Also benefits such as tax credits for the purchase of electric vehicles at either the federal or state level, may be available. Such credits would improve the economic feasibility of purchasing an electric piece of equipment.

- **Operating Cost -** Operating costs are a recurring expenditure for the life of the equipment. Elements of the operating costs include fuel and operating labor. Since operating labor costs are assumed to be the same for both conventional GSE and alternatively fueled or electric, they are excluded from these cost calculations. The actual local cost of operating equipment should be used where available. If no direct source of operating costs is available, operating costs can be estimated based on fuel consumption rates (or fuel flow), usage, and a given fuel cost. Estimated operating costs are provided in Table 6.

TABLE 6: REPLACEMENT GSE CAPITAL, OPERATING AND MAINTENANCE COST INPUTS[1]

Equipment Type	Replacement Conventional GSE Cost			Replacement Electric GSE Cost[2]			Replacement CNG GSE Cost			Replacement LNG GSE Cost		
	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)
Aircraft Tug (Narrow Body)	$100.0	$16.67		$120.0	$12.50							
Aircraft Tug (Wide Body)	$190.0	$26.41		$250.0	$19.71							
Air Conditioner[3]	$60.0	$12.15		$55.0	$9.11							
Air Start	$80.0	$33.76		N/A	$25.32							
Bag Tug	$15.5	$8.06		$28.0	$6.04							
Belt Loader	$23.0	$6.63		$35.0	$4.97							
Bobtail	$24.0	$13.82		$35.0	$10.37							
Bus	$110.0	$9.58		N/A	$9.58							
Car	$15.0	$2.10		N/A	$2.10							
Cargo Loader[4]	$150.0	$9.84		$180.0	$7.38							
Cart	$6.0	$1.69		$6.0	$1.27							
Deicer	$5.0	$4.63		$5.0	$3.47							
Forklift	$18.0	$10.32		$20.0	$7.74							
Fuel Truck	$65.0	$16.83		N/A	$16.83							
GPU	$32.0	$10.44		N/A	$7.83							
Lav Cart	$7.0	$2.44		$7.0	$2.44							
Lav Truck	$35.0	$12.15		$42.0	$9.11							
Lift	$45.0	$13.73		$54.0	$10.30							
Maintenance Truck	$25.0	$12.82		$30.0	$9.62							
Other	$20.0	$10.97		$30.0	$8.23							
Pickup	$18.0	$9.65		$27.0	$7.24							
Service Truck	$25.0	$12.82		$30.0	$9.62							
Van	$22.0	$10.09		N/A	$10.09							
Water Truck	$32.0	$14.04		$38.5	$10.53							

Abbreviations: Cap. refers to Capital; Maint. refers to Maintenance; Op. refers to Operating

[1] Data is compiled from industry sources.

[2] Add an additional $2,500 per piece of electric equipment for the electric GSE recharger capital cost.

[3] Add on to an existing gate.

[4] Refers to a lower lob cargo loader (15,000 lbs).

TABLE 7: CONVERSION AND MODIFICATION GSE CAPITAL, OPERATING, AND MAINTENANCE COST INPUTS[1]

Equipment Type	Conversion Electric GSE Cost[2]			Conversion CNG GSE Cost			Modification LNG GSE Cost			Conversion LNG GSE Cost		
	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)	Cap. ($000)	Maint. ($/hr)	Op. ($/hr)
Aircraft Tug (Narrow Body)							$20.0					
Aircraft Tug (Wide Body)							$35.0					
Air Conditioner[3]										$55.0		
Air Start							$35.0					
Bag Tug										$5.0		
Belt Loader										$5.0		
Bobtail												
Bus							$35.0[5] $10.0[6]					
Car										$5.0		
Cargo Loader[4]							$35.0[7]			$10.0		
Cart												
Deicer										$40.0		
Forklift										$5.0		
Fuel Truck										$5.0		
GPU							$35.0					
Lav Cart	$1.0									$1.0		
Lav Truck										$5.0		
Lift												
Maintenance Truck										$5.0		
Other												
Pickup										$5.0		
Service Truck										$5.0		
Van										$5.0		
Water Truck										$5.0		

* Footnotes contained on the following page

TABLE 7: CONVERSION AND MODIFICATION GSE CAPITAL, OPERATING, AND MAINTENANCE COST INPUTS[1]

FOOTNOTES

Abbreviations: Cap. refers to Capital; Maint. refers to Maintenance; Op. refers to Operating

[1] Data is compiled from industry sources. Unit conversion is defined as converting a unit's existing engine for use with an alternative fuel power plant. Unit modification is defined as replacing a unit's existing power plant with an alternative fuel power plant.

[2] The electric GSE recharger capital cost is assumed to be an additional $2,500 per piece of equipment, excluding air conditioners, air starts, GPUs, lav carts, and on-road vehicles.

[3] Add on to an existing gate.

[4] Refers to a lower lob cargo loader (15,000 lbs).

[5] Cost applies to a 42 passenger bus.

[6] Cost applies to a 16 passenger bus.

[7] Refers to a main deck cargo loader (30-40,000 lbs).

- **Maintenance Cost -** Maintenance costs are a recurring expenditure for the life of the equipment. Elements of the maintenance costs include replacement parts, general upkeep of the equipment body and engine, and labor costs. A specific maintenance cost for a piece of equipment should be used where available. The estimated hourly maintenance costs for conventional and electric GSE are listed in Table 6.

GSE COST/BENEFIT ANALYSIS

This section discusses the emission reductions and cost (or savings) of purchasing, operating, and maintaining equipment that operates on alternative fuels or electricity instead of gasoline or diesel. In performing a cost/benefit analysis, the costs (or savings) and emission reductions of equipment are evaluated over the life of the equipment. The remainder of this section discusses the emission reduction and cost analyses, including calculation methodologies and sample calculations for purchasing an electric vehicle in place of a conventional fueled vehicle. Finally, the cost/benefit calculation methodology and sample calculations are provided.

Emission Reduction Analysis

Cost Analysis

To determine the cost of purchasing, operating, and maintaining one piece of equipment (e.g., electric baggage tug) over another piece that is the same type of equipment but a different fuel type (e.g, diesel baggage tug), the total costs of the equipment over a lifetime are evaluated. To evaluate the total cost of a piece of equipment over a lifetime, the capital, operating, and maintenance costs have to be combined. As discussed previously in the GSE cost section, the two costs have different characteristics: the capital cost is a one-time expenditure, while the annual operating and maintenance cost is a recurring expenditure.

A method of evaluating the total (i.e., capital plus operating and maintenance) cost of a piece of equipment over its lifetime is the Annualized Cash Flow (ACF) method. The ACF method annualizes costs. The capital cost is multiplied by a capital recovery factor (CRF) to obtain an equivalent end-of-year annual capital cost payment necessary to repay the investment over the life of the equipment given a specified interest rate. The resulting annualized capital cost is added to the annual operating and maintenance costs to obtain an annualized total cost.

If the annual cost or the interest rate changes from year to year, capital costs occur beyond the first year, or risk factors have to be addressed, an alternative method should be used to evaluate costs. The Discount Cash Flow (DCF) method can be used to calculate costs and address such complexities. The DCF method calculates the cost by determining the present value of the costs of buying, operating, and maintaining a piece of equipment over the equipment life. The CRF then can be applied to determine the annualized cost. For this report it will be assumed that the ACF method can be used to evaluate the cost of purchasing, operating, and maintaining a piece of equipment with one fuel type versus another.

Cost Analysis - Calculation Methodology

To compare the cost of owning and operating one type of GSE versus another, the total costs of each type are first determined on an annualized basis and then compared. As mentioned above, the annualized capital cost is added to the annual O&M cost to get a total annual cost of operation.

The capital cost is multiplied by the capital recovery factor (CRF) to obtain the equivalent end-of-year annual capital cost payment necessary to repay the investment over the life of the equipment given a specified interest rate. The CRF is a function of the interest rate and equipment life. The following equation is used to determine the CRF.

$$CRF = \frac{i \times (1 + i)^n}{(1 + i)^n - 1}$$

Where: CRF - capital recovery factor
i - interest rate
n - economic life, in years

After the CRF has been determined, the following equation is used to determine the annualized capital cost of a piece of equipment.

$$ACC = CC \times CRF$$

Where: ACC - annualized capital cost, in dollars per year, of a piece of equipment
CC - capital costs, in dollars, of a piece of equipment

The annualized capital cost is then added to the annual O&M cost for each type of GSE. The two equipment types can be compared and the annual cost of using an alternative type of equipment is simply the difference in annualized costs. The following equation calculates the annual cost (or savings) of converting to an alternative fueled or electric GSE.

$$C_{t1,t2} = (ACC_{t2} + OMC_{t2}) - (ACC_{t1} + OMC_{t1})$$

Where: $C_{t1,t2}$ - total annual cost (or savings), in dollars per year, of purchasing, operating, and maintaining a piece of GSE operating on one fuel type t2 (e.g., electric baggage tug) instead of another t1 (e.g., diesel baggage tug)
ACC_{t1} - annualized capital cost, in dollars per year, of equipment type t1
ACC_{t2} - annualized capital cost, in dollars per year, of equipment type t2
OMC_{t1} - annual O&M cost, in dollars per year, of equipment type t1
OMC_{t2} - annual O&M cost, in dollars per year, of equipment type t2
t1 - GSE type operating on first fuel type (e.g., diesel baggage tug), which is to be replaced with t2
t2 - GSE type operating on second fuel type (e.g., electric baggage tug), which is to be purchased, operated, and maintained in place of t1 for emission benefits

Cost Analysis - Sample Calculation

This example evaluates the replacement of a diesel baggage tug with an electric baggage tug. The diesel tug is assumed to have a 78 horsepower engine and is used for 1,021 hours per year. From Table 6, the capital cost of the diesel tug is $15,500 and the O&M cost is $8.06 per hour. An electric replacement tug has a capital cost of $30,500 ($28,000 for the tug and $2,500 for the recharger) and an O&M cost of $6.04 per hour. Both vehicles have an 8 year economic life. The capital recovery factor is based on an interest rate of 10%.

$$\begin{aligned} CRF &= i \times (1 + i)^n / [(1 + i)^n - 1] \\ &= 0.10 \times (1 + 0.10)^8 / [(1 + 0.10)^8 - 1] \\ &= 0.187 \end{aligned}$$

The CRF is used to annualize the GSE capital costs, which is then added to the O&M cost.

Diesel Baggage Tug (t2)

$$= (0.187 \times \$15{,}500) + (\$8.06/hr \times 1{,}021\ hr/yr)$$
$$= (\$2{,}898.50\ ) + (\$8{,}229.26)$$
$$= \$11{,}127.76/yr$$

Electric Baggage Tug (t1)

$$= (0.187 \times \$30{,}500) + (\$6.04/hr \times 1{,}021\ hr/yr)$$
$$= (\$5{,}703.50) + (\$6{,}166.84)$$
$$= \$11{,}870.34/yr$$

For this example, conversion to an electric baggage tug to reduce GSE emissions costs $742.58 per year.

$$C_{t1,t2} = \$11{,}870.34/yr - \$11{,}127.76/yr$$
$$= \$742.58/yr$$

The earlier sample emissions calculations for these GSE showed NO_x emissions of 1,062 lbs/yr for the diesel and 19 lbs/yr for the electric for an emissions reduction of 1,043 lbs/yr. The cost/benefit ratio can be calculated:

$$= \$742.58/yr \div (1{,}043\ lbs/yr \div 2{,}000\ lbs/ton)$$
$$= \$1{,}424/ton$$

AUXILIARY POWER UNITS

An auxiliary power unit (APU), which is a component of a large aircraft, is essentially a small turbine engine. An APU generates electricity and compressed air to operate the aircraft's instruments, lights, ventilation, and other equipment and for starting the aircraft main engines. If a ground-based power or air source is unavailable, the APU may be operated for extended periods when the aircraft is on the ground with its engines shut down. APUs burn jet fuel and create exhaust emissions like larger engines. There are different models and series of APUs to meet the needs of various civil aircraft. APUs are not common on smaller civil aircraft.

APUs are used on a routine basis throughout much of the time when an aircraft is on the ground. Operating practices largely are determined by individual airlines and vary considerably among aircraft types and airlines. Some airlines start the APU when the aircraft is on approach and keep it on during the entire taxi-in phase as a precaution to insure its availability if needed for engine restart. Some airlines only operate their APUs on taxi-in if they are practicing single/reduced engine taxiing. Again, this is to insure its availability if the main engine(s) shuts down and must be restarted. Some airlines do not operate APUs during the taxi-in phase at all or only for particular aircraft types. During quick turnaround flights or where electricity is unavailable the APU typically also is operated while docked at a passenger gate.

If a ground power system (400 Hz) and source of ventilation air are available at the docking location, the APU may not be needed. To connect the aircraft to a ground power system, a cable is plugged into an electrical connector on the aircraft. This commonly is done on arrival as soon as the aircraft comes to a stop, requiring less than one minute of APU operation after the aircraft has come to a full stop. The ground-based air system is then connected to the aircraft cabin via a flexible hose.

Prior to main engine start for departure the cockpit crew goes through their departure checklist and readies their flight plan. During this time, course settings and communication frequencies are programmed into the on-board avionics. If an aircraft is relying on electric power provided from a ground-based system that must be disconnected, it is possible that the on-board power may be interrupted or perturbed. If the aircraft electrical system is interrupted while the avionics are being programmed, some of the data may be lost. For this reason, most airlines prefer to have the APU running for approximately 10 minutes to provide the electric power for the aircraft during flight preparation.

On departure, the critical service provided by the APU is main engine start. This requires a large volume of air to initiate rotation of the turbine and mass flow through the combustor. For routine operation this takes less than one minute. Once the main engine(s) are started they provide the electric power and ventilation to the aircraft. Again, some airlines prefer to keep the APU running during taxi-out as a back-up. An APU also is operated during taxi out if the aircraft must temporarily park away from the gate due to a delayed departure.

In addition to the time the aircraft is docked at a gate for passenger loading and unloading, aircraft also can be docked at remote gates or hardstand areas for cargo or passenger loading and unloading and for maintenance. For these locations the needs for APU operation are similar, except that passengers typically are not aboard the aircraft in these locations and thus the ventilation needs for passenger comfort may not exist.

OPPORTUNITY FOR EMISSION REDUCTIONS

Emissions from APUs can be reduced by turning off the APU while an aircraft is docked at the gate. Turning off an APU reduces fuel combustion. When available at the gate, a 400 Hz ground power system and ventilation air source often provide a reasonable alternative to using an APU to support normal aircraft operations. These fixed systems operate at a greater energy efficiency than an APU and substantially reduce pollutant emissions. In addition, the emissions attributable to the generation of electricity for use by the fixed systems are generated at an off-airport electric power plant. The emissions generated at the power plant are lower due to higher efficiency and emission controls. Often, the cost of the fuel saved is greater than the cost of electricity. Therefore, a project to reduce emissions by substituting fixed systems for APU use actually may save money. The following section discuss how to determine emission reductions and costs (or savings) through the use of ground-based power and preconditioned air instead of an APU. The balance of this section discusses APU emissions and operating costs including calculation methodologies, sample calculations, and data inputs. APU emissions and costs described in this section will be compared later with the emissions and costs of fixed systems, and a cost/benefit analysis will be performed.

APU EMISSIONS

This section discusses the calculation methodology and data inputs for calculating the emissions from APUs. APU engines burn jet fuel and create exhaust emissions like larger engines. APU emissions of significance are hydrocarbon (HC), carbon monoxide (CO), oxides of nitrogen (NO_x), and sulfur dioxide (SO_2). The factors that determine the quantity of pollutant emitted are the pollutant's emission index (pounds of pollutant per 1000 pounds of fuel consumed), the fuel consumption rate, and the duration of APU operation.

APU Emissions - Calculation Methodology

The methodology for calculating emissions from APUs is adapted from the U.S. EPA's *Procedures for Emission Inventory Preparation* (Reference 21). The following equation calculates the pollutant emissions from an APU on a particular aircraft based on APU operating time, fuel flow, and the emission indices for the specific APU.

$$E_{ij} = T \text{ X } (FF_j/1000) \text{ X } (EI_{ij})$$

Where:

- E_{ij} - emissions of pollutant i, in pounds, produced by the APU model installed on aircraft type j for one LTO cycle
- T - operating time per LTO cycle, in minutes
- FF_j - fuel flow, in pounds per minute, for each APU used on aircraft type j
- EI_{ij} - emission index for pollutant i, in pounds of pollutant per one thousand pounds of fuel, for each APU used on aircraft type j
- i - pollutant type (HC, NO_x)
- j - aircraft type (e.g., B-737, MD-11)

To calculate APU emissions for multiple aircraft at an airport, the above equation also would be used to calculate APU emissions for each operating condition (e.g., aircraft type or operating time per LTO). Then, to calculate the total APU emissions for multiple aircraft the following equation would be used. This second equation multiplies the APU emissions per LTO for a given aircraft type and operating time by the number of corresponding LTOs, then sums the emissions over all aircraft types.

$$E_{Ti} = \sum (E_{ij} \text{ X } LTO_j)$$

Where:

E_{Ti} - total APU emissions of pollutant i, in pounds, produced by all aircraft types in question

LTO_j - number of landing and takeoff cycles by aircraft j for the inventory time period

APU Emissions - Sample Calculation

This sample calculation illustrates the procedure for determining the pollutant emissions from an APU while it is docked at an airport gate. This is the target operating period for using a low emission, ground-based system instead of the APU. This calculation is based on a Boeing B-737-300 aircraft with APU model GTCP85-129ck. The LTO is assumed to occur at Los Angeles International Airport (LAX) in California at the 1990 average APU operating time for LAX of 105.34 minutes per LTO. Since the APU operating time includes APU operation during aircraft taxi, the average taxi time for LAX, 23.8 minutes as determined by FAA, is subtracted to obtain the estimated APU operating time at the gate of 81.54 minutes (105.34 - 23.80 = 81.54).

Pollutant	Time (min)		Fuel Flow (lb/min)		Emission Rate (lb/1000 lb)		Emissions (lb)
HC	81.54	x (	3.92 / 1000)	x	1.03	=	0.329
CO	81.54	x (	3.92 / 1000)	x	17.99	=	5.750
NO_x	81.54	x (	3.92 / 1000)	x	4.75	=	1.518

APU pollutant emissions from multiple aircraft and/or LTOs are determined using the same calculation as above, applying the corresponding number of LTOs, and summing over all aircraft.

APU Emissions - Data Inputs

In addition to knowing aircraft type and number of operations, the data needed for calculating pollutant emissions from an APU include APU model, APU emission factors, and APU operating time.

- **APU Model -** The specific APU model that is installed on an aircraft must be determined to select the emission factors used in calculating the emissions. Table 8 lists APUs and the aircraft on which they are installed. For some aircraft, an APU model is listed (e.g., GTCP 85), but a particular series (e.g., -300) is not indicated. In general, one set of emission factors is not available for all series of an APU model. In these cases, a possible APU series for which emission factors are available is noted in a footnote. For some aircraft models, information on their APUs may not be available. For these aircraft an APU can be assigned based on APUs used on similar aircraft. This gives a reasonable estimate of APU power requirements since typically there are only one or two APUs available in a particular size range. This assumption gives reasonable and repeatable results.

- **Emission Factors -** Emission factors for several APUs have been compiled from various sources into Table 9. Emission factors are listed where available for hydrocarbon, carbon monoxide, nitrogen oxides, and sulphur dioxide. Where emission factors are unavailable for a specific APU, factors for an alternative unit of the same or similar horsepower should be used. Engine manufacturers also may be contacted for specific emission data not available in Table 9.

- **Operating Time -** The APU operating time at the gate must be known to calculate emissions. If the specific APU operating time is unavailable, an airport average APU operating time or aircraft time at the gate can be used. Table 10 lists 1990 average APU operating times for several airports in the South Coast Air Basin of California. These operating times include any time the APU was operating at the gate as well as during aircraft taxi, safety, and maintenance operations.

  To determine emission reductions possible through the use of ground-based systems, the APU operation while at the gate is the period of interest. Since the APU operating times shown in Table 10 include APU operation during aircraft taxi (i.e., operation away from the gate), the aircraft taxi time should be subtracted from the total APU operating time to obtain the APU operating time while at the gate. If the particular aircraft's taxi time is not available, an airport average aircraft taxi time

TABLE 8: APUs AND COMMERCIAL AIRCRAFT MODELS[1]

Auxiliary Power Unit (Shaft Horsepower)	Aircraft Model
AlliedSignal, Inc.	
GTP 30 Series[2]	Fairchild F-27[3]
GTCP 30 Series[2]	Dassault-Bregue Falcon 20[3] Jet Commander[3]
GTCP 35-300[2]	Airbus A-321[4]
GTCP 36 Series[5] (80 HP)	Airbus A320 Airbus A-320-100[6] Airbus A-320-200[6] Airbus A-321[6] Aerospatiale ATR-42[3] Beechcraft Beech 18[7] Brit. Aero. 111-400[7] Brit. Aero. BAe 146 Brit. Aero. BAe 146-100[6] Brit. Aero. BAe 146-200[6] Brit. Aero. Jetstream 31[7] Brit. Aero. Super 31[7] Canadair CL600/CL601[3] Cessna C-208[7] Dassault-Bregue Falcon 50[3] DeHavilland Dash 7[7] DeHavilland DHC-6/300[7] DeHavilland DHC-8[7] DeHavilland DHC-8-100[7] Embraer EMB-110[6] Embraer EMB-120[3] Embraer EMB-145[6] Fokker F-27 Series[6] Fokker F-28 Fokker F-100 Fokker F-100-100[6] NAMC YS-11[3] Saab Fairchild 340[3] Saab Fairchild 340A[6] Short Brothers SHT-360[7] Swearingen SA227[7]

TABLE 8: APUs AND COMMERCIAL AIRCRAFT MODELS[1]
(Continued)

Auxiliary Power Unit (Shaft Horsepower)	**Aircraft Model**
AlliedSignal, Inc. (Continued)	
GTC 85[2]	Convair CV-580[3]
GTCP 85 Series[8] (200 HP)	Boeing B-707 Boeing B-707-300[6] Boeing B-727 Boeing B-727-100[6] Boeing B-727-200[6] Boeing B-737[9] Boeing B-737-100[9] Boeing B-737-200[9] Boeing B-737-300[10] Boeing B-737-400[10] Boeing B-737-500[10] Lockheed L-100[3] McDonnell Douglas DC-8 McDonnell Douglas DC-8-50F[6] McDonnell Douglas DC-8-60[6] McDonnell Douglas DC-8-62[6] McDonnell Douglas DC-8-63F[6] McDonnell Douglas DC-8-70[6] McDonnell Douglas DC-8-71[6] McDonnell Douglas DC-8-73[6] McDonnell Douglas DC-9 McDonnell Douglas DC-9-15F[6] McDonnell Douglas DC-9-30[6] McDonnell Douglas DC-9-40[6] McDonnell Douglas DC-9-50[6] McDonnell Douglas MD-80
GTCP 331 Series[11] (143 HP)	Airbus A-300-600 Airbus A-310 Airbus A-310-200[6] Airbus A-310-300[6] Airbus A-330[4] Airbus A-340[4] Boeing B-757[12] Boeing B-757-200[12]

TABLE 8: APUs AND COMMERCIAL AIRCRAFT MODELS[1] (Continued)

Auxiliary Power Unit (Shaft Horsepower)	Aircraft Model
AlliedSignal, Inc. (Continued)	
(GTCP 331 Series[11] - Continued) (143 HP)	Boeing B-767[12] Boeing B-767-200[12] Boeing B-767-200ER[12] Boeing B-767-300[6,12] Boeing B-767-300ER[6,12] Boeing B-777[4,13] Boeing B-777-200[6,13]
GTCP 660[14] (300 HP)	Boeing B-747 Boeing B-747-100[6] Boeing B-747-200[6] Boeing B-747-300[6]
TSCP 700[15] (142 HP)	Airbus A-300B[6] Airbus A-300-B2 Airbus A-300-B4 McDonnell Douglas DC-10 McDonnell Douglas DC-10-10[6] McDonnell Douglas DC-10-30[6] McDonnell Douglas DC-10-40[6] McDonnell Douglas MD-11 McDonnell Douglas MD-11-11[6]
Hamilton Standard	
ST-6[16]	Lockheed L-1011 Lockheed L-1011-100[6] Lockheed L-1011-50[6] Lockheed L-1011-500[6]
Pratt & Whitney	
PW 901A	Boeing B-747 Boeing B-747-400[6] Boeing B-747-SP[6]

* Footnotes contained on the following page.

TABLE 8: APU'S AND COMMERCIAL AIRCRAFT MODELS[1] (Continued)

FOOTNOTES

[1] SOURCE: *Federal Express Fleet Guide* (Reference 10), unless otherwise noted.

[2] No emission factor data available.

[3] SOURCE: *Reference Guide - Auxiliary Power Systems* (Reference 11).

[4] New aircraft scheduled to enter production.

[5] Emission factors for the GTCP36-300 Series can be used for calculation purposes as representative of all series of the APU model.

[6] APU for a particular aircraft model assumed to be the same as other aircraft in that series or for similar aircraft.

[7] GTCP 36 Series assumed to be representative for this aircraft.

[8] Emission factors for the GTCP85-98ck Series can be used for calculation purposes as representative of all series of the APU model, unless otherwise noted.

[9] Emission factors for the GTCP85-129 Series should be used for calculation purposes.

[10] Emission factors for the GTCP85-129ck Series should be used for calculation purposes.

[11] Emission factors for the GTCP331-200/250 Series can be used for calculation purposes as representative of all series of the APU model, unless otherwise noted.

[12] Emission factors for the GTCP331-200ER Series should be used for calculation purposes.

[13] Emission factors for the GTCP331-500 Series should be used for calculation purposes.

[14] Emission factors for the GTCP660-4 Series can be used for calculation purposes as representative of all series of the APU model.

[15] Emission factors for the TSCP700-4B Series can be used for calculation purposes as representative of all series of the APU model.

[16] Emission factors for the ST-6 L-73 Series can be used for calculation purposes as representative of all series of the APU model.

TABLE 9: MODAL EMISSION RATES - AUXILIARY POWER UNITS

Model - Series (Shaft HP)	Mode	Fuel Flow (lb/hr)	Emission Rates (lb/1000 lb)			
			HC	CO	NO_x	SO_2
GTC85-72[1] (200)	Load	210.00	0.13	14.83	3.88	0.54
GTCP100-544[1] (400)	Load	412.80	0.16	5.89	5.95	0.54
GTCP30-300[2]		282.20	0.20		10.10	
GTCP331-200/250[2] (143[3])		267.92	0.43		9.51	
GTCP331-200ER[2] (143[3])		267.92	0.43	4.13[6]	9.51	
GTCP331-500[2] (143[3])		536.00	0.13	0.09[6]	14.67	
GTCP36-300[2] (80[3])		282.20	0.20	2.05[6]	10.10	
GTCP660-4[2] (300[3])		862.92	0.28	8.65[6]	5.33	
GTCP85[2] (200[3])		235.28	1.03		4.75	
GTCP85-129[2] (200[3])		235.28	1.03	17.99[6]	4.75	
GTCP85-129ck[2] (200[3])		235.28	1.03	17.99[6]	4.75	
GTCP85-98ck[2] (200[3])		235.28	1.03	17.99[6]	4.75	
GTCP95-2[1] (300)	Load	292.80	0.36	3.20	5.65	0.54
PWC 901A[4]	No Load	510	2.00	20.50	1.8	
PWC 901A[4]	Max. Load	899	0.00	5.60	6.5	
PWC 901A[2]		862.92	1.50	16.78[6]	3.15	

TABLE 9: MODAL EMISSION RATES - AUXILIARY POWER UNITS (Continued)

Model - Series (Shaft HP)	Mode	Fuel Flow (lb/hr)	Emission Rates (lb/1000 lb)			
			HC	CO	NO_x	SO_2
ST6/ST6 L-73[5]		440.00	0.02	0.05	8.90	
T-62T-27[1] (100)	Load	102.00	7.79	42.77	3.94	0.54
T-62T-47C1[6]		235.28	0.16	40.20	4.30	
TSCP 700[2] (142[3])		323.68	0.26		8.55	
TSCP 700-4B[2] (142[3])		323.68	0.26	1.48[6]	8.55	
WR27-1[1] (85)	Load	139.80	0.21	5.66	4.63	0.54

[1] SOURCE: *Summary Table of Gaseous and Particulate Emissions from Aircraft Engines* (Reference 2)

[2] SOURCE: *Proposed Federal Implementation Plan for California, Docket No. A-94-09* memorandum (Reference 9)

[3] SOURCE: *Federal Express Fleet Guide* (Reference 10) (note: the APU model's horsepower was assumed to be representative for all series of the APU model)

[4] SOURCE: *PW901A Gaseous Exhaust Emissions* memorandum (Reference 15)

[5] SOURCE: *AIA Exhaust Emissions Data Sheet* letter (Reference 5)

[6] SOURCE: United Air Lines' APU Emissions Database (note: data for LAX 1991) (Reference 22)

TABLE 10: SUMMARY OF APU OPERATING TIMES - 1990
(min/LTO)

Airport	Time in Mode
South Coast Air Basin	
Burbank	44.28
John Wayne	33.48
Long Beach	98.99
Los Angeles Intl	105.34
Ontario Intl	115.62

Source: *Comments of the Air Transport Association on EPA's Proposed Federal Implementation Plan: Measures for Commercial Aviation* (Reference 1) can be used. Average aircraft taxi times for several California airports during the period of June to December 1992 were estimated by FAA, and are included in Table 11. Information on aircraft taxi times is available from FAA's Office of Aviation Policy, Plans, and Management Analysis for some airports. If unavailable from FAA, it may be necessary to calculate taxi times for the airport of interest.

If the APU operating time is unavailable, an airport average operating time can be estimated by considering the services APUs provide. APUs sometimes are used during aircraft taxi for safety reasons. APUs also are used to provide power and ventilation for aircraft at a docking location (e.g., passenger, cargo, maintenance) that have shut down their engines. If either of these services is provided at the docking location, APU operating time can be reduced.

On departure the essential preparations and main engine start can be accomplished in three to five minutes. (Most air carriers do not start their main engines until they have been pushed back from the gate. Since this takes less than one minute, the time of main engine start has only a small effect on the minimum time needed to operate the APU on departure.) The need for pneumatic air sets the lower boundary of APU use. Approximately 10 minutes is a reasonable minimum APU operating period for a single LTO. This estimate is applicable to aircraft docked at a gate for passenger loading and unloading, as well as aircraft docked for cargo loading and unloading and for maintenance.

If only 400 Hz is available (i.e., no PCA), some additional APU operation may be required depending on ambient temperature and weather conditions. If only PCA is available, the APU must run for the entire turnaround.

APU COSTS

This section discusses the calculation methodology and data inputs for calculating the cost of operating and maintaining APUs. The factors that determine the cost of operating and maintaining an APU are fuel consumption, fuel cost, maintenance costs, and the duration of APU operation.

APU Cost - Calculation Methodology

The cost of operating and maintaining APUs is calculated by adding the hourly operating cost to the hourly maintenance cost, and multiplying the total cost per hour times the APU operating time per LTO cycle. If the APU operating cost is not known, it can be calculating using the APU fuel flow (or fuel consumption) and fuel cost. The following equation calculates the cost to operate and maintain an APU on a particular aircraft.

TABLE 11: AVERAGE AIRCRAFT TAXI TIMES

Airport	**Average Taxi-Out Time (minutes)**	**Average Taxi-In Time (minutes)**	**Average Total Taxi Time (minutes)**
Burbank	10.8	2.7	13.5
Fresno Air Terminal	7.7	4.4	12.1
Los Angeles Intl	15.0	8.8	23.8
Long Beach	9.9	4.6	14.5
Monterey	6.1	4.3	10.4
Oakland Intl	9.5	4.6	14.1
Ontario Intl	12.1	3.1	15.2
Palm Springs Muni.	9.0	4.2	13.2
San Diego Lindberg	12.7	4.2	16.9
Santa Barbara	6.8	4.1	10.9
San Francisco	15.8	5.7	21.5
San Jose Intl	13.8	5.3	19.1
Sacramento Metro	10.3	3.6	13.9
Santa Ana/Orange County/John Wayne	12.3	6.1	18.4

Source: Louise E. Maillett letter (Reference 14)

$$C_j = TIM \times [MC_j + OC_j]$$

Or $$C_j = TIM \times [MC_j + (FF_j / D \times FC)]$$

Where:

- C_j - total operating and maintenance cost of APU model installed on aircraft type j for one LTO cycle
- TIM - APU operating time per LTO cycle (time in mode), in hours
- MC_j - cost, in dollars per hour, of maintaining the APU model installed on aircraft type j
- OC_j - cost, in dollars per hour, of operating the APU model installed on aircraft type j
- FF_j - APU fuel flow (or fuel consumption), in pounds per hour, of APU model installed on aircraft type j
- D - jet fuel density of 6.6751 pounds per gallon to convert fuel flow units from pounds per hour to gallons per hour
- FC - fuel cost, in dollars per gallon
- j - aircraft type

To calculate APU costs for multiple aircraft at an airport, the above equation(s) also would be used to calculate APU costs for each operating condition (e.g., aircraft type or operating time per LTO). Then, to calculate the total APU costs for multiple aircraft the following equation would be used. This second equation multiplies the APU costs per LTO for a given aircraft type and time in mode by the number of corresponding LTOs, then sums the costs over all aircraft types.

$$C_T = \sum (C_j \times LTO_j)$$

Where:

- C_T - total cost of operating and maintaining APU models installed on all aircraft types in question
- LTO_j - number of landing and takeoff cycles by aircraft j for the inventory time period

APU Cost - Sample Calculation

This sample calculation illustrates the procedure for determining the cost of operating and maintaining an APU on a particular aircraft. As with the example emissions calculation discussed earlier, this cost calculation is based on a Boeing B-737-300 aircraft with APU model GTCP85-129ck. The LTO is assumed to occur at Los Angeles International Airport (LAX) in California at the 1990 average APU operating time for LAX of 105.34 minutes per

LTO. Since the APU operating time includes APU operation during aircraft taxi, the average taxi time for LAX, 23.8 minutes, is subtracted to obtain the estimated APU operating time at the gate of 81.54 minutes (105.34 - 23.80 = 81.54) or 1.359 hours. An average APU maintenance cost for narrow body aircraft of $14.60/hour is assumed to be representative for the B-737-300 aircraft. Finally, an average fuel cost of $0.53/gallon[1] is used to estimate the operating cost.

Time (hr)		Maintenance Cost ($/hr)			Fuel Flow (lb/hr)	Jet Fuel Density (lb/gal)		Fuel Cost ($/gal)		Total O&M Cost ($)
1.359	x [	14.60	+	(	235.28 /	6.6751	x	0.53	)] =	45.23

The cost of operating and maintaining APUs installed on multiple aircraft and/or an aircraft performing multiple LTOs is determined using the same calculation as above, applying the corresponding number of LTOs, and summing over all aircraft.

APU Cost - Data Inputs

The data needed for calculating the cost of operating and maintaining an APU include APU model, APU operating time, APU maintenance cost, and APU operating cost. As discussed above, if the APU operating cost is not known it can be calculating using the APU fuel flow (or fuel consumption) and fuel cost. The APU model, APU operating time, and APU fuel flow (included under the emission factor discussion) are discussed above. Maintenance and operating cost are discussed below.

- **APU Maintenance Cost -** The hourly cost of maintaining an APU should be used in calculating the APU's total operating and maintenance cost if available. This cost likely varies by air carrier. If APU maintenance cost is not available, reasonable default values

[1] The average fuel cost is for total (scheduled and non-scheduled) domestic service of U.S. majors, nationals, and large regionals for April 1995. Source: *Air Transport World* (Reference 16)

might be $14.60/hour for narrow body aircraft, $50.90/hour for wide body aircraft, and $41.00/hour for jumbo body aircraft.[2]

- **APU Operating Cost -** The hourly cost of operating a specific APU should be used in calculating the APU's total operating and maintenance cost if available. If the APU's specific operating cost is unavailable, the APU operating cost can be calculated using the APU fuel flow and an average fuel cost. For some APU models and series, fuel flow information may not be available. For APU models in which information is not available, the operating cost can be estimated using an average fuel consumption. Fuel cost should be available for each airport. For a fuel cost default value, national jet fuel costs are published in a variety of references (e.g., Penton Publication's *Air Transport World*).

PRECONDITIONED AIR AND 400 HZ GROUND POWER

A combination of 400 Hz electric power and preconditioned air (PCA) must be supplied to the aircraft at each gate to allow normal operations in the absence of APU usage. Benefits of ground-based systems include a greater energy efficiency than APU usage, substantially reduced pollutant emissions, and lower noise levels.

This section summarizes the various ground power and PCA systems available for replacing APU use. A method for estimating pollutant emissions from ground power and PCA systems is provided as a basis for comparison with APU emissions. In addition, capital, operating, and maintenance costs for each alternative are estimated based on information from several airports where these systems have been installed or considered.

400 Hz Ground Power

The APU provides electric power for aircraft operations while docked at the gate. A ground-based power source designed to replace this APU power must be provided in order to shut off the APU during this time. Commercial aircraft use 115/200V, 400 Hz power. Equipment must be installed to provide this power to individual gates at sufficient levels to maintain normal aircraft operations while the aircraft is parked at the gate. There are several different

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[2] These average costs are taken from *A 1994 feasibility study of preconditioned air for Northwest Airlines at Logan International Airport, Boston, Massachusetts* (Reference 3).

options for providing 400 Hz power to the aircraft at the gate: mobile generator units, point-of-use converters at each gate, and centralized 400 Hz generators which serve a number of gates.

Mobile Generator Units

Both electric-powered and diesel-powered mobile generator units are available to provide aircraft with the required 400 Hz power. Diesel-powered generators suffer from the same problems that make APU use unattractive: low fuel efficiency, high pollutant emissions, and high noise levels. For these reasons, they are not considered low emissions alternatives to APU use. Electric-powered mobile generators have similar equipment, load capacity, and power requirements as the 400 Hz point-of-use equipment described below.

400 Hz Point-of-Use Converters

Solid state frequency converters may be used at each gate to convert standard 480V, 60 Hz power to 115/200V, 400 Hz power with low harmonic distortion. The only requirement is sufficient 480V, 60 Hz power at the gate to supply power to the aircraft. Advantages of using the solid-state frequency converters at each gate include low power consumption, low fixed capital cost, flexibility of use, ease of repair, and low maintenance costs.

Centralized 400 Hz Power Supply

Supply of 400 Hz electric power to a number of gates may be provided by a centralized motor-generator system. This equipment typically converts the standard 480 V, 60 Hz power to 575 V, 400 Hz power in a centrally located substation room. A transformer at each gate steps the voltage down to the required 115/200 V, 400 Hz power. Design of centralized systems usually includes a redundant motor-generator to provide backup in case of motor failure.

An alternative to the use of motor-generators is the use of static inverters to provide 400 Hz power. Inverters, unlike motor-generators, have the advantage of requiring only the amount of input power which is required for the load at any given time, plus a small amount to account for power loss within the inverter.

The physical layout of the gates is important to the design of a centralized 400 Hz ground power system. Distribution losses require generation to occur as close as possible to the gates. As a result, a "mini-central" system with two or more 400 Hz generators may be preferable to one centrally located power supply.

An advantage of the centralized ground power systems is the ability to design generators for less than the peak load at every gate. However, both centralized and mini-central systems have a high fixed capital cost and significant space requirements. If motor-generators are used to supply 400 Hz power, efficiency is less than that of point-of-use converters at each gate.

Preconditioned Air Systems

Ground-based preconditioned air systems supply the cabin with temperature-controlled fresh air while the aircraft is parked at the gate. The systems typically deliver air to the cabin while the aircraft is mated to the bridge. Two types of electrically-powered PCA systems are available: individual packaged airconditioning assemblies at each gate and centralized systems providing PCA to a number of gates. In both cases, standard 480V, 60 Hz electrical power is used. Mobile diesel-powered airconditioning units are also available, but these offer lower emissions benefits than the electric PCA systems and are not considered low-emission alternatives to APU usage.

Individual packaged assemblies at each gate

Individual packaged airconditioning assemblies may be installed on the bridge of each gate. These systems draw on the 480V, 60 Hz power supplies already in place at most gates. Power requirements are dependent upon the cooling or heating loads of the aircraft being serviced by PCA. A typical point-of-use PCA system consists of air input filters, compressors and condenser coils, blower and blower motor, evaporator coils, and a resistance heating element.

The advantages of a simple system such as this at each gate include:

- applicable for all airports, independent of gate layout
- unit breakdown affects only one gate
- low fixed capital costs

The disadvantages of point-of-use PCA systems include:

- higher maintenance costs
- lower energy efficiency than centralized PCA
- design for maximum real-time cooling load for each gate required

Centralized PCA Systems

Centralized PCA systems provide temperature-controlled fresh air to aircraft at a number of gates from a central refrigeration plant. This arrangement is suitable for airports with a high total aircraft cooling load and a physical layout that allows a central refrigeration plant to service many gates. A typical plant supplies a chilled solution of ethylene glycol and water through an insulated pipeline to the gates. An airhandling unit at each gate blows filtered outside air through coils containing the chilled solution, which is returned to the refrigeration plant. Electric resistance heating units are also available at each gate for winter conditions. The central refrigeration plant typically contains chillers and chiller pump, condenser water pump, loop pump, expansion tank, air separator, cooling tower, motor-controlled valves, motor control center, and a computer control system. Ice storage may be provided to reduce the peak demand required by real-time cooling systems.

Advantages of the centralized PCA systems include:

- energy efficiency
- low maintenance costs
- ability to design for less than the maximum demand at every gate

Disadvantages of centralized PCA are:

- high fixed capital costs
- space requirements for the central refrigeration plant
- possible breakdown affecting a large number of gates

Estimating Emissions From Ground Power and PCA Systems

This section discusses the methodology and data inputs for calculating emissions by ground power and PCA systems. No direct pollutant emissions result from the supply of 400 Hz power or preconditioned air to the aircraft. However, pollutant emissions do result from the generation of electric power at the power plant. In order to estimate those emissions, we must know how much electricity is consumed by aircraft at the gate as well as emission factors at the power plant.

Ground-based 400 Hz Emissions - Calculation Methodology

Electric power consumption by a frequency converter or generator supplying 400 Hz power to aircraft should be calculated as a monthly or yearly average per gate. This power consumption is a function of both expected aircraft loads and the overall design of the 400 Hz supply system. The following equation may be used to estimate power plant emissions resulting from 400 Hz supply to aircraft at one gate:

$$E_{ij} = PC_j \times EI_i$$

Where:
- E_{ij} - emission of pollutant i, in pounds, produced by the power plant as a result of 400 Hz power supply to aircraft j
- PC_j - total power consumption, in kWh, by the 400 Hz power supply system for gate servicing aircraft type j
- EI_i - emission index for pollutant i, in pounds of pollutant per kWh electric power produced

To calculate emissions for multiple gates at an airport, the above equation need only be applied to all gates being serviced by 400 Hz ground power. The sum of those emissions represents all emissions to the atmosphere as a result of supplying 400 Hz power to aircraft by ground equipment.

400 Hz Ground Power Emissions - Sample Calculation

This calculation illustrates the procedure for determining the pollutant emissions from a power plant resulting from 400 Hz power being supplied to an aircraft while it is docked at an airport gate. A typical power consumption rate for a wide body gate 400 Hz power supply system is 10,000 kWh per month or 120,000 kWh per year. Emission rates from power plants are a function of the regional power supply network. Assuming the example gate is in California in 2000, 1 kWh of power supplied results in 0.00004 lb of hydrocarbon emissions, 0.00044 lb of carbon monoxide emissions, and 0.00031 lb of nitrogen oxide emissions (see Table 1). Total annual pollutant emissions from the power plant would be:

Pollutant	Power Consumption (kWh/year)		Emission Rate (lb/kWh)		Emissions (lb/year)
HC	120,000	x	0.00004	=	4.8
CO	120,000	x	0.00044	=	52.8
NO_x	120,000	x	0.001031	=	37.2

400 Hz Ground Power Emissions - Data Inputs

Only two pieces of information are required to estimate emissions from 400 Hz power supply to aircraft: power consumption at the gate and pollutant emissions rates from the power plant. These are multiplied together to estimate the total emissions in a given period of time under investigation. Emissions from power plants were discussed earlier.

- **Electric Power Consumption at the Gate by 400 Hz Supply** - Power consumption (in kWh) by the 400 Hz supply system is a result of both the aircraft load and the type of system delivering 400 Hz power to the aircraft. As a result, a simple calculation based on the amount of time aircraft spend at the gate with the APU shut down is not warranted. Power is consumed by the electric motor-generator or frequency converter even in the absence of a load, although often at a very low rate, depending on the type of equipment. In many cases an estimate of the total power consumption by a gate's 400 Hz power supply is available. A summary of information from several airports is given in Table 12.

  If a per-gate power consumption figure is not available, an estimate may be derived by considering the expected mix of aircraft serviced by a gate and the average power loads corresponding to those aircraft. These loads for common commercial aircraft

TABLE 12: 400 HZ SUPPLY SYSTEM ELECTRIC POWER CONSUMPTION[1]

Airport	No. Gates	400 Hz System	Electric Consumption (kWh/y and kW demand)	
			Total	Per Gate
San Francisco	21 JB 3 WB	Centralized (split)	1.82M kWh 760 kW	75,800 kWh 32 kW
		Point-of-use	1.65M kWh 740 kW	68,600 kWh 31 kW
Washington National	23 WB 21 NB	Centralized (vertical M-G)	5.48M kWh 900 kW	124,500 kWh 20 kW
		Centralized (horiz. M-G)	5.48M kWh 900 kW	124,500 kWh 20 kW
		Centralized (inverters)	2.61M kWh 585 kW	59,300 kWh 13 kW
		Mini-central (vertical M-G)	5.15M kWh 650 kW	117,000 kWh 15 kW
		Mini-central (horiz. M-G)	5.15M kWh 650 kW	117,000 kWh 15 kW
		Mini-central (inverters)	2.61M kWh 585 kW	59,300 kWh 13 kW
		Point-of-use	2.61M kWh 585 kW	59,300 kWh 13 kW
		Electric Mobile Units	2.61M kWh 585 kW	59,300 kWh 13 kW
		Diesel Mobile Units	440,000 gallons	10,000 gallons

Note: JB=Jumbo Body, WB=Wide Body, NB=Narrow Body; M-G = motor-generator

[1] Sources:

San Francisco - *Preconditioned Air and 400 Hz Study for San Francisco International Airport New Concourses "A" and "G"* (Reference 4)

Washington National - *400 Hz Power System Study* (Reference 17) docked at a gate are given in Table 13. Loads in kVA must be converted to kilowatts (kW) and multiplied by the average time (in hours) per LTO with electric power supplied to the aircraft. The result is total power consumption per LTO, measured in kWh.

PCA System Emissions - Calculation Methodology

The methodology for calculating pollutant emissions resulting from the supply of preconditioned air to the aircraft is similar to that used for 400 Hz ground power systems. The two pieces of information required are the average consumption of electric power per gate by the PCA system and the power plant emission factors given previously.

PCA System Emissions - Sample Calculation

This calculation illustrates the procedure for determining the pollutant emissions from a power plant resulting from PCA being supplied to an aircraft while it is docked at a gate. The power consumption rate for a PCA supply system (including heated air in winter) at San Francisco Airport was estimated to be 212,000 kWh per year for a gate capable of serving jumbo aircraft. Emission rates from power plants are a function of the regional power supply network. Assuming the example gate is in California in 2000, 1 kWh of power supplied results in 0.00004 lb of hydrocarbon emissions, 0.00044 lb of carbon monoxide emissions, and 0.001031 lb of nitrogen oxide emissions. Total annual pollutant emissions from the power plant would be:

Pollutant	Power Consumption (kWh/year)		Emission Rate (lb/kWh)		Emissions (lb/year)
HC	212,000	x	0.00004	=	8.5
CO	212,000	x	0.00044	=	93.3
NO_x	212,000	x	0.00031	=	65.7

PCA System Emissions - Data Inputs

Only two pieces of information are required to estimate emissions from PCA supply to aircraft: power consumption by the PCA system and pollutant emissions rates from the power plant. These are multiplied together to estimate the total emissions in a given period of time under investigation. Power plant emissions were discussed earlier.

TABLE 13: TYPICAL 400 HZ LOAD REQUIRED BY VARIOUS AIRCRAFT[1]

Aircraft	Peak Load (KVA)	Average Design Load (KVA)
A-320	60	20
B-727-200	60	18
B-737-300	60	15
B-747-400	120[2]	50
B-757-200	60	30
B-767-300	90	45
MD-80	60	20

[1] Source: *Preconditioned Air and 400 Hz Study for San Francisco International Airport New Concourses "A" and "G"* (Reference 4)

[2] 211 kVA required for the B-747-400 if cooking with all 16 ovens is done at the gate (Reference 13)

- **Electric Power Consumption at the Gate by PCA Equipment** - Power consumption (in kWh) by the PCA system is largely a result of the cooling and heating loads of the aircraft being serviced. The PCA system must be designed to accommodate both the hottest day in summer and the coldest day in winter. These peak demand conditions, however, are much higher than the annual average power consumption. An in-depth analysis of power consumption based on aircraft mix at a gate, passenger loading, and weather conditions is beyond the scope of this section. However, analyses for PCA systems at Logan International Airport (Boston), San Francisco International Airport, and Zurich Airport have been performed. The results of these studies are summarized in Table 14. The relatively mild summertime conditions at these three airports should be taken into consideration when applying these figures to warmer climates.

Costs of 400 Hz Power Supply and PCA Systems

Per gate capital, operating, and maintenance costs for 400 Hz power supply and PCA systems are quite variable. The number and type of aircraft serviced at a gate, outside weather conditions, and the type of systems chosen to provide these services all have a great impact on costs. However, comprehensive cost studies which have been performed for other airports give a range of expected costs per gate.

400 Hz Power Supply Costs

Table 15 gives an overview of capital, maintenance, and fuel costs for two airports at which studies of 400 Hz supply were carried out. Fuel costs were based on local electric rates which take both demand (in kW) and energy consumption (in kWh) into account. A sample set of electric utility rates is given in Table 16.

PCA System Costs

Table 17 gives an overview of capital and maintenance costs for three airports at which studies of PCA were carried out. The Zurich Airport study includes costs for both 400 Hz supply and PCA.

Summary - 400 Hz and PCA System Costs and Emissions

Based on the information presented above, costs and emissions per gate for typical 400 Hz and PCA supply systems can be estimated. These are shown in Table 18.

TABLE 14: PCA SYSTEM ELECTRIC CONSUMPTION[1]

Airport	No. Gates	PCA System	Electric Consumption (kWh/y and kW demand)	
			Total	Per Gate
Boston	3 WB 6 NB	Individual PCA assemblies at gate	-	-
San Francisco	21 JB 3 WB	Individual PCA assemblies at gate	5.08M kWh 3500 kW	212,000 kWh 146 kW
		Central PCA (no ice storage)	5.15M kWh 3342 kW	215,000 kWh 139 kW
		Central PCA (with ice storage)	5.08M kWh 3213 kW	212,000 kWh 134 kW
Zurich	28	Central PCA + 400 Hz Supply	10M kWh	357,000 kWh

Note: JB=Jumbo Body, WB=Wide Body, NB=Narrow Body

[1] Sources:

Boston - *A feasibility study of preconditioned air for Northwest Airlines at Logan International Airport, Boston, Massachusetts* (Reference 3)

San Francisco - *Preconditioned Air and 400 Hz Study for San Francisco International Airport Concourses "A" and "G"* (Reference 4)

Zurich - *Airport Ground Power Concepts for Aircraft Energy and Environmental Concerns: A Holistic Approach* (Reference 12) (note: The Zurich airport study gives information for combined 400 Hz and PCA Supply)

TABLE 15: SUMMARY OF 400 HZ SYSTEM COSTS AT SAN FRANCISCO AND WASHINGTON NATIONAL[1]

Airport	No. Gates	400 Hz System	Capital Cost ($)		Electric Costs (based on local rates)		O & M costs ($) (including electric)	
			Total[2]	Per Gate	Total	Per Gate	Total	Per Gate
San Francisco	21 JB 3 WB	Centralized (split)	$1.54M	$64,100	$231,000	$9,600	$275,000	$11,500
		Point-of-use	$2.15M	$89,600	$216,000	$9,000	$275,000	$11,500
Wash. National	23 WB 21 NB	Centralized (vertical M-G)	$3.96M	$90,100	$232,000	$5,300	$232,000 (electric only)	$5,300 (electric only)
		Centralized (horiz. M-G)	$4.01M	$91,100	$232,000	$5,300	$232,000 (electric only)	$5,300 (electric only)
		Centralized (inverters)	$4.02M	$91,400	$181,000	$4,100	$181,000 (electric only)	$4,100 (electric only)
		Mini-central (vertical M-G)	$2.45M	$55,600	$190,000	$4,300	$190,000 (electric only)	$4,300 (electric only)
		Mini-central (horiz. M-G)	$2.55M	$57,900	$190,000	$4,300	$190,000 (electric only)	$4,300 (electric only)
		Mini-central (inverters)	$2.33M	$53,000	$181,000	$4,100	$181,000 (electric only)	$4,100 (electric only)
		Point-of-use	$2.31M	$52,500	$181,000	$4,100	$181,000 (electric only)	$4,100 (electric only)
		Electric Mobile Units	$2.45M	$55,700	$181,000	$4,100	$181,000 (electric only)	$4,100 (electric only)
		Diesel Mobile Units	$2.06M	$46,800	$326,000	$7,400	$377,000	$8,600

Note: JB=Jumbo Body, WB=Wide Body, NB=Narrow Body; M-G=motor-generator

[1] Sources:
San Francisco - *Preconditioned Air and 400 Hz Study for San Francisco International Airport New Concourses "A" and "G"* (Reference 4)
Washington National - *400 Hz Power System Study* (Reference 17)

[2] $M = million dollars

TABLE 16: SAMPLE UTILITY COST RATES[1]

Charge	Rate
Basic Charge	$69 / Month
Demand Charge (30 min.)	$10.258 / kW
Distribution Demand Charge	
1. First 700 Kw	$1.406 / kW
2. Next 4300 Kw	$1.123 / kW
3. Additional Kw	$0.967 / kW
Energy Charge	
1. First 24,000 kWh	$0.01345 / kWh
2. Next 186,000 kWh[2]	$0.00701 / kWh
3. Additional kWh[2]	$0.00290 / kWh
Fuel Charge	$0.01641 / kWh
RKVA Demand Charge	$0.15 / RKVA

[1] Source: Rates from Virginia Electric Power Co. and *400 Hz Power System Study* (Reference 17)
[2] Add 210 kWh for each kW in excess of 1000 kW demand

TABLE 17: SUMMARY OF PCA SYSTEM COSTS AT VARIOUS AIRPORTS[1]

Airport	No. Gates	PCA System	Capital Cost ($)		Electric Costs (based on local rates)		O & M costs ($) (including electric)	
			Total	**Per Gate**	**Total**	**Per Gate**	**Total**	**Per Gate**
Boston	3 WB 6 NB	Individual PCA assemblies at gate	$610,000	$68,000	N/A	N/A	$83,000	$9,200
San Francisco	21 JB 3 WB	Individual PCA assemblies at gate	$4.44M	$185,000	$489,000	$20,400	$629,000	$26,200
		Central PCA (no ice storage)	$4.93M	$205,000	$484,000	$20,200	$571,000	$23,800
		Central PCA (with ice storage)	$4.63M	$193,000	$464,000	$19,300	$550,000	$22,900
Zurich	28	Central PCA + 400 Hz Supply	$19.9M	$711,000	N/A	N/A	$1.66M	$59,000

Note: JB=Jumbo Body, WB=Wide Body, NB=Narrow Body, N/A = Not Available

[1] Sources:
Boston - *A feasibility study of preconditioned air for Northwest Airlines at Logan International Airport, Boston, Massachusetts* (Reference 3)
San Francisco - *Preconditioned Air and 400 Hz Study for San Francisco International Airport New Concourses "A" and "G"* (Reference 4)
Zurich - *Airport Ground Power Concepts for Aircraft Energy and Environmental Concerns: A Holistic Approach* (Reference 12)

TABLE 18: ESTIMATED COSTS AND EMISSIONS PER GATE FOR 400 HZ AND PCA SUPPLY[1]

Gate Type	Annual Electric Consumption (kWh)	Capital Costs ($)	Annual O & M Costs (including electric) ($/yr)	2000 Emissions (lb/y)		
				HC	CO	NO_x
Jumbo	286,000	$271,000	$35,800	8.9	95	935
Wide/Narrow Body	159,000	$123,000	$13,400	4.9	53	520

[1] This table was derived by averaging costs and emissions from some of the low cost alternatives presented in the following studies:

- *Preconditioned Air and 400 Hz Study for San Francisco International Airport Concourses "A" and "G"* (Reference 4),
- *400 Hz Power System Study* (Reference 17),
- *A feasibility study of preconditioned air for Northwest Airlines at Logan International Airport, Boston, Massachusetts* (Reference 3), and
- *Airport Ground Power Concepts for Aircraft Energy and Environmental Concerns: A Holistic Approach* (Reference 12).

Total Costs and Benefits of Converting to Ground Power and PCA

Advantages of converting from APU usage to ground-based 400 Hz and PCA occur both in the form of reduced emissions and reduced operating and maintenance costs. Over a period of time these reduced costs are likely to make up for the capital cost of installing the equipment. In order to quantify these costs and benefits, the results of the previous sections must be compared.

Calculation Methodology - Overall Costs and Benefits - To quantify the costs and benefits of converting from APU usage to ground power and PCA, total costs and emissions for both cases must be compared. The previous sections gave a methodology for producing these estimates, but in order to compare "apples to apples" we must ensure that the time frames considered are the same for both cases. Table 18 shows costs and emissions on a per gate, per year basis, whereas the APU costs and emissions are derived per aircraft landing/takeoff (LTO) cycle. These must be converted to a per gate, per year total.

Sample Calculation - Overall Costs and Benefits - This calculation is based on a B-737-300 with APU model GTCP85-129ck at Los Angeles International Airport. For the first case, it is assumed that no ground power or PCA equipment is available at the gate. As calculated previously, the aircraft has an average gate time of 81.54 minutes. Costs and emissions were calculated for one LTO, as summarized in Table 19. If we assume that a gate serves nine aircraft LTO's per day, annual costs as shown in Table 19 may also be derived by multiplying the LTO figures by 9 (LTO's per day) and 365 (days per year).

For the second case, it is assumed that 400 Hz power and PCA are supplied by ground equipment. In addition to the cost and emissions information shown in Table 18, there are some costs and emissions associated with the small amount of time an APU must operate while the aircraft is docked. As mentioned earlier, the APU can be shut off approximately 30 seconds after mating with the bridge. In addition, the APU must be turned on about 5 minutes before the aircraft leaves the gate so that it may be properly warmed up for starting the main engines. If we assume 5.5 minutes of APU operation

TABLE 19: COSTS AND EMISSIONS FROM B737-300 APU USAGE AT ONE GATE

No. of LTOs	Fuel Consumption	O & M Costs (including fuel)	Emissions (lb)		
			HC	CO	NO_x
One LTO	319.6 lbs jet fuel	$45.23	0.329	5.750	1.518
One Year @ 9 LTO's / day	1,049,900 lbs jet fuel	$148,580	1,080	18,890	4,990

time per LTO, then the total cost and emissions for this case would be as shown in Table 20.

Summary - Overall Costs and Benefits

Table 21 shows that the use of ground 400 Hz power and PCA systems can significantly reduce both fuel costs and emission. For the example shown, based on the CRF calculated previously, the annualized cost would be:

APU Only (t1)
= (0.187 x $0) + $148,580/yr
= ($0) + $148,580/yr
= $148,580/yr

400 Hz and PCA (t2)
= (0.187 x $123,000) + $23,420/yr
= ($23,001/yr) + $23,420/yr
= $46,421/yr

For this example, addition of 400 Hz power and PCA systems to mitigate emissions from APU use saves $102,159/yr.

$C_{t1,t2}$ = $46,421/yr - $148,580/yr
= $102,159/yr

This results in a very favorable cost/benefit ration for NO_x of $49,460/ton.

= $102,159/yr ÷ [(4,990 lbs - 859 lbs) ÷ 2,000 lbs/ton)
= $49,460/ton

TABLE 20: COSTS AND EMISSIONS FOR EXAMPLE CASE - 400 HZ AND PCA SUPPLY AVAILABLE[1] -

Source	Fuel Consumption	O & M Costs (including fuel)	Emissions (lb)		
			HC	CO	NO_x
APU Usage: 1 LTO (5.5 min)	21.56 lb jet fuel	$3.05	0.0222	0.3879	0.1024
APU usage: 1 year	70,820 lbs jet fuel	$10,020	72.9	1,274	336
Ground Power / PCA: 1 year	159,000 kWh electric	$13,400	4.9	53	520
Total: 1 year	-	$23,420	77.8	1,327	856

[1] Includes 5.5 minutes of APU operation per LTO

TABLE 21: COMPARISON OF APU USAGE TO GROUND 400 HZ POWER AND PCA SYSTEM USAGE FOR A B737-300 at LAX

Source	Annual Fuel Consumption	Capital Costs	Annual O & M Costs (including fuel)	Emissions (lb/yr)		
				HC	CO	NO_x
APU usage only	1,049,900 lbs jet fuel	$0	$148,580	1,080	18,890	4,990
PCA / Ground Power Available	159,000 kWh electric 70,820 lbs jet fuel	$123,000	$23,420	77.8	1,327	856

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APPENDIX 1

U.S. COMMERCIAL SERVICE AIRPORT DATABASE

* **Geographic Information**
* **Aircraft Activity Data**

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Air Carrier	Air Taxi	General Aviation	Military
AL	ANNISTON METROPOLITAN	ANB	ANNISTON	CALHOUN	1,000	3,300	12,000	5,200
AL	BIRMINGHAM	BHM	BIRMINGHAM	JEFFERSON	37,936	24,615	80,715	12,716
AL	DANNELLY FIELD	MGM	MONTGOMERY	MONTGOMERY	5,099	13,983	32,237	21,287
AL	GADSDEN MUNI	GAD	GADSDEN	ETOWAH	1,408	1,200	4,200	400
AL	HUNTSVILLE INTL-CARL T JONES FIELD	HSV	HUNTSVILLE	MADISON	16,371	9,947	30,204	4,373
AL	MOBILE REGIONAL	MOB	MOBILE	MOBILE	12,779	10,941	27,206	27,723
AL	MUSCLE SHOALS REGIONAL	MSL	MUSCLE SHOALS	COLBERT	200	3,000	55,000	2,000
AL	TALLADEGA MUNI	ASN	TALLADEGA	TALLADEGA	8	992	31,500	2,500
AL	TUSCALOOSA MUNI	TCL	TUSCALOOSA	TUSCALOOSA	11	4,466	24,106	5,397
AR	ADAMS FIELD	LIT	LITTLE ROCK	PULASKI	38,381	23,602	80,884	20,825
AR	BAXTER COUNTY REGIONAL	BPK	MOUNTAIN HOME	BAXTER	924	8,000	18,000	1,500
AR	BOONE COUNTY	HRO	HARRISON	BOONE	2,903	500	8,000	200
AR	DRAKE FIELD	FYV	FAYETTEVILLE	WASHINGTON	189	26,373	13,039	240
AR	FORT SMITH REGIONAL	FSM	FORT SMITH	SEBASTIAN	103	12,340	27,848	28,759
AR	HARRELL FIELD	CDH	CAMDEN	OUACHITA	2,248	1,000	8,000	400
AR	JONESBORO MUNI	JBR	JONESBORO	CRAIGHEAD	2,920	3,100	59,400	2,500
AR	MEMORIAL FIELD	HOT	HOT SPRINGS	GARLAND	4,142	2,346	30,000	800
AR	SOUTH ARKANSAS REGIONAL AT GOODWIN FIELD	ELD	EL DORADO	UNION	3,640	2,920	3,000	400
AR	SPRINGDALE MUNI	ASG	SPRINGDALE	WASHINGTON	520	10,000	50,000	800
AR	TEXARKANA REGIONAL-WEBB FIELD	TXK	TEXARKANA	MILLER	102	10,788	18,661	3,022
AZ	ERNEST A. LOVE FIELD	PRC	PRESCOTT	YAVAPAI	590	6,954	104,033	577
AZ	FLAGSTAFF PULLIAM	FLG	FLAGSTAFF	COCONINO	11	8,300	27,073	578
AZ	GRAND CANYON NATIONAL PARK	GCN	GRAND CANYON	COCONINO	756	174,875	7,130	163
AZ	KINGMAN	IGM	KINGMAN	MOHAVE	1,764	0	15,540	590
AZ	LAUGHLIN / BULLHEAD CITY	P06	BULLHEAD CITY	MOHAVE	7,600	2,500	60,000	3,500
AZ	NOGALES INTL	OLS	NOGALES	SANTA CRUZ	1,050	3,150	18,900	210
AZ	PAGE MUNI	PGA	PAGE	COCONINO	1,660	7,560	12,992	179
AZ	PHOENIX SKY HARBOR INTL	PHX	PHOENIX	MARICOPA	307,586	84,913	95,299	10,650
AZ	PHOENIX-GOODYEAR MUNICIPAL	GYR	GOODYEAR	MARICOPA	56	168	53,822	144
AZ	SEDONA	SEZ	SEDONA	YAVAPAI	3,500	3,000	26,000	1,000
AZ	TUCSON INTL	TUS	TUCSON	PIMA	43,911	18,239	95,119	40,431
AZ	WHITERIVER	E24	WHITERIVER	NAVAJO	500	1,000	2,590	60
AZ	YUMA MCAS/YUMA INTL	YUM	YUMA	YUMA	13,642	74	15,058	116,695
CA	ARCATA	ACV	ARCATA/EUREKA	HUMBOLDT	12,000	500	20,000	10,000
CA	BERMUDA DUNES	UDD	PALM SPRINGS	RIVERSIDE	960	6,000	34,000	0
CA	BISHOP	BIH	BISHOP	INYO	8,000	7,000	16,000	2,500
CA	BUCHANAN FIELD	CCR	CONCORD	CONTRA COSTA	406	949	108,598	579
CA	BURBANK-GLENDALE-PASADENA	BUR	BURBANK	LOS ANGELES	56,923	41,640	92,219	598
CA	FRESNO AIR TERMINAL	FAT	FRESNO	FRESNO	8,836	54,595	79,933	10,176
CA	IMPERIAL COUNTY	IPL	IMPERIAL	IMPERIAL	4,114	3,800	28,000	200
CA	INYOKERN	IYK	INYOKERN	KERN	4,300	2,100	12,000	200
CA	JACK MC NAMARA FIELD	CEC	CRESCENT CITY	DEL NORTE	700	200	4,100	200
CA	JOHN WAYNE AIRPORT-ORANGE COUNTY	SNA	SANTA ANA	ORANGE	68,567	37,233	245,629	1,189
CA	LAKE TAHOE	TVL	SOUTH LAKE TAHOE	EL DORADO	52	3,224	17,579	520
CA	LONG BEACH /DAUGHERTY FIELD/	LGB	LONG BEACH	LOS ANGELES	10,640	590	249,627	1,554
CA	LOS ANGELES INTL	LAX	LOS ANGELES	LOS ANGELES	408,823	214,671	47,055	16,794
CA	MAMMOTH - JUNE LAKES	MMH	MAMMOTH LAKES	MONO	2,000	1,000	17,000	30
CA	MC CLELLAN-PALOMAR	CRQ	CARLSBAD	SAN DIEGO	509	10,227	136,074	2,552
CA	MEADOWS FIELD	BFL	BAKERSFIELD	KERN	1,134	23,112	67,729	1,860
CA	MERCED MUNICIPAL/MACREADY FIELD	MCE	MERCED	MERCED	4,730	3,500	18,000	500
CA	METROPOLITAN OAKLAND INTL	OAK	OAKLAND	ALAMEDA	130,335	57,770	142,389	844
CA	MONTEREY PENINSULA	MRY	MONTEREY	MONTEREY	2,977	26,818	53,413	1,753
CA	ONTARIO INTL	ONT	ONTARIO	SAN BERNARDINO	94,714	33,495	26,965	520
CA	PALM SPRINGS REGIONAL	PSP	PALM SPRINGS	RIVERSIDE	7,209	35,572	39,623	1,067
CA	PALMDALE PRODN FLT/TEST INSTLN AF PLANT 4	PMD	PALMDALE	LOS ANGELES	147	5,943	5,677	35,181
CA	REDDING MUNI	RDD	REDDING	SHASTA	86	22,086	55,004	1,916
CA	SACRAMENTO METROPOLITAN	SMF	SACRAMENTO	SACRAMENTO	64,433	36,486	28,593	2,449
CA	SAN DIEGO INTL-LINDBERGH FLD	SAN	SAN DIEGO	SAN DIEGO	140,934	46,841	21,764	5,676
CA	SAN FRANCISCO INTL	SFO	SAN FRANCISCO	SAN MATEO	287,742	105,492	24,427	2,672
CA	SAN JOSE INTERNATIONAL	SJC	SAN JOSE	SANTA CLARA	105,314	17,405	104,157	844
CA	SAN LUIS OBISPO COUNTY-MC CHESNEY FIELD	SBP	SAN LUIS OBISPO	SAN LUIS OBISPO	21,160	24,095	48,450	832
CA	SANTA BARBARA MUNI	SBA	SANTA BARBARA	SANTA BARBARA	5,449	46,006	75,998	1,088
CA	SANTA MARIA PUBLIC	SMX	SANTA MARIA	SANTA BARBARA	69	18,339	38,609	672
CA	SONOMA COUNTY	STS	SANTA ROSA	SONOMA	36	7,625	90,881	710
CA	STOCKTON METROPOLITAN	SCK	STOCKTON	SAN JOAQUIN	112	3,725	35,108	6,566
CA	VAN NUYS	VNY	VAN NUYS	LOS ANGELES	12	2,185	280,292	693
CA	VISALIA MUNI	VIS	VISALIA	TULARE	5,000	8,000	35,000	200
CO	ASPEN-PITKIN CO/SARDY FIELD	ASE	ASPEN	PITKIN	9,437	4,519	25,238	59
CO	CITY OF COLORADO SPRINGS MUNI	COS	COLORADO SPRINGS	EL PASO	23,739	11,601	66,691	41,471
CO	CORTEZ-MONTEZUMA COUNTY	CEZ	CORTEZ	MONTEZUMA	1,704	2,500	4,400	50
CO	DURANGO-LA PLATA COUNTY	DRO	DURANGO	LA PLATA	13,898	2,400	15,000	500
CO	EAGLE COUNTY REGIONAL	EGE	EAGLE	EAGLE	107	1,648	2,240	785
CO	FORT COLLINS-LOVELAND MUNI	FNL	FORT COLLINS/LOVELAND	LARIMER	5,500	2,020	50,000	200
CO	GARFIELD COUNTY REGIONAL	RIL	RIFLE	GARFIELD	6	2,256	12,939	0
CO	GUNNISON COUNTY	GUC	GUNNISON	GUNNISON	2,607	0	9,132	100
CO	LAMAR MUNI	LAA	LAMAR	PROWERS	1,248	1,352	6,868	400
CO	MONTROSE REGIONAL	MTJ	MONTROSE	MONTROSE	5,114	2,600	7,000	100
CO	PUEBLO MEMORIAL	PUB	PUEBLO	PUEBLO	214	9,679	23,603	23,248
CO	SAN LUIS VALLEY REGIONAL/BERGMAN FIELD	ALS	ALAMOSA	ALAMOSA	2,704	4,380	14,568	750
CO	STAPLETON INTL	DEN	DENVER	DENVER	331,777	185,203	27,631	1,617
CO	TELLURIDE REGIONAL	TEX	TELLURIDE	SAN MIGUEL	6,000	50	3,960	25
CO	WALKER FIELD	GJT	GRAND JUNCTION	MESA	3,947	16,517	38,044	3,635
CO	YAMPA VALLEY	HDN	HAYDEN	ROUTT	2,372	1,560	2,500	24
CT	BRADLEY INTL	BDL	WINDSOR LOCKS	HARTFORD	60,466	48,478	43,846	9,220
CT	GROTON-NEW LONDON	GON	GROTON/NEW LONDON/	NEW LONDON	13	6,104	33,220	4,036

State	Airport Name	Airport ID	City	County	Air Carrier	Air Taxi	General Aviation	Military
					---------- Operations			----------
CT	IGOR I SIKORSKY MEMORIAL	BDR	BRIDGEPORT	FAIRFIELD	34	6,921	48,089	976
CT	TWEED-NEW HAVEN	HVN	NEW HAVEN	NEW HAVEN	1,677	9,015	27,041	323
DC	WASHINGTON DULLES INTERNATIONAL	IAD	WASHINGTON	LOUDOUN	88,969	148,050	51,548	7,154
DC	WASHINGTON NATIONAL	DCA	WASHINGTON	ARLINGTON	189,213	70,464	54,351	2,762
DE	NEW CASTLE COUNTY	ILG	WILMINGTON	NEW CASTLE	170	2,790	62,171	16,338
FL	CENTRAL FLORIDA REGIONAL	SFB	ORLANDO	SEMINOLE	258	374	79,575	1,194
FL	DADE-COLLIER TRAINING AND TRANSITION	TNT	MIAMI	DADE	11,000	0	3,000	6,000
FL	DAYTONA BEACH REGIONAL	DAB	DAYTONA BEACH	VOLUSIA	10,068	7,267	184,329	1,154
FL	FORT LAUDERDALE/HOLLYWOOD INTL	FLL	FORT LAUDERDALE	BROWARD	106,135	57,167	66,077	1,229
FL	GAINESVILLE REGIONAL	GNV	GAINESVILLE	ALACHUA	2,852	11,510	38,622	5,900
FL	JACKSONVILLE INTL	JAX	JACKSONVILLE	DUVAL	57,659	38,825	22,929	16,558
FL	KEY WEST INTL	EYW	KEY WEST	MONROE	2	37,167	42,422	3,141
FL	MARATHON	MTH	MARATHON	MONROE	14,600	3,650	22,500	100
FL	MELBOURNE REGIONAL	MLB	MELBOURNE	BREVARD	7,457	10,347	81,993	601
FL	MIAMI INTL	MIA	MIAMI	DADE	317,127	156,824	70,637	5,606
FL	NASA SHUTTLE LANDING FACILITY	X68	TITUSVILLE	BREVARD	10	0	3,856	508
FL	ORLANDO INTL	MCO	ORLANDO	ORANGE	188,340	120,283	28,403	7,187
FL	PALM BEACH INTL	PBI	WEST PALM BEACH	PALM BEACH	57,252	23,756	99,743	1,513
FL	PANAMA CITY-BAY COUNTY	PFN	PANAMA CITY	BAY	2,458	24,628	31,135	4,823
FL	PENSACOLA REGIONAL	PNS	PENSACOLA	ESCAMBIA	14,044	30,041	31,522	26,251
FL	SARASOTA-BRADENTON	SRQ	SARASOTA/BRADENTON/	SARASOTA	19,683	19,061	83,174	2,202
FL	SOUTHWEST FLORIDA REGIONAL	RSW	FORT MYERS	LEE	40,480	15,721	7,000	1,043
FL	ST PETERSBURG/CLEARWATER INTL	PIE	ST PETERSBURG/CLEARWATER	PINELLAS	7,655	4,605	68,561	19,651
FL	TALLAHASSEE REGIONAL	TLH	TALLAHASSEE	LEON	13,769	32,307	41,566	5,879
FL	TAMPA INTL	TPA	TAMPA	HILLSBOROUGH	140,421	75,975	45,537	1,608
FL	VERO BEACH MUNI	VRB	VERO BEACH	INDIAN RIVER	13	1,787	87,514	359
GA	ATHENS/BEN EPPS	AHN	ATHENS	CLARKE	7,225	2,328	14,143	402
GA	BUSH FIELD	AGS	AUGUSTA	RICHMOND	6,473	5,961	16,896	5,677
GA	COLUMBUS METROPOLITAN	CSG	COLUMBUS	MUSCOGEE	2,095	11,086	31,734	2,469
GA	GLYNCO JETPORT	BQK	BRUNSWICK	GLYNN	3,640	250	11,000	1,300
GA	MIDDLE GEORGIA REGIONAL	MCN	MACON	BIBB	240	4,597	21,764	1,416
GA	SAVANNAH INTERNATIONAL	SAV	SAVANNAH	CHATHAM	15,102	9,819	39,263	16,681
GA	SOUTHWEST GEORGIA REGIONAL	ABY	ALBANY	DOUGHERTY	314	8,972	25,240	3,447
GA	THE WILLIAM B HARTSFIELD ATLANTA INTL	ATL	ATLANTA	FULTON	518,447	154,559	23,384	2,949
GA	VALDOSTA REGIONAL	VLD	VALDOSTA	LOWNDES	50	3,160	22,869	4,495
IA	BURLINGTON MUNI	BRL	BURLINGTON	DES MOINES	8,960	1,000	10,000	100
IA	CEDAR RAPIDS MUNI	CID	CEDAR RAPIDS	LINN	14,703	18,649	28,955	218
IA	DES MOINES INTL	DSM	DES MOINES	POLK	29,270	26,120	58,924	6,913
IA	DUBUQUE REGIONAL	DBQ	DUBUQUE	DUBUQUE	302	6,933	20,578	400
IA	FORT DODGE REGIONAL	FOD	FORT DODGE	WEBSTER	14,000	0	13,000	200
IA	MASON CITY MUNI	MCW	MASON CITY	CERRO GORDO	9,854	1,000	12,000	500
IA	OTTUMWA INDUSTRIAL	OTM	OTTUMWA	WAPELLO	1,740	300	7,500	150
IA	SIOUX GATEWAY	SUX	SIOUX CITY	WOODBURY	381	22,045	23,128	9,467
IA	WATERLOO MUNI	ALO	WATERLOO	BLACK HAWK	217	18,809	26,652	5,446
ID	BOISE AIR TERMINAL /GOWEN FLD/	BOI	BOISE	ADA	25,536	33,348	62,637	18,030
ID	COEUR D'ALENE AIR TERM	COE	COEUR D'ALENE	KOOTENAI	2,392	17,500	43,000	1,400
ID	FANNING FIELD	IDA	IDAHO FALLS	BONNEVILLE	2,314	10,940	21,155	442
ID	FRIEDMAN MEMORIAL	SUN	HAILEY	BLAINE	38	9,901	45,257	51
ID	LEWISTON-NEZ PERCE COUNTY	LWS	LEWISTON	NEZ PERCE	108	17,140	21,895	2,122
ID	POCATELLO REGIONAL	PIH	POCATELLO	POWER	80	12,010	18,530	542
ID	TWIN FALLS-SUN VALLEY REGIONAL JOSLIN FLI	TWF	TWIN FALLS	TWIN FALLS	292	12,675	25,304	558
IL	BLOOMINGTON/NORMAL	BMI	BLOOMINGTON/NORMAL	MC LEAN	93	16,182	39,470	866
IL	CAPITAL	SPI	SPRINGFIELD	SANGAMON	505	25,717	44,138	12,969
IL	CHICAGO MIDWAY	MDW	CHICAGO	COOK	113,828	66,055	71,370	1,656
IL	CHICAGO O'HARE INTL	ORD	CHICAGO	COOK	743,688	100,349	36,227	3,216
IL	COLES COUNTY MEMORIAL	MTO	MATTOON/CHARLESTON	COLES	50	4,000	19,000	250
IL	DECATUR	DEC	DECATUR	MACON	95	7,889	25,091	6,805
IL	GREATER PEORIA REGIONAL	PIA	PEORIA	PEORIA	8,047	22,933	31,440	8,788
IL	GREATER ROCKFORD	RFD	ROCKFORD	WINNEBAGO	1,385	16,456	46,840	7,130
IL	LOGAN COUNTY	3LC	LINCOLN	LOGAN	950	1,550	4,000	50
IL	MOUNT VERNON	MVN	MOUNT VERNON	JEFFERSON	3,120	2,420	32,000	560
IL	QUAD-CITY	MLI	MOLINE	ROCK ISLAND	10,590	21,340	31,066	3,798
IL	QUINCY MUNI BALDWIN FIELD	UIN	QUINCY	ADAMS	9,890	5,100	15,000	500
IL	UNIVERSITY OF ILLINOIS-WILLARD	CMI	CHAMPAIGN/URBANA/	CHAMPAIGN	2,062	18,789	39,741	906
IL	WILLIAMSON COUNTY REGIONAL	MWA	MARION	WILLIAMSON	124	3,029	11,507	255
IN	ANDERSON MUNI	AID	ANDERSON	MADISON	2	1,524	15,419	86
IN	DELAWARE COUNTY-JOHNSON FIELD	MIE	MUNCIE	DELAWARE	4	357	31,183	464
IN	EVANSVILLE REGIONAL	EVV	EVANSVILLE	VANDERBURGH	2,904	28,304	32,786	1,148
IN	FORT WAYNE INTERNATIONAL	FWA	FORT WAYNE	ALLEN	12,944	16,880	30,712	8,650
IN	GARY REGIONAL	GYY	GARY	LAKE	156	1,034	16,957	881
IN	HULMAN REGIONAL	HUF	TERRE HAUTE	VIGO	3,309	3,506	25,845	9,694
IN	INDIANAPOLIS INTL	IND	INDIANAPOLIS	MARION	113,240	70,588	51,542	2,206
IN	KOKOMO MUNI	OKK	KOKOMO	HOWARD	139	3,071	3,071	139
IN	MICHIANA REGIONAL	SBN	SOUTH BEND	ST JOSEPH	15,379	21,940	26,415	299
IN	PURDUE UNIVERSITY	LAF	LAFAYETTE	TIPPECANOE	56	3,596	42,529	266
KS	DODGE CITY REGIONAL	DDC	DODGE CITY	FORD	2,300	500	25,000	200
KS	EMPORIA MUNI	EMP	EMPORIA	LYON	1,000	0	15,000	250
KS	FORBES FIELD	FOE	TOPEKA	SHAWNEE	251	4,625	17,973	13,861
KS	GARDEN CITY REGIONAL	GCK	GARDEN CITY	FINNEY	2,500	1,500	20,000	300
KS	GREAT BEND MUNI	GBD	GREAT BEND	BARTON	2,000	1,000	24,000	200
KS	HAYS MUNI	HYS	HAYS	ELLIS	3,200	200	15,000	200
KS	LIBERAL MUNI	LBL	LIBERAL	SEWARD	2,012	1,000	23,600	500
KS	MANHATTAN MUNI	MHK	MANHATTAN	RILEY	3,133	500	14,247	3,396
KS	RENNER FLD /GOODLAND MUNI/	GLD	GOODLAND	SHERMAN	2,200	200	8,000	300
KS	SALINA MUNI	SLN	SALINA	SALINE	134	3,148	27,192	7,890

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Operations Air Carrier	Air Taxi	General Aviation	Military
KS	WICHITA MID-CONTINENT	ICT	WICHITA	SEDGWICK	27,138	15,431	91,796	1,594
KY	BARKLEY REGIONAL	PAH	PADUCAH	MC CRACKEN	10	9,391	23,478	1,357
KY	BLUE GRASS	LEX	LEXINGTON	FAYETTE	13,984	20,201	46,276	1,740
KY	CINCINNATI/NORTHERN KENTUCKY INTERNATION	CVG	COVINGTON/CINCINNATI, OH	BOONE	155,729	162,647	14,047	1,409
KY	STANDIFORD FIELD	SDF	LOUISVILLE	JEFFERSON	103,201	31,953	38,872	5,241
LA	BATON ROUGE METROPOLITAN, RYAN FIELD	BTR	BATON ROUGE	EAST BATON ROUG	11,627	20,004	54,264	2,835
LA	LAFAYETTE REGIONAL	LFT	LAFAYETTE	LAFAYETTE	669	36,376	35,955	6,348
LA	LAKE CHARLES REGIONAL	LCH	LAKE CHARLES	CALCASIEU	5	13,692	16,534	889
LA	MONROE REGIONAL	MLU	MONROE	OUACHITA	5,030	10,219	32,705	10,383
LA	NEW ORLEANS INTL/MOISANT FLD/	MSY	NEW ORLEANS	JEFFERSON	101,868	31,553	28,454	5,500
LA	POLK AAF	POE	FORT POLK	VERNON	1,460	2,596	900	160,000
LA	SHREVEPORT REGIONAL	SHV	SHREVEPORT	CADDO	12,866	25,311	23,925	3,924
MA	BARNES MUNI	BAF	WESTFIELD	HAMPDEN	2	200	33,528	3,726
MA	BARNSTABLE MUNI-BOARDMAN/POLANDO FIELD	HYA	HYANNIS	BARNSTABLE	51,114	60,836	32,606	215
MA	GENERAL EDWARD LAWRENCE LOGAN INTL	BOS	BOSTON	SUFFOLK	246,233	202,391	29,416	620
MA	MARTHAS VINEYARD	MVY	VINEYARD HAVEN	DUKES	8	18,407	27,404	663
MA	NANTUCKET MEMORIAL	ACK	NANTUCKET	NANTUCKET	52	70,890	40,907	1,378
MA	NEW BEDFORD MUNI	EWB	NEW BEDFORD	BRISTOL	13,000	10,600	39,058	1,493
MA	PROVINCETOWN MUNI	PVC	PROVINCETOWN	BARNSTABLE	4,100	2,500	125,000	200
MA	WORCESTER MUNI	ORH	WORCESTER	WORCESTER	454	9,184	26,933	444
MD	BALTIMORE-WASHINGTON INTL	BWI	BALTIMORE	ANNE ARUNDEL	156,024	78,384	37,376	4,774
MD	CUMBERLAND	CBE	CUMBERLAND	MINERAL	3,300	0	6,000	200
MD	OCEAN CITY MUNI	N80	OCEAN CITY	WORCESTER	1,000	250	25,000	50
MD	SALISBURY-WICOMICO COUNTY REGIONAL	SBY	SALISBURY	WICOMICO	18,000	7,000	49,000	19,000
MD	WASHINGTON COUNTY REGIONAL	HGR	HAGERSTOWN	WASHINGTON	40	6,044	30,486	1,353
ME	AUBURN/LEWISTON MUNI	LEW	AUBURN/LEWISTON	ANDROSCOGGIN	3,000	4,000	25,000	10
ME	AUGUSTA STATE	AUG	AUGUSTA	KENNEBEC	13,500	4,000	18,000	1,000
ME	BANGOR INTL	BGR	BANGOR	PENOBSCOT	8,592	22,831	22,307	23,062
ME	HANCOCK COUNTY-BAR HARBOR	BHB	BAR HARBOR	HANCOCK	7,000	0	18,000	400
ME	KNOX COUNTY REGIONAL	RKD	ROCKLAND	KNOX	7,500	500	27,000	125
ME	NORTHERN MAINE REGIONAL ARPT AT PRESQUE I	PQI	PRESQUE ISLE	AROOSTOOK	6,500	3,728	750	100
ME	PORTLAND INTL JETPORT	PWM	PORTLAND	CUMBERLAND	13,595	32,124	33,965	2,589
MI	ALPENA COUNTY REGIONAL	APN	ALPENA	ALPENA	2,104	3,200	3,900	13,000
MI	ANTRIM COUNTY	ACB	BELLAIRE	ANTRIM	1	0	10,130	100
MI	BISHOP INTERNATIONAL	FNT	FLINT	GENESEE	3,720	19,293	28,749	1,275
MI	CAPITAL CITY	LAN	LANSING	CLINTON	7,697	33,821	38,211	5,093
MI	CHERRY CAPITAL	TVC	TRAVERSE CITY	GRAND TRAVERSE	3,712	15,888	40,021	7,587
MI	CHIPPEWA COUNTY INTL	CIU	SAULT STE MARIE	CHIPPEWA	627	670	6,700	43
MI	DELTA COUNTY	ESC	ESCANABA	DELTA	6,500	3,000	1,895	20
MI	DETROIT CITY	DET	DETROIT	WAYNE	60	7,940	71,137	354
MI	DETROIT METROPOLITAN WAYNE COUNTY	DTW	DETROIT	WAYNE	316,855	94,316	66,682	1,885
MI	FORD	IMT	IRON MOUNTAIN/KINGSFORD	DICKINSON	3,782	800	700	10
MI	GOGEBIC COUNTY	IWD	IRONWOOD	GOGEBIC	3,556	250	6,700	100
MI	HOUGHTON COUNTY MEMORIAL	CMX	HANCOCK	HOUGHTON	7,000	1,095	4,000	340
MI	KALAMAZOO/BATTLE CREEK INTERNATIONAL	AZO	KALAMAZOO	KALAMAZOO	7,392	17,801	44,370	409
MI	KENT COUNTY INTL	GRR	GRAND RAPIDS	KENT	25,345	32,620	54,893	2,430
MI	MANISTEE CO.-BLACKER	MBL	MANISTEE	MANISTEE	626	150	7,150	25
MI	MARQUETTE COUNTY	MQT	MARQUETTE	MARQUETTE	6,594	1,120	4,037	111
MI	MENOMINEE-MARINETTE TWIN COUNTY	MNM	MENOMINEE	MENOMINEE	2,184	350	9,000	10
MI	OAKLAND-PONTIAC	PTK	PONTIAC	OAKLAND	282	22,155	141,207	421
MI	PELLSTON REGIONAL AIRPORT OF EMMET COUNT	PLN	PELLSTON	EMMET	2,000	600	5,600	100
MI	TRI CITY INTERNATIONAL	MBS	SAGINAW	SAGINAW	7,832	10,518	20,263	1,663
MI	WILLOW RUN	YIP	DETROIT	WAYNE	10,275	42,361	33,509	448
MN	BEMIDJI-BELTRAMI COUNTY	BJI	BEMIDJI	BELTRAMI	3,942	2,080	16,500	130
MN	BRAINERD-CROW WING CO REGIONAL	BRD	BRAINERD	CROW WING	5,390	1,200	8,100	400
MN	CHISHOLM-HIBBING	HIB	HIBBING	ST LOUIS	2,912	2,524	7,768	200
MN	DULUTH INTL	DLH	DULUTH	ST LOUIS	3,767	7,952	18,889	14,492
MN	FAIRMONT MUNI	FRM	FAIRMONT	MARTIN	5,512	1,200	2,400	30
MN	FALLS INTL	INL	INTERNATIONAL FALLS	KOOCHICHING	5,760	2,500	20,000	100
MN	GRAND RAPIDS/ITASCA CO-GORDON NEWSTROM FI	GPZ	GRAND RAPIDS	ITASCA	2,600	1,500	4,000	60
MN	MANKATO MUNI	MKT	MANKATO	BLUE EARTH	5,000	3,000	13,500	500
MN	MARSHALL MUNI-RYAN FIELD	MML	MARSHALL	LYON	1,248	6,100	9,000	150
MN	MINNEAPOLIS-ST PAUL INTL/WOLD-CHAMBERLAI	MSP	MINNEAPOLIS	HENNEPIN	258,745	121,763	67,033	2,476
MN	ROCHESTER MUNI	RST	ROCHESTER	OLMSTED	6,977	1,430	26,757	7,418
MN	THIEF RIVER FALLS REGIONAL	TVF	THIEF RIVER FALLS	PENNINGTON	3,310	0	5,106	12
MN	WORTHINGTON MUNI	OTG	WORTHINGTON	NOBLES	1,144	312	2,200	700
MO	COLUMBIA REGIONAL	COU	COLUMBIA	BOONE	569	7,388	20,279	1,563
MO	FORNEY AAF	TBN	FORT LEONARD WOOD	PULASKI	1,556	0	1,091	4,308
MO	JOPLIN REGIONAL	JLN	JOPLIN	JASPER	47	10,130	19,845	266
MO	KANSAS CITY DOWNTOWN	MKC	KANSAS CITY	CLAY	223	8,356	85,644	1,005
MO	KANSAS CITY INTL	MCI	KANSAS CITY	PLATTE	127,146	52,107	17,265	1,424
MO	KIRKSVILLE REGIONAL	IRK	KIRKSVILLE	ADAIR	1,600	500	5,000	300
MO	LAMBERT-ST LOUIS INTL	STL	ST LOUIS	ST LOUIS CITY	303,091	114,252	41,056	8,240
MO	SPIRIT OF ST LOUIS	SUS	ST LOUIS	ST LOUIS	9	451	69,585	342
MO	SPRINGFIELD REGIONAL	SGF	SPRINGFIELD	GREENE	7,612	25,615	38,755	11,401
MS	COLUMBUS AFB	CBM	COLUMBUS	LOWNDES	700	0	0	452,820
MS	GOLDEN TRIANGLE REGIONAL	GTR	COLUMBUS/W POINT/STARKVI	LOWNDES	15,000	0	9,000	500
MS	GREENVILLE MUNI	GLH	GREENVILLE	WASHINGTON	55	3,154	10,130	10,947
MS	GULFPORT-BILOXI RGNL	GPT	GULFPORT	HARRISON	2,638	16,437	26,190	30,050
MS	HATTIESBURG-LAUREL REGIONAL	PIB	HATTIESBURG/LAUREL	JONES	1,500	3,200	10,000	15,000
MS	JACKSON INTERNATIONAL	JAN	JACKSON	RANKIN	13,367	22,132	19,979	17,893
MS	KEY FIELD	MEI	MERIDIAN	LAUDERDALE	1,500	5,409	12,628	18,876
MS	TUPELO MUNICIPAL - C D LEMONS	TUP	TUPELO	LEE	12,138	3,603	18,017	9,408
MS	UNIVERSITY-OXFORD	UOX	OXFORD	LAFAYETTE	62	4,000	12,600	200
MT	BERT MOONEY	BTM	BUTTE	SILVER BOW	8,840	6,000	6,643	147

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Air Carrier	Air Taxi	General Aviation	Military
					---- Operations ----			
MT	BILLINGS LOGAN INTL	BIL	BILLINGS	YELLOWSTONE	11,706	33,053	35,886	1,244
MT	DAWSON COMMUNITY	GDV	GLENDIVE	DAWSON	1,196	1,405	1,500	15
MT	FRANK WILEY FIELD	MLS	MILES CITY	CUSTER	1,248	1,840	4,380	0
MT	GALLATIN FIELD	BZN	BOZEMAN	GALLATIN	13,140	3,444	5,000	488
MT	GLACIER PARK INTL	FCA	KALISPELL	FLATHEAD	10,640	1,825	28,000	250
MT	GLASGOW INTL	GGW	GLASGOW	VALLEY	1,248	1,125	12,983	100
MT	GREAT FALLS INTL	GTF	GREAT FALLS	CASCADE	6,632	16,493	18,472	7,944
MT	HAVRE CITY-COUNTY	HVR	HAVRE	HILL	1,240	850	2,000	48
MT	HELENA REGIONAL	HLN	HELENA	LEWIS AND CLARK	2,053	14,437	19,226	10,281
MT	L M CLAYTON	OLF	WOLF POINT	ROOSEVELT	990	1,920	600	0
MT	LEWISTOWN MUNI	LWT	LEWISTOWN	FERGUS	2,600	350	6,000	700
MT	MISSOULA INTERNATIONAL	MSO	MISSOULA	MISSOULA	4,688	12,933	29,227	698
MT	SIDNEY-RICHLAND MUNI	SDY	SIDNEY	RICHLAND	2,650	2,350	15,500	0
MT	YELLOWSTONE	WYS	WEST YELLOWSTONE	GALLATIN	776	190	11,050	30
NC	ALBERT J ELLIS	OAJ	JACKSONVILLE	ONSLOW	5,110	2,300	10,000	8,000
NC	ASHEVILLE REGIONAL	AVL	ASHEVILLE	BUNCOMBE	6,384	16,067	35,019	2,328
NC	CHARLOTTE/DOUGLAS INTL	CLT	CHARLOTTE	MECKLENBURG	261,756	138,216	66,896	4,260
NC	CRAVEN COUNTY REGIONAL	EWN	NEW BERN	CRAVEN	8,760	5,360	9,693	1,240
NC	FAYETTEVILLE REGIONAL/GRANNIS FIELD	FAY	FAYETTEVILLE	CUMBERLAND	5,603	11,661	23,717	14,783
NC	HICKORY REGIONAL	HKY	HICKORY	CATAWBA	5,840	7,000	22,000	250
NC	KINSTON REGIONAL JETPORT AT STALLINGS FLI	ISO	KINSTON	LENOIR	67	5,086	16,521	4,116
NC	MOORE COUNTY	SOP	SOUTHERN PINES	MOORE	1,000	3,000	30,000	200
NC	NEW HANOVER INTERNATIONAL	ILM	WILMINGTON	NEW HANOVER	4,423	14,489	28,828	9,562
NC	PIEDMONT TRIAD INTERNATIONAL	GSO	GREENSBORO	GUILFORD	70,704	22,302	53,579	2,149
NC	PITT-GREENVILLE	PGV	GREENVILLE	PITT	12,000	4,500	18,000	500
NC	RALEIGH-DURHAM INTERNATIONAL	RDU	RALEIGH/DURHAM	WAKE	112,126	99,390	64,511	6,469
NC	SMITH REYNOLDS	INT	WINSTON SALEM	FORSYTH	328	4,629	39,159	338
ND	BISMARCK MUNI	BIS	BISMARCK	BURLEIGH	3,361	16,608	24,673	4,374
ND	DEVILS LAKE MUNI	DVL	DEVILS LAKE	RAMSEY	6,134	295	5,410	272
ND	GRAND FORKS INTL	GFK	GRAND FORKS	GRAND FORKS	4,197	9,134	82,583	2,854
ND	HECTOR INTERNATIONAL	FAR	FARGO	CASS	5,513	16,775	31,965	10,037
ND	JAMESTOWN MUNI	JMS	JAMESTOWN	STUTSMAN	3,536	520	3,000	60
ND	MINOT INTL	MOT	MINOT	WARD	2,162	7,281	14,241	3,326
ND	SLOULIN FLD INTL	ISN	WILLISTON	WILLIAMS	4,000	1,100	3,650	50
NE	ALLIANCE MUNI	AIA	ALLIANCE	BOX BUTTE	2,500	500	4,000	200
NE	CENTRAL NEBRASKA REGIONAL	GRI	GRAND ISLAND	HALL	104	11,524	11,797	1,058
NE	CHADRON MUNI	CDR	CHADRON	DAWES	1,200	400	3,500	300
NE	EPPLEY AIRFIELD	OMA	OMAHA	DOUGLAS	41,429	28,337	50,738	3,532
NE	HASTINGS MUNI	HSI	HASTINGS	ADAMS	2,000	400	9,000	100
NE	KARL STEFAN MEMORIAL	OFK	NORFOLK	MADISON	4,000	500	14,000	200
NE	KEARNEY MUNI	EAR	KEARNEY	BUFFALO	1,600	1,000	15,000	300
NE	LINCOLN MUNI	LNK	LINCOLN	LANCASTER	6,930	12,124	36,274	25,832
NE	MC COOK MUNI	MCK	MC COOK	RED WILLOW	2,200	300	10,000	200
NE	NORTH PLATTE REGIONAL	LBF	NORTH PLATTE	LINCOLN	4,824	800	19,000	700
NE	SIDNEY MUNI	SNY	SIDNEY	CHEYENNE	2,000	400	3,500	300
NE	WILLIAM B. HEILIG FIELD	BFF	SCOTTSBLUFF	SCOTTS BLUFF	4,300	500	15,000	400
NH	DILLANT-HOPKINS	EEN	KEENE	CHESHIRE	3,345	710	4,500	2,000
NH	LACONIA MUNI	LCI	LACONIA	BELKNAP	3,126	1,596	32,257	134
NH	LEBANON MUNI	LEB	LEBANON	GRAFTON	33	11,146	19,714	200
NH	MANCHESTER	MHT	MANCHESTER	HILLSBOROUGH	11,308	37,864	34,070	633
NJ	ALLAIRE	BLM	BELMAR/FARMINGDALE	MONMOUTH	3,155	23,230	59,125	30,000
NJ	ATLANTIC CITY INTERNATIONAL	ACY	ATLANTIC CITY	ATLANTIC	11,698	16,002	32,845	33,805
NJ	LINCOLN PARK	N07	LINCOLN PARK	MORRIS	300	4,500	24,000	200
NJ	MERCER COUNTY	TTN	TRENTON	MERCER	7	2,225	78,727	6,934
NJ	NEWARK INTL	EWR	NEWARK	ESSEX	304,782	116,249	20,544	422
NM	ALAMOGORDO-WHITE SANDS REGIONAL	ALM	ALAMOGORDO	OTERO	2,000	500	10,000	800
NM	ALBUQUERQUE INTL	ABQ	ALBUQUERQUE	BERNALILLO	77,978	41,349	67,424	29,929
NM	CAVERN CITY AIR TRML	CNM	CARLSBAD	EDDY	5,400	200	7,500	200
NM	CLOVIS MUNI	CVN	CLOVIS	CURRY	1,260	1,600	22,000	140
NM	DOUBLE EAGLE II	AEG	ALBUQUERQUE	BERNALILLO	12,775	0	9,125	1,825
NM	GALLUP MUNICIPAL	GUP	GALLUP	MC KINLEY	5,138	3,000	12,213	1,200
NM	GRANT COUNTY	SVC	SILVER CITY	GRANT	1,240	1,200	4,300	300
NM	LAS CRUCES INTERNATIONAL	LRU	LAS CRUCES	DONA ANA	2,658	2,500	21,000	2,784
NM	LEA COUNTY/HOBBS/	HOB	HOBBS	LEA	4,618	4,414	14,176	2,158
NM	LOS ALAMOS	LAM	LOS ALAMOS	LOS ALAMOS	2,613	0	1,050	4
NM	ROSWELL INDUSTRIAL AIR CENTER	ROW	ROSWELL	CHAVES	25	10,149	22,573	43,124
NM	TAOS MUNI	SKX	TAOS	TAOS	1,956	300	8,500	0
NV	DESERT ROCK	DRA	MERCURY	NYE	1,600	1,600	500	1,000
NV	ELKO MUNI-J.C. HARRIS FIELD	EKO	ELKO	ELKO	703	10,000	1,500	300
NV	ELY ARPT /YELLAND FLD/	ELY	ELY	WHITE PINE	900	2,500	6,000	100
NV	MC CARRAN INTL	LAS	LAS VEGAS	CLARK	229,497	104,395	116,422	17,280
NV	RENO CANNON INTL	RNO	RENO	WASHOE	60,961	31,895	50,944	7,262
NV	TONOPAH	TPH	TONOPAH	NYE	149	3,135	1,540	220
NY	ADIRONDACK	SLK	SARANAC LAKE	FRANKLIN	3,370	3,600	14,560	2,000
NY	ALBANY COUNTY	ALB	ALBANY	ALBANY	26,478	72,888	43,683	9,002
NY	BINGHAMTON REGIONAL/EDWIN A LINK FIELD	BGM	BINGHAMTON	BROOME	2,880	24,256	13,408	788
NY	BROOKHAVEN	HWV	SHIRLEY	SUFFOLK	200	0	45,000	100
NY	CHAUTAUQUA COUNTY/JAMESTOWN	JHW	JAMESTOWN	CHAUTAUQUA	8,841	170	7,001	302
NY	CLINTON CO	PLB	PLATTSBURGH	CLINTON	10,000	150	6,000	0
NY	DUTCHESS COUNTY	POU	POUGHKEEPSIE	DUTCHESS	2,334	3,675	66,738	1,435
NY	EAST HAMPTON	HTO	EAST HAMPTON	SUFFOLK	40,000	3,200	31,350	50
NY	ELMIRA/CORNING REGIONAL	ELM	ELMIRA	CHEMUNG	2,847	10,935	20,962	701
NY	GREATER BUFFALO INTL	BUF	BUFFALO	ERIE	57,405	34,004	38,548	4,226
NY	GREATER ROCHESTER INTERNATIONAL	ROC	ROCHESTER	MONROE	46,879	44,704	45,820	2,111
NY	GREENVILLE-RAINBOW	NY25	GREENVILLE	GREENE	100	0	500	30

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Operations: Air Carrier	Air Taxi	eneral Aviation	Military
NY	JOHN F KENNEDY INTL	JFK	NEW YORK	QUEENS	214,469	123,948	13,769	308
NY	LA GUARDIA	LGA	NEW YORK	QUEENS	250,039	67,227	18,014	259
NY	LONG ISLAND MAC ARTHUR	ISP	ISLIP	SUFFOLK	10,305	27,761	76,939	4,309
NY	MASSENA INTL-RICHARDS FIELD	MSS	MASSENA	ST LAWRENCE	3,536	660	4,150	550
NY	MONTAUK	MTP	MONTAUK	SUFFOLK	7,170	5,000	7,500	0
NY	NIAGARA FALLS INTL	IAG	NIAGARA FALLS	NIAGARA	309	369	27,480	27,131
NY	OGDENSBURG INTL	OGS	OGDENSBURG	ST LAWRENCE	1,095	0	1,050	250
NY	ONEIDA COUNTY	UCA	UTICA	ONEIDA	141	15,923	24,850	2,811
NY	STEWART INT'L	SWF	NEWBURGH	ORANGE	12,001	13,004	31,792	9,799
NY	SULLIVAN COUNTY INTL	MSV	MONTICELLO	SULLIVAN	39	210	19,588	171
NY	SYRACUSE HANCOCK INTL	SYR	SYRACUSE	ONONDAGA	38,978	65,355	38,798	8,554
NY	TOMPKINS COUNTY	ITH	ITHACA	TOMPKINS	1,880	14,440	17,681	254
NY	WARREN COUNTY	GFL	GLENS FALLS	WARREN	25	1,864	4,222	78
NY	WATERTOWN INTERNATIONAL	ART	WATERTOWN	JEFFERSON	3,600	500	6,000	16,000
NY	WESTCHESTER COUNTY	HPN	WHITE PLAINS	WESTCHESTER	11,391	34,622	104,615	288
OH	AIRBORNE AIRPARK	ILN	WILMINGTON	CLINTON	40,000	0	2,000	0
OH	AKRON-CANTON REGIONAL	CAK	AKRON	SUMMIT	6,229	20,473	53,866	12,495
OH	BURKE LAKEFRONT	BKL	CLEVELAND	CUYAHOGA	10	12,812	32,891	798
OH	CARL R KELLER FIELD	PCW	PORT CLINTON	OTTAWA	5,840	11,000	10,000	750
OH	CLEVELAND-HOPKINS INTL	CLE	CLEVELAND	CUYAHOGA	117,908	107,971	31,007	3,593
OH	JAMES M COX DAYTON INTL	DAY	DAYTON	MONTGOMERY	72,657	29,180	47,095	2,443
OH	KELLEYS ISLAND LAND FLD	89D	KELLEYS ISLAND	ERIE	5,000	3,695	9,500	0
OH	MANSFIELD LAHM MUNI	MFD	MANSFIELD	RICHLAND	48	587	23,780	9,996
OH	PORT COLUMBUS INTL	CMH	COLUMBUS	FRANKLIN	87,888	62,112	50,833	1,926
OH	PUT IN BAY	OH30	PUT IN BAY	OTTAWA	3,200	1,800	6,000	10
OH	SPRINGFIELD-BECKLEY MUNI	SGH	SPRINGFIELD	CLARK	6	2,500	18,500	10,000
OH	TOLEDO EXPRESS	TOL	TOLEDO	LUCAS	20,852	21,250	32,108	8,650
OH	YOUNGSTOWN MUNI	YNG	YOUNGSTOWN	TRUMBULL	1,570	7,368	31,363	12,993
OK	ENID WOODRING MUNI	WDG	ENID	GARFIELD	1,405	1,388	14,246	8,994
OK	LAWTON MUNI	LAW	LAWTON	COMANCHE	2	9,131	6,731	20,725
OK	PONCA CITY MUNI	PNC	PONCA CITY	KAY	1,872	2,700	31,000	2,000
OK	STILLWATER MUNI	SWO	STILLWATER	PAYNE	445	1,500	29,000	1,500
OK	TULSA INTL	TUL	TULSA	TULSA	51,733	9,840	86,607	26,034
OK	WILL ROGERS WORLD	OKC	OKLAHOMA CITY	OKLAHOMA	47,881	11,469	60,518	25,573
OR	KLAMATH FALLS INTERNATIONAL	LMT	KLAMATH FALLS	KLAMATH	5,389	9,337	22,858	26,396
OR	MAHLON SWEET FIELD	EUG	EUGENE	LANE	6,769	21,121	51,246	3,928
OR	MCNARY FLD	SLE	SALEM	MARION	99	926	32,678	5,183
OR	MEDFORD-JACKSON COUNTY	MFR	MEDFORD	JACKSON	2,953	14,016	34,167	393
OR	NORTH BEND MUNI	OTH	NORTH BEND	COOS	3,536	150	16,153	3,822
OR	PENDLETON MUNI	PDT	PENDLETON	UMATILLA	1,706	6,865	21,603	2,231
OR	PORTLAND INTL	PDX	PORTLAND	MULTNOMAH	98,959	114,414	49,847	12,135
OR	ROBERTS FIELD	RDM	REDMOND	DESCHUTES	14,250	2,000	9,000	1,750
PA	ALLENTOWN-BETHLEHEM-EASTON	ABE	ALLENTOWN	LEHIGH	16,675	22,366	45,386	5,542
PA	ALTOONA-BLAIR COUNTY	AOO	ALTOONA	BLAIR	6,000	3,000	24,000	300
PA	BRADFORD REGIONAL	BFD	BRADFORD	MC KEAN	3,274	300	1,500	1,000
PA	CHESS-LAMBERTON	FKL	FRANKLIN	VENANGO	2,780	72	4,686	56
PA	DU BOIS-JEFFERSON COUNTY	DUJ	DU BOIS	JEFFERSON	3,766	1,176	4,370	506
PA	ERIE INTL	ERI	ERIE	ERIE	2,958	9,546	28,790	1,099
PA	GREATER PITTSBURGH INTL	PIT	PITTSBURGH	ALLEGHENY	277,854	128,344	21,367	7,868
PA	HARRISBURG INTERNATIONAL	MDT	HARRISBURG	DAUPHIN	20,216	29,742	19,331	8,810
PA	JOHNSTOWN-CAMBRIA COUNTY	JST	JOHNSTOWN	CAMBRIA	5,846	8,200	21,000	500
PA	LANCASTER	LNS	LANCASTER	LANCASTER	12,867	10,935	70,678	7,526
PA	PHILADELPHIA INTL	PHL	PHILADELPHIA	PHILADELPHIA	219,170	132,309	45,965	5,401
PA	READING REGIONAL/CARL A SPAATZ FIELD	RDG	READING	BERKS	82	10,415	57,584	5,332
PA	UNIVERSITY PARK	UNV	STATE COLLEGE	CENTRE	11,600	2,400	10,960	480
PA	WESTMORELAND COUNTY	LBE	LATROBE	WESTMORELAND	3,764	346	38,923	1,725
PA	WILKES-BARRE/SCRANTON INTL	AVP	WILKES-BARRE/SCRANTON	LUZERNE	5,127	16,156	24,894	2,546
PA	WILLIAMSPORT-LYCOMING COUNTY	IPT	WILLIAMSPORT	LYCOMING	8	7,518	23,232	537
PA	WINGS FIELD	N67	PHILADELPHIA	MONTGOMERY	4,500	2,500	11,100	100
RI	BLOCK ISLAND STATE	BID	BLOCK ISLAND	WASHINGTON	8,998	230	12,735	4
RI	THEODORE FRANCIS GREEN STATE	PVD	PROVIDENCE	KENT	30,100	38,589	37,892	2,877
RI	WESTERLY STATE	WST	WESTERLY	WASHINGTON	8,165	2,000	8,000	34
SC	CHARLESTON AFB/INTL	CHS	CHARLESTON	CHARLESTON	30,242	3,341	32,937	77,822
SC	COLUMBIA METROPOLITAN	CAE	COLUMBIA	LEXINGTON	16,888	24,344	38,258	9,974
SC	FLORENCE REGIONAL	FLO	FLORENCE	FLORENCE	2	9,552	21,496	2,302
SC	GREENVILLE-SPARTANBURG	GSP	GREER	GREENVILLE	23,497	14,809	20,148	2,822
SC	HILTON HEAD	49J	HILTON HEAD ISLAND	BEAUFORT	8,215	7,072	36,500	250
SC	RUSSELL	SC17	HOLLY HILL	ORANGEBURG	8,215	0	0	0
SD	ABERDEEN REGIONAL	ABR	ABERDEEN	BROWN	12,240	15,150	13,326	876
SD	BROOKINGS MUNI	BKX	BROOKINGS	BROOKINGS	3,000	1,650	4,000	200
SD	CHAN GURNEY MUNI	YKN	YANKTON	YANKTON	2,000	2,500	6,000	0
SD	HURON REGIONAL	HON	HURON	BEADLE	1,235	3,390	19,408	560
SD	JOE FOSS FIELD	FSD	SIOUX FALLS	MINNEHAHA	11,097	15,393	39,284	10,197
SD	MITCHELL MUNI	MHE	MITCHELL	DAVISON	3,450	700	7,400	400
SD	PIERRE MUNI	PIR	PIERRE	HUGHES	1,460	965	17,000	105
SD	RAPID CITY REGIONAL	RAP	RAPID CITY	PENNINGTON	3,355	14,773	22,389	6,215
SD	WATERTOWN MUNI	ATY	WATERTOWN	CODINGTON	20,850	5,400	6,000	350
TN	LOVELL FIELD	CHA	CHATTANOOGA	HAMILTON	7,389	17,784	52,368	6,107
TN	MC GHEE TYSON	TYS	KNOXVILLE	BLOUNT	20,633	26,386	57,669	13,021
TN	MC KELLAR-SIPES REGIONAL	MKL	JACKSON	MADISON	1,806	2,190	31,306	1,887
TN	MEMPHIS INTL	MEM	MEMPHIS	SHELBY	177,563	100,128	61,153	6,470
TN	NASHVILLE INTERNATIONAL	BNA	NASHVILLE	DAVIDSON	111,862	117,750	60,948	4,998
TN	TRI-CITY REGIONAL	TRI	BRISTOL/JOHNSON/KINGSPORT	SULLIVAN	7,301	16,273	35,961	989
TX	ABILENE REGIONAL	ABI	ABILENE	TAYLOR	225	19,290	30,972	27,595
TX	AMARILLO INTL	AMA	AMARILLO	POTTER	10,541	10,322	19,571	37,469

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Air Carrier	Air Taxi	General Aviation	Military
TX	BROWNSVILLE/SOUTH PADRE ISLAND INT'L	BRO	BROWNSVILLE	CAMERON	3,535	2,044	38,795	3,309
TX	BROWNWOOD MUNI	BWD	BROWNWOOD	BROWN	750	0	2,800	240
TX	CORPUS CHRISTI INTL	CRP	CORPUS CHRISTI	NUECES	16,954	15,519	35,823	48,481
TX	COX FLD	PRX	PARIS	LAMAR	1,064	0	3,500	360
TX	DALLAS LOVE FIELD	DAL	DALLAS	DALLAS	93,501	31,901	90,434	1,495
TX	DALLAS/FORT WORTH INTERNATIONAL	DFW	DALLAS-FORT WORTH	TARRANT	611,487	205,509	13,392	747
TX	EASTERWOOD FIELD	CLL	COLLEGE STATION	BRAZOS	24	13,305	26,342	9,134
TX	EL PASO INTL	ELP	EL PASO	EL PASO	61,487	8,418	59,624	5,440
TX	ELLINGTON FIELD	EFD	HOUSTON	HARRIS	45,375	1,872	16,820	37,279
TX	FORT WORTH ALLIANCE	AFW	FORT WORTH	TARRANT	1,057	103	30,670	1,502
TX	FORT WORTH MEACHAM	FTW	FORT WORTH	TARRANT	332	937	115,629	894
TX	GREGG COUNTY	GGG	LONGVIEW	GREGG	70	10,063	30,504	3,612
TX	HOUSTON INTERCONTINENTAL	IAH	HOUSTON	HARRIS	243,248	65,208	42,734	1,195
TX	JEFFERSON COUNTY	BPT	BEAUMONT/PORT ARTHUR	JEFFERSON	44	19,192	15,868	648
TX	KILLEEN MUNI	ILE	KILLEEN	BELL	11,680	0	6,400	3,640
TX	LAREDO INTL	LRD	LAREDO	WEBB	2,831	16,394	27,042	10,068
TX	LUBBOCK INTL	LBB	LUBBOCK	LUBBOCK	20,670	16,216	31,744	21,778
TX	MATHIS FIELD	SJT	SAN ANGELO	TOM GREEN	23	11,703	27,727	16,052
TX	MIDLAND INTERNATIONAL	MAF	MIDLAND	MIDLAND	17,061	10,137	21,210	30,596
TX	MILLER INTL	MFE	MC ALLEN	HIDALGO	7,028	8,704	34,225	1,657
TX	RIO GRANDE VALLEY INTL	HRL	HARLINGEN	CAMERON	13,206	5,915	15,805	7,010
TX	ROBERT MUELLER MUNI	AUS	AUSTIN	TRAVIS	71,531	22,538	90,202	5,110
TX	SAN ANTONIO INTL	SAT	SAN ANTONIO	BEXAR	83,998	38,158	99,012	9,555
TX	SHEPPARD AFB/WICHITA FALLS MUNI	SPS	WICHITA FALLS	WICHITA	10,972	0	16,382	23,000
TX	VICTORIA REGIONAL	VCT	VICTORIA	VICTORIA	3,438	1,800	7,930	0
TX	WACO REGIONAL	ACT	WACO	MC LENNAN	521	10,608	23,236	6,135
TX	WILLIAM P HOBBY	HOU	HOUSTON	HARRIS	116,982	6,092	112,351	145
UT	CANYONLANDS FIELD	CNY	MOAB	GRAND	2,000	3,200	6,250	0
UT	CEDAR CITY MUNI	CDC	CEDAR CITY	IRON	3,770	4,380	15,500	50
UT	OGDEN-HINCKLEY	OGD	OGDEN	WEBER	248	281	37,388	1,409
UT	SALT LAKE CITY INTL	SLC	SALT LAKE CITY	SALT LAKE	179,584	72,998	85,868	4,438
UT	ST GEORGE MUNI	SGU	ST GEORGE	WASHINGTON	8,030	1,274	14,000	50
UT	VERNAL	VEL	VERNAL	UINTAH	1,248	1,460	8,000	0
VA	ACCOMACK COUNTY	MFV	MELFA	ACCOMACK	48	2,500	1,200	100
VA	CHARLOTTESVILLE-ALBEMARLE	CHO	CHARLOTTESVILLE	ALBEMARLE	13	20,351	23,308	3,059
VA	CHESTERFIELD COUNTY	W98	RICHMOND	CHESTERFIELD	47	235	24,000	700
VA	DANVILLE REGIONAL	DAN	DANVILLE	PITTSYLVANIA	2,000	150	15,000	200
VA	INGALLS FIELD	HSP	HOT SPRINGS	BATH	1,080	0	6,100	250
VA	LYNCHBURG REGIONAL/PRESTON GLENN FIELD	LYH	LYNCHBURG	CAMPBELL	14	15,302	24,654	1,330
VA	NEWPORT NEWS/WILLIAMSBURG INTERNATIONAL	PHF	NEWPORT NEWS	NEWPORT NEWS	2,780	17,124	55,049	47,200
VA	NORFOLK INTL	ORF	NORFOLK	NORFOLK	51,135	22,586	60,951	11,289
VA	RICHMOND INTL (BYRD FIELD)	RIC	RICHMOND	HENRICO	38,985	31,677	53,932	20,576
VA	ROANOKE REGIONAL/WOODRUM FIELD	ROA	ROANOKE	ROANOKE	8,437	31,819	31,051	1,628
VA	SHENANDOAH VALLEY REGIONAL	SHD	STAUNTON/WAYNESB/HARRISON	AUGUSTA	2,309	901	0	122
VT	BURLINGTON INTL	BTV	BURLINGTON	CHITTENDEN	7,909	39,505	28,553	11,087
WA	ANACORTES	74S	ANACORTES	SKAGIT	7,300	3,800	20,000	404
WA	BELLINGHAM INTL	BLI	BELLINGHAM	WHATCOM	813	19,398	39,052	1,472
WA	BOEING FIELD/KING COUNTY INTL	BFI	SEATTLE	KING	5,452	35,564	230,877	3,273
WA	GRANT COUNTY	MWH	MOSES LAKE	GRANT	6,806	4,900	21,970	11,018
WA	OAK HARBOR AIR PARK	76S	OAK HARBOR	ISLAND	3,775	228	10,924	0
WA	PANGBORN MEMORIAL	EAT	WENATCHEE	DOUGLAS	10,000	6,000	36,000	500
WA	PULLMAN/MOSCOW REGIONAL	PUW	PULLMAN/MOSCOW,ID	WHITMAN	14,004	100	25,100	24
WA	SEATTLE-TACOMA INTL	SEA	SEATTLE	KING	208,259	128,606	7,767	249
WA	SEQUIM VALLEY	WN41	SEQUIM	CLALLAM	1,080	0	5,500	0
WA	SKAGIT REGIONAL/BAY VIEW	75S	BURLINGTON/MOUNT VERNON	SKAGIT	180	4,000	26,780	100
WA	SNOHOMISH COUNTY (PAINE FLD)	PAE	EVERETT	SNOHOMISH	2,733	1,421	86,822	5,892
WA	SPOKANE INTL	GEG	SPOKANE	SPOKANE	32,867	46,325	25,705	4,057
WA	TRI-CITIES	PSC	PASCO	FRANKLIN	2,645	21,807	28,088	2,597
WA	WALLA WALLA REGIONAL	ALW	WALLA WALLA	WALLA WALLA	6,491	6,324	20,571	508
WA	WILLIAM R FAIRCHILD INTL	CLM	PORT ANGELES	CLALLAM	12,712	100	29,700	750
WA	YAKIMA AIR TERMINAL	YKM	YAKIMA	YAKIMA	672	19,273	28,314	6,667
WI	AUSTIN STRAUBEL INTERNATIONAL	GRB	GREEN BAY	BROWN	9,612	13,351	33,481	2,066
WI	CENTRAL WISCONSIN	CWA	MOSINEE	MARATHON	6,824	9,431	11,642	163
WI	CHIPPEWA VALLEY REGIONAL	EAU	EAU CLAIRE	CHIPPEWA	11,019	3,796	28,507	402
WI	DANE COUNTY REGIONAL-TRUAX FIELD	MSN	MADISON	DANE	17,417	13,855	54,707	9,757
WI	DOOR COUNTY CHERRYLAND	SUE	STURGEON BAY	DOOR	2,500	2,400	18,750	300
WI	EAGLE RIVER UNION	EGV	EAGLE RIVER	VILAS	200	1,500	8,000	50
WI	GENERAL MITCHELL INTERNATIONAL	MKE	MILWAUKEE	MILWAUKEE	80,093	64,579	49,012	5,416
WI	KENOSHA REGIONAL	ENW	KENOSHA	KENOSHA	300	9,900	42,000	2,000
WI	LA CROSSE MUNI	LSE	LA CROSSE	LA CROSSE	2,380	12,707	35,919	3,642
WI	LAKELAND/NOBLE F. LEE MEMORIAL FIELD	ARV	MINOCQUA/WOODRUFF	VILAS	1,100	2,200	15,000	10
WI	MANITOWOC COUNTY	MTW	MANITOWOC	MANITOWOC	3,328	1,460	9,070	0
WI	OUTAGAMIE COUNTY	ATW	APPLETON	OUTAGAMIE	8,037	13,236	32,000	156
WI	RHINELANDER-ONEIDA COUNTY	RHI	RHINELANDER	ONEIDA	5,602	300	14,200	98
WI	RICHLAND	93C	RICHLAND CENTER	RICHLAND	4	100	4,000	100
WI	ROCK COUNTY	JVL	JANESVILLE	ROCK	422	4,344	48,658	1,420
WI	WITTMAN REGIONAL	OSH	OSHKOSH	WINNEBAGO	1,229	276	40,258	2,084
WV	BENEDUM	CKB	CLARKSBURG	HARRISON	2	7,122	21,214	13,273
WV	ELKINS-RANDOLPH CO-JENNINGS RANDOLPH FLD	EKN	ELKINS	RANDOLPH	2,200	0	4,000	350
WV	GREENBRIER VALLEY	LWB	LEWISBURG	GREENBRIER	95	2,215	12,609	635
WV	MERCER COUNTY	BLF	BLUEFIELD	MERCER	2,584	500	9,100	100
WV	MORGANTOWN MUNI-WALTER L. BILL HART FLD	MGW	MORGANTOWN	MONONGALIA	11,056	10,748	23,208	6,034
WV	RALEIGH COUNTY MEMORIAL	BKW	BECKLEY	RALEIGH	4,015	3,500	4,000	900
WV	TRI-STATE/MILTON J.FERGUSON FIELD	HTS	HUNTINGTON	WAYNE	2,705	11,176	16,550	1,229
WV	WOOD COUNTY AIRPORT GILL ROBB WILSON FLD	PKB	PARKERSBURG	WOOD	2	7,078	19,567	13,778

AIRPORT DATABASE

State	Airport Name	Airport ID	City	County	Operations: Air Carrier	Air Taxi	General Aviation	Military
WV	YEAGER	CRW	CHARLESTON	KANAWHA	6,935	23,264	34,977	7,414
WY	CHEYENNE	CYS	CHEYENNE	LARAMIE	181	13,621	18,128	13,154
WY	GILLETTE-CAMPBELL COUNTY	GCC	GILLETTE	CAMPBELL	2,945	8,057	11,050	150
WY	JACKSON HOLE	JAC	JACKSON	TETON	5,188	2,609	14,208	50
WY	LARAMIE REGIONAL	LAR	LARAMIE	ALBANY	3,651	1,000	7,500	300
WY	NATRONA COUNTY INTL	CPR	CASPER	NATRONA	1,792	16,211	18,686	926
WY	RIVERTON REGIONAL	RIW	RIVERTON	FREMONT	4,361	67	5,600	56
WY	ROCK SPRINGS-SWEETWATER COUNTY	RKS	ROCK SPRINGS	SWEETWATER	1,494	939	8,736	224
WY	SHERIDAN COUNTY	SHR	SHERIDAN	SHERIDAN	3,416	1,810	10,770	350
WY	WORLAND MUNI	WRL	WORLAND	WASHAKIE	1,460	1,297	2,300	10
WY	YELLOWSTONE REGIONAL	COD	CODY	PARK	2,920	3,250	14,500	20

APPENDIX 2

U.S. COMMERCIAL SERVICE AIRPORT DATABASE

* **Ozone Nonattainment Status**
* **Carbon Monoxide Nonattainment Status**
* **Ozone Transport Region**

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
AL	ANNISTON METROPOLITAN	ANB	ANNISTON			
AL	BIRMINGHAM	BHM	BIRMINGHAM	Marginal		
AL	DANNELLY FIELD	MGM	MONTGOMERY			
AL	GADSDEN MUNI	GAD	GADSDEN			
AL	HUNTSVILLE INTL-CARL T JONES FIELD	HSV	HUNTSVILLE			
AL	MOBILE REGIONAL	MOB	MOBILE			
AL	MUSCLE SHOALS REGIONAL	MSL	MUSCLE SHOALS			
AL	TALLADEGA MUNI	ASN	TALLADEGA			
AL	TUSCALOOSA MUNI	TCL	TUSCALOOSA			
AR	ADAMS FIELD	LIT	LITTLE ROCK			
AR	BAXTER COUNTY REGIONAL	BPK	MOUNTAIN HOME			
AR	BOONE COUNTY	HRO	HARRISON			
AR	DRAKE FIELD	FYV	FAYETTEVILLE			
AR	FORT SMITH REGIONAL	FSM	FORT SMITH			
AR	HARRELL FIELD	CDH	CAMDEN			
AR	JONESBORO MUNI	JBR	JONESBORO			
AR	MEMORIAL FIELD	HOT	HOT SPRINGS			
AR	SOUTH ARKANSAS REGIONAL AT GOODWIN FIELD	ELD	EL DORADO			
AR	SPRINGDALE MUNI	ASG	SPRINGDALE			
AR	TEXARKANA REGIONAL-WEBB FIELD	TXK	TEXARKANA			
AZ	ERNEST A. LOVE FIELD	PRC	PRESCOTT			
AZ	FLAGSTAFF PULLIAM	FLG	FLAGSTAFF			
AZ	GRAND CANYON NATIONAL PARK	GCN	GRAND CANYON			
AZ	KINGMAN	IGM	KINGMAN			
AZ	LAUGHLIN / BULLHEAD CITY	P06	BULLHEAD CITY			
AZ	NOGALES INTL	OLS	NOGALES			
AZ	PAGE MUNI	PGA	PAGE			
AZ	PHOENIX SKY HARBOR INTL	PHX	PHOENIX	Moderate	Moderate <= 12.7ppm (P)	
AZ	PHOENIX-GOODYEAR MUNICIPAL	GYR	GOODYEAR	Moderate	Moderate <= 12.7ppm (P)	
AZ	SEDONA	SEZ	SEDONA			
AZ	TUCSON INTL	TUS	TUCSON		Not Classified (P)	
AZ	WHITERIVER	E24	WHITERIVER			
AZ	YUMA MCAS/YUMA INTL	YUM	YUMA			
CA	ARCATA	ACV	ARCATA/EUREKA			
CA	BERMUDA DUNES	UDD	PALM SPRINGS	Extreme (P2)	Serious (P)	
CA	BISHOP	BIH	BISHOP			
CA	BUCHANAN FIELD	CCR	CONCORD	Moderate	Moderate <= 12.7ppm (P)	
CA	BURBANK-GLENDALE-PASADENA	BUR	BURBANK	Extreme (P2)	Serious (P)	
CA	FRESNO AIR TERMINAL	FAT	FRESNO	Serious	Moderate > 12.7ppm (P)	
CA	IMPERIAL COUNTY	IPL	IMPERIAL	Transitional		
CA	INYOKERN	IYK	INYOKERN	Serious	Not Classified (P)	
CA	JACK MC NAMARA FIELD	CEC	CRESCENT CITY			
CA	JOHN WAYNE AIRPORT-ORANGE COUNTY	SNA	SANTA ANA	Extreme	Serious	
CA	LAKE TAHOE	TVL	SOUTH LAKE TAHOE	Serious (P)	Moderate <= 12.7ppm (P)	
CA	LONG BEACH /DAUGHERTY FIELD/	LGB	LONG BEACH	Extreme (P2)	Serious (P)	
CA	LOS ANGELES INTL	LAX	LOS ANGELES	Extreme (P2)	Serious (P)	
CA	MAMMOTH - JUNE LAKES	MMH	MAMMOTH LAKES			
CA	MC CLELLAN-PALOMAR	CRQ	CARLSBAD	Serious	Moderate <= 12.7ppm (P)	
CA	MEADOWS FIELD	BFL	BAKERSFIELD	Serious	Not Classified (P)	
CA	MERCED MUNICIPAL/MACREADY FIELD	MCE	MERCED	Serious		
CA	METROPOLITAN OAKLAND INTL	OAK	OAKLAND	Moderate	Moderate <= 12.7ppm (P)	
CA	MONTEREY PENINSULA	MRY	MONTEREY	Moderate		
CA	ONTARIO INTL	ONT	ONTARIO	Extreme (P2)	Serious (P)	
CA	PALM SPRINGS REGIONAL	PSP	PALM SPRINGS	Extreme (P2)	Serious (P)	
CA	PALMDALE PRODN FLT/TEST INSTLN AF PLANT 4	PMD	PALMDALE	Extreme (P2)	Serious (P)	
CA	REDDING MUNI	RDD	REDDING			
CA	SACRAMENTO METROPOLITAN	SMF	SACRAMENTO	Serious	Moderate <= 12.7ppm (P)	
CA	SAN DIEGO INTL-LINDBERGH FLD	SAN	SAN DIEGO	Serious	Moderate <= 12.7ppm (P)	
CA	SAN FRANCISCO INTL	SFO	SAN FRANCISCO	Moderate	Moderate <= 12.7ppm (P)	
CA	SAN JOSE INTERNATIONAL	SJC	SAN JOSE	Moderate	Moderate <= 12.7ppm (P)	
CA	SAN LUIS OBISPO COUNTY-MC CHESNEY FIELD	SBP	SAN LUIS OBISPO			
CA	SANTA BARBARA MUNI	SBA	SANTA BARBARA	Moderate		
CA	SANTA MARIA PUBLIC	SMX	SANTA MARIA	Moderate		
CA	SONOMA COUNTY	STS	SANTA ROSA	Moderate (P)	Moderate <= 12.7ppm (P)	
CA	STOCKTON METROPOLITAN	SCK	STOCKTON	Serious	Moderate <= 12.7ppm (P)	
CA	VAN NUYS	VNY	VAN NUYS	Extreme (P2)	Serious (P)	
CA	VISALIA MUNI	VIS	VISALIA	Serious		
CO	ASPEN-PITKIN CO/SARDY FIELD	ASE	ASPEN			
CO	CITY OF COLORADO SPRINGS MUNI	COS	COLORADO SPRINGS		Moderate <=12.7ppm (P)	
CO	CORTEZ-MONTEZUMA COUNTY	CEZ	CORTEZ			
CO	DURANGO-LA PLATA COUNTY	DRO	DURANGO			
CO	EAGLE COUNTY REGIONAL	EGE	EAGLE			
CO	FORT COLLINS-LOVELAND MUNI	FNL	FORT COLLINS/LOVELAND		Moderate <=12.7ppm (P)	
CO	GARFIELD COUNTY REGIONAL	RIL	RIFLE			
CO	GUNNISON COUNTY	GUC	GUNNISON			
CO	LAMAR MUNI	LAA	LAMAR			
CO	MONTROSE REGIONAL	MTJ	MONTROSE			
CO	PUEBLO MEMORIAL	PUB	PUEBLO			
CO	SAN LUIS VALLEY REGIONAL/BERGMAN FIELD	ALS	ALAMOSA			

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
CO	STAPLETON INTL	DEN	DENVER	Transitional	Moderate >12.7ppm	
CO	TELLURIDE REGIONAL	TEX	TELLURIDE			
CO	WALKER FIELD	GJT	GRAND JUNCTION			
CO	YAMPA VALLEY	HDN	HAYDEN			
CT	BRADLEY INTL	BDL	WINDSOR LOCKS	Serious	Moderate <=12.7ppm	X
CT	GROTON-NEW LONDON	GON	GROTON/NEW LONDON/	Serious		X
CT	IGOR I SIKORSKY MEMORIAL	BDR	BRIDGEPORT		Moderate >12.7ppm	X
CT	TWEED-NEW HAVEN	HVN	NEW HAVEN	Serious	Not Classified	X
DC	WASHINGTON DULLES INTERNATIONAL	IAD	WASHINGTON	Serious		X
DC	WASHINGTON NATIONAL	DCA	WASHINGTON	Serious		X
DE	NEW CASTLE COUNTY	ILG	WILMINGTON	Severe-15		X
FL	CENTRAL FLORIDA REGIONAL	SFB	ORLANDO			
FL	DADE-COLLIER TRAINING AND TRANSITION	TNT	MIAMI	Moderate		
FL	DAYTONA BEACH REGIONAL	DAB	DAYTONA BEACH			
FL	FORT LAUDERDALE/HOLLYWOOD INTL	FLL	FORT LAUDERDALE	Moderate		
FL	GAINESVILLE REGIONAL	GNV	GAINESVILLE			
FL	JACKSONVILLE INTL	JAX	JACKSONVILLE			
FL	KEY WEST INTL	EYW	KEY WEST			
FL	MARATHON	MTH	MARATHON			
FL	MELBOURNE REGIONAL	MLB	MELBOURNE			
FL	MIAMI INTL	MIA	MIAMI	Moderate		
FL	NASA SHUTTLE LANDING FACILITY	X68	TITUSVILLE			
FL	ORLANDO INTL	MCO	ORLANDO			
FL	PALM BEACH INTL	PBI	WEST PALM BEACH	Moderate		
FL	PANAMA CITY-BAY COUNTY	PFN	PANAMA CITY			
FL	PENSACOLA REGIONAL	PNS	PENSACOLA			
FL	SARASOTA-BRADENTON	SRQ	SARASOTA/BRADENTON/			
FL	SOUTHWEST FLORIDA REGIONAL	RSW	FORT MYERS			
FL	ST PETERSBURG/CLEARWATER INTL	PIE	ST PETERSBURG/CLEARWATE	Marginal		
FL	TALLAHASSEE REGIONAL	TLH	TALLAHASSEE			
FL	TAMPA INTL	TPA	TAMPA	Marginal		
FL	VERO BEACH MUNI	VRB	VERO BEACH			
GA	ATHENS/BEN EPPS	AHN	ATHENS			
GA	BUSH FIELD	AGS	AUGUSTA			
GA	COLUMBUS METROPOLITAN	CSG	COLUMBUS			
GA	GLYNCO JETPORT	BQK	BRUNSWICK			
GA	MIDDLE GEORGIA REGIONAL	MCN	MACON			
GA	SAVANNAH INTERNATIONAL	SAV	SAVANNAH			
GA	SOUTHWEST GEORGIA REGIONAL	ABY	ALBANY			
GA	THE WILLIAM B HARTSFIELD ATLANTA INTL	ATL	ATLANTA	Serious		
GA	VALDOSTA REGIONAL	VLD	VALDOSTA			
IA	BURLINGTON MUNI	BRL	BURLINGTON			
IA	CEDAR RAPIDS MUNI	CID	CEDAR RAPIDS			
IA	DES MOINES INTL	DSM	DES MOINES			
IA	DUBUQUE REGIONAL	DBQ	DUBUQUE			
IA	FORT DODGE REGIONAL	FOD	FORT DODGE			
IA	MASON CITY MUNI	MCW	MASON CITY			
IA	OTTUMWA INDUSTRIAL	OTM	OTTUMWA			
IA	SIOUX GATEWAY	SUX	SIOUX CITY			
IA	WATERLOO MUNI	ALO	WATERLOO			
ID	BOISE AIR TERMINAL /GOWEN FLD/	BOI	BOISE		Not Classified (P)	
ID	COEUR D'ALENE AIR TERM	COE	COEUR D'ALENE			
ID	FANNING FIELD	IDA	IDAHO FALLS			
ID	FRIEDMAN MEMORIAL	SUN	HAILEY			
ID	LEWISTON-NEZ PERCE COUNTY	LWS	LEWISTON			
ID	POCATELLO REGIONAL	PIH	POCATELLO			
ID	TWIN FALLS-SUN VALLEY REGIONAL JOSLIN FLI	TWF	TWIN FALLS			
IL	BLOOMINGTON/NORMAL	BMI	BLOOMINGTON/NORMAL			
IL	CAPITAL	SPI	SPRINGFIELD			
IL	CHICAGO MIDWAY	MDW	CHICAGO	Severe-17		
IL	CHICAGO O'HARE INTL	ORD	CHICAGO	Severe-17		
IL	COLES COUNTY MEMORIAL	MTO	MATTOON/CHARLESTON			
IL	DECATUR	DEC	DECATUR			
IL	GREATER PEORIA REGIONAL	PIA	PEORIA			
IL	GREATER ROCKFORD	RFD	ROCKFORD			
IL	LOGAN COUNTY	3LC	LINCOLN			
IL	MOUNT VERNON	MVN	MOUNT VERNON			
IL	QUAD-CITY	MLI	MOLINE			
IL	QUINCY MUNI BALDWIN FIELD	UIN	QUINCY			
IL	UNIVERSITY OF ILLINOIS-WILLARD	CMI	CHAMPAIGN/URBANA/			
IL	WILLIAMSON COUNTY REGIONAL	MWA	MARION			
IN	ANDERSON MUNI	AID	ANDERSON			
IN	DELAWARE COUNTY-JOHNSON FIELD	MIE	MUNCIE			
IN	EVANSVILLE REGIONAL	EVV	EVANSVILLE	Marginal		
IN	FORT WAYNE INTERNATIONAL	FWA	FORT WAYNE			
IN	GARY REGIONAL	GYY	GARY	Severe-17		
IN	HULMAN REGIONAL	HUF	TERRE HAUTE			
IN	INDIANAPOLIS INTL	IND	INDIANAPOLIS		Not Classified (P)	
IN	KOKOMO MUNI	OKK	KOKOMO			

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
IN	MICHIANA REGIONAL	SBN	SOUTH BEND			
IN	PURDUE UNIVERSITY	LAF	LAFAYETTE			
KS	DODGE CITY REGIONAL	DDC	DODGE CITY			
KS	EMPORIA MUNI	EMP	EMPORIA			
KS	FORBES FIELD	FOE	TOPEKA			
KS	GARDEN CITY REGIONAL	GCK	GARDEN CITY			
KS	GREAT BEND MUNI	GBD	GREAT BEND			
KS	HAYS MUNI	HYS	HAYS			
KS	LIBERAL MUNI	LBL	LIBERAL			
KS	MANHATTAN MUNI	MHK	MANHATTAN			
KS	RENNER FLD /GOODLAND MUNI/	GLD	GOODLAND			
KS	SALINA MUNI	SLN	SALINA			
KS	WICHITA MID-CONTINENT	ICT	WICHITA			
KY	BARKLEY REGIONAL	PAH	PADUCAH			
KY	BLUE GRASS	LEX	LEXINGTON	Marginal		
KY	CINCINNATI/NORTHERN KENTUCKY INTERNATION	CVG	COVINGTON/CINCINNATI, O	Moderate		
KY	STANDIFORD FIELD	SDF	LOUISVILLE	Moderate		
LA	BATON ROUGE METROPOLITAN, RYAN FIELD	BTR	BATON ROUGE	Serious		
LA	LAFAYETTE REGIONAL	LFT	LAFAYETTE	Transitional		
LA	LAKE CHARLES REGIONAL	LCH	LAKE CHARLES			
LA	MONROE REGIONAL	MLU	MONROE			
LA	NEW ORLEANS INTL/MOISANT FLD/	MSY	NEW ORLEANS	Transitional		
LA	POLK AAF	POE	FORT POLK			
LA	SHREVEPORT REGIONAL	SHV	SHREVEPORT			
MA	BARNES MUNI	BAF	WESTFIELD	Serious		X
MA	BARNSTABLE MUNI-BOARDMAN/POLANDO FIELD	HYA	HYANNIS	Serious		X
MA	GENERAL EDWARD LAWRENCE LOGAN INTL	BOS	BOSTON	Serious	Moderate <=12.7ppm	X
MA	MARTHAS VINEYARD	MVY	VINEYARD HAVEN	Serious		X
MA	NANTUCKET MEMORIAL	ACK	NANTUCKET	Serious		X
MA	NEW BEDFORD MUNI	EWB	NEW BEDFORD	Serious		X
MA	PROVINCETOWN MUNI	PVC	PROVINCETOWN	Serious		X
MA	WORCESTER MUNI	ORH	WORCESTER	Serious	Not Classified	X
MD	BALTIMORE-WASHINGTON INTL	BWI	BALTIMORE	Severe-15	Moderate <=12.7ppm (P)	X
MD	CUMBERLAND	CBE	CUMBERLAND			X
MD	OCEAN CITY MUNI	N80	OCEAN CITY			X
MD	SALISBURY-WICOMICO COUNTY REGIONAL	SBY	SALISBURY			X
MD	WASHINGTON COUNTY REGIONAL	HGR	HAGERSTOWN			X
ME	AUBURN/LEWISTON MUNI	LEW	AUBURN/LEWISTON	Moderate		X
ME	AUGUSTA STATE	AUG	AUGUSTA	Moderate		X
ME	BANGOR INTL	BGR	BANGOR			X
ME	HANCOCK COUNTY-BAR HARBOR	BHB	BAR HARBOR	Marginal		X
ME	KNOX COUNTY REGIONAL	RKD	ROCKLAND	Moderate		X
ME	NORTHERN MAINE REGIONAL ARPT AT PRESQUE I	PQI	PRESQUE ISLE			X
ME	PORTLAND INTL JETPORT	PWM	PORTLAND	Moderate		X
MI	ALPENA COUNTY REGIONAL	APN	ALPENA			
MI	ANTRIM COUNTY	ACB	BELLAIRE			
MI	BISHOP INTERNATIONAL	FNT	FLINT	Transitional		
MI	CAPITAL CITY	LAN	LANSING	Transitional		
MI	CHERRY CAPITAL	TVC	TRAVERSE CITY			
MI	CHIPPEWA COUNTY INTL	CIU	SAULT STE MARIE			
MI	DELTA COUNTY	ESC	ESCANABA			
MI	DETROIT CITY	DET	DETROIT	Moderate	Not Classified (P)	
MI	DETROIT METROPOLITAN WAYNE COUNTY	DTW	DETROIT	Moderate	Not Classified (P)	
MI	FORD	IMT	IRON MOUNTAIN/KINGSFORD			
MI	GOGEBIC COUNTY	IWD	IRONWOOD			
MI	HOUGHTON COUNTY MEMORIAL	CMX	HANCOCK			
MI	KALAMAZOO/BATTLE CREEK INTERNATIONAL	AZO	KALAMAZOO	Incomplete		
MI	KENT COUNTY INTL	GRR	GRAND RAPIDS			
MI	MANISTEE CO.-BLACKER	MBL	MANISTEE			
MI	MARQUETTE COUNTY	MQT	MARQUETTE			
MI	MENOMINEE-MARINETTE TWIN COUNTY	MNM	MENOMINEE			
MI	OAKLAND-PONTIAC	PTK	PONTIAC		Not Classified (P)	
MI	PELLSTON REGIONAL AIRPORT OF EMMET COUNTY	PLN	PELLSTON			
MI	TRI CITY INTERNATIONAL	MBS	SAGINAW	Incomplete		
MI	WILLOW RUN	YIP	DETROIT	Moderate	Not Classified (P)	
MN	BEMIDJI-BELTRAMI COUNTY	BJI	BEMIDJI			
MN	BRAINERD-CROW WING CO REGIONAL	BRD	BRAINERD			
MN	CHISHOLM-HIBBING	HIB	HIBBING			
MN	DULUTH INTL	DLH	DULUTH			
MN	FAIRMONT MUNI	FRM	FAIRMONT			
MN	FALLS INTL	INL	INTERNATIONAL FALLS			
MN	GRAND RAPIDS/ITASCA CO-GORDON NEWSTROM F	GPZ	GRAND RAPIDS			
MN	MANKATO MUNI	MKT	MANKATO			
MN	MARSHALL MUNI-RYAN FIELD	MML	MARSHALL			
MN	MINNEAPOLIS-ST PAUL INTL/WOLD-CHAMBERLAI	MSP	MINNEAPOLIS		Moderate <= 12.7ppm	
MN	ROCHESTER MUNI	RST	ROCHESTER			
MN	THIEF RIVER FALLS REGIONAL	TVF	THIEF RIVER FALLS			
MN	WORTHINGTON MUNI	OTG	WORTHINGTON			
MO	COLUMBIA REGIONAL	COU	COLUMBIA			

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
MO	FORNEY AAF	TBN	FORT LEONARD WOOD			
MO	JOPLIN REGIONAL	JLN	JOPLIN			
MO	KANSAS CITY DOWNTOWN	MKC	KANSAS CITY			
MO	KANSAS CITY INTL	MCI	KANSAS CITY			
MO	KIRKSVILLE REGIONAL	IRK	KIRKSVILLE			
MO	LAMBERT-ST LOUIS INTL	STL	ST LOUIS	Moderate	Not Classified	
MO	SPIRIT OF ST LOUIS	SUS	ST LOUIS	Moderate	Not Classified (P)	
MO	SPRINGFIELD REGIONAL	SGF	SPRINGFIELD			
MS	COLUMBUS AFB	CBM	COLUMBUS			
MS	GOLDEN TRIANGLE REGIONAL	GTR	COLUMBUS/W POINT/STARKVILL			
MS	GREENVILLE MUNI	GLH	GREENVILLE			
MS	GULFPORT-BILOXI RGNL	GPT	GULFPORT			
MS	HATTIESBURG-LAUREL REGIONAL	PIB	HATTIESBURG/LAUREL			
MS	JACKSON INTERNATIONAL	JAN	JACKSON			
MS	KEY FIELD	MEI	MERIDIAN			
MS	TUPELO MUNICIPAL - C D LEMONS	TUP	TUPELO			
MS	UNIVERSITY-OXFORD	UOX	OXFORD			
MT	BERT MOONEY	BTM	BUTTE			
MT	BILLINGS LOGAN INTL	BIL	BILLINGS		Not Classified (P)	
MT	DAWSON COMMUNITY	GDV	GLENDIVE			
MT	FRANK WILEY FIELD	MLS	MILES CITY			
MT	GALLATIN FIELD	BZN	BOZEMAN			
MT	GLACIER PARK INTL	FCA	KALISPELL			
MT	GLASGOW INTL	GGW	GLASGOW			
MT	GREAT FALLS INTL	GTF	GREAT FALLS		Not Classified (P)	
MT	HAVRE CITY-COUNTY	HVR	HAVRE			
MT	HELENA REGIONAL	HLN	HELENA			
MT	L M CLAYTON	OLF	WOLF POINT			
MT	LEWISTOWN MUNI	LWT	LEWISTOWN			
MT	MISSOULA INTERNATIONAL	MSO	MISSOULA		Moderate <= 12.7ppm	
MT	SIDNEY-RICHLAND MUNI	SDY	SIDNEY			
MT	YELLOWSTONE	WYS	WEST YELLOWSTONE			
NC	ALBERT J ELLIS	OAJ	JACKSONVILLE			
NC	ASHEVILLE REGIONAL	AVL	ASHEVILLE			
NC	CHARLOTTE/DOUGLAS INTL	CLT	CHARLOTTE	Moderate	Not Classified	
NC	CRAVEN COUNTY REGIONAL	EWN	NEW BERN			
NC	FAYETTEVILLE REGIONAL/GRANNIS FIELD	FAY	FAYETTEVILLE			
NC	HICKORY REGIONAL	HKY	HICKORY			
NC	KINSTON REGIONAL JETPORT AT STALLINGS FL	ISO	KINSTON			
NC	MOORE COUNTY	SOP	SOUTHERN PINES			
NC	NEW HANOVER INTERNATIONAL	ILM	WILMINGTON			
NC	PIEDMONT TRIAD INTERNATIONAL	GSO	GREENSBORO			
NC	PITT-GREENVILLE	PGV	GREENVILLE			
NC	RALEIGH-DURHAM INTERNATIONAL	RDU	RALEIGH/DURHAM		Moderate <= 12.7ppm	
NC	SMITH REYNOLDS	INT	WINSTON SALEM			
ND	BISMARCK MUNI	BIS	BISMARCK			
ND	DEVILS LAKE MUNI	DVL	DEVILS LAKE			
ND	GRAND FORKS INTL	GFK	GRAND FORKS			
ND	HECTOR INTERNATIONAL	FAR	FARGO			
ND	JAMESTOWN MUNI	JMS	JAMESTOWN			
ND	MINOT INTL	MOT	MINOT			
ND	SLOULIN FLD INTL	ISN	WILLISTON			
NE	ALLIANCE MUNI	AIA	ALLIANCE			
NE	CENTRAL NEBRASKA REGIONAL	GRI	GRAND ISLAND			
NE	CHADRON MUNI	CDR	CHADRON			
NE	EPPLEY AIRFIELD	OMA	OMAHA			
NE	HASTINGS MUNI	HSI	HASTINGS			
NE	KARL STEFAN MEMORIAL	OFK	NORFOLK			
NE	KEARNEY MUNI	EAR	KEARNEY			
NE	LINCOLN MUNI	LNK	LINCOLN			
NE	MC COOK MUNI	MCK	MC COOK			
NE	NORTH PLATTE REGIONAL	LBF	NORTH PLATTE			
NE	SIDNEY MUNI	SNY	SIDNEY			
NE	WILLIAM B. HEILIG FIELD	BFF	SCOTTSBLUFF			
NH	DILLANT-HOPKINS	EEN	KEENE	Incomplete		X
NH	LACONIA MUNI	LCI	LACONIA	Incomplete		X
NH	LEBANON MUNI	LEB	LEBANON			X
NH	MANCHESTER	MHT	MANCHESTER	Marginal (P2)	Not Classified	X
NJ	ALLAIRE	BLM	BELMAR/FARMINGDALE	Severe-17	Not Classified (P)	X
NJ	ATLANTIC CITY INTERNATIONAL	ACY	ATLANTIC CITY	Moderate	Not Classified	X
NJ	LINCOLN PARK	N07	LINCOLN PARK	Severe-17		X
NJ	MERCER COUNTY	TTN	TRENTON	Severe-15	Not Classified	X
NJ	NEWARK INTL	EWR	NEWARK	Severe-17	Moderate > 12.7ppm	X
NM	ALAMOGORDO-WHITE SANDS REGIONAL	ALM	ALAMOGORDO			
NM	ALBUQUERQUE INTL	ABQ	ALBUQUERQUE		Moderate <= 12.7ppm	
NM	CAVERN CITY AIR TRML	CNM	CARLSBAD			
NM	CLOVIS MUNI	CVN	CLOVIS			
NM	DOUBLE EAGLE II	AEG	ALBUQUERQUE		Moderate <= 12.7ppm	
NM	GALLUP MUNICIPAL	GUP	GALLUP			

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
NM	GRANT COUNTY	SVC	SILVER CITY			
NM	LAS CRUCES INTERNATIONAL	LRU	LAS CRUCES			
NM	LEA COUNTY/HOBBS/	HOB	HOBBS			
NM	LOS ALAMOS	LAM	LOS ALAMOS			
NM	ROSWELL INDUSTRIAL AIR CENTER	ROW	ROSWELL			
NM	TAOS MUNI	SKX	TAOS			
NV	DESERT ROCK	DRA	MERCURY			
NV	ELKO MUNI-J.C. HARRIS FIELD	EKO	ELKO			
NV	ELY ARPT /YELLAND FLD/	ELY	ELY			
NV	MC CARRAN INTL	LAS	LAS VEGAS		Moderate > 12.7ppm (P)	
NV	RENO CANNON INTL	RNO	RENO	Marginal	Moderate <= 12.7ppm	
NV	TONOPAH	TPH	TONOPAH			
NY	ADIRONDACK	SLK	SARANAC LAKE			X
NY	ALBANY COUNTY	ALB	ALBANY	Marginal		X
NY	BINGHAMTON REGIONAL/EDWIN A LINK FIELD	BGM	BINGHAMTON			X
NY	BROOKHAVEN	HWV	SHIRLEY	Severe-17		X
NY	CHAUTAUQUA COUNTY/JAMESTOWN	JHW	JAMESTOWN			X
NY	CLINTON CO	PLB	PLATTSBURGH			X
NY	DUTCHESS COUNTY	POU	POUGHKEEPSIE	Moderate		X
NY	EAST HAMPTON	HTO	EAST HAMPTON	Severe-17		X
NY	ELMIRA/CORNING REGIONAL	ELM	ELMIRA			X
NY	GREATER BUFFALO INTL	BUF	BUFFALO	Marginal		X
NY	GREATER ROCHESTER INTERNATIONAL	ROC	ROCHESTER			X
NY	GREENVILLE-RAINBOW	NY25	GREENVILLE	Marginal		X
NY	JOHN F KENNEDY INTL	JFK	NEW YORK	Severe-17	Moderate > 12.7ppm	X
NY	LA GUARDIA	LGA	NEW YORK	Severe-17	Moderate > 12.7ppm	X
NY	LONG ISLAND MAC ARTHUR	ISP	ISLIP	Severe-17		X
NY	MASSENA INTL-RICHARDS FIELD	MSS	MASSENA			X
NY	MONTAUK	MTP	MONTAUK	Severe-17		X
NY	NIAGARA FALLS INTL	IAG	NIAGARA FALLS	Marginal		X
NY	OGDENSBURG INTL	OGS	OGDENSBURG			X
NY	ONEIDA COUNTY	UCA	UTICA			X
NY	STEWART INT'L	SWF	NEWBURGH	Moderate		X
NY	SULLIVAN COUNTY INTL	MSV	MONTICELLO			X
NY	SYRACUSE HANCOCK INTL	SYR	SYRACUSE			X
NY	TOMPKINS COUNTY	ITH	ITHACA			X
NY	WARREN COUNTY	GFL	GLENS FALLS			X
NY	WATERTOWN INTERNATIONAL	ART	WATERTOWN	Marginal		X
NY	WESTCHESTER COUNTY	HPN	WHITE PLAINS	Severe-17	Moderate > 12.7ppm	X
OH	AIRBORNE AIRPARK	ILN	WILMINGTON	Transitional		
OH	AKRON-CANTON REGIONAL	CAK	AKRON	Moderate		
OH	BURKE LAKEFRONT	BKL	CLEVELAND	Moderate		
OH	CARL R KELLER FIELD	PCW	PORT CLINTON			
OH	CLEVELAND-HOPKINS INTL	CLE	CLEVELAND	Moderate		
OH	JAMES M COX DAYTON INTL	DAY	DAYTON	Moderate		
OH	KELLEYS ISLAND LAND FLD	89D	KELLEYS ISLAND			
OH	MANSFIELD LAHM MUNI	MFD	MANSFIELD			
OH	PORT COLUMBUS INTL	CMH	COLUMBUS	Marginal		
OH	PUT IN BAY	OH30	PUT IN BAY			
OH	SPRINGFIELD-BECKLEY MUNI	SGH	SPRINGFIELD	Moderate		
OH	TOLEDO EXPRESS	TOL	TOLEDO	Moderate		
OH	YOUNGSTOWN MUNI	YNG	YOUNGSTOWN	Marginal		
OK	ENID WOODRING MUNI	WDG	ENID			
OK	LAWTON MUNI	LAW	LAWTON			
OK	PONCA CITY MUNI	PNC	PONCA CITY			
OK	STILLWATER MUNI	SWO	STILLWATER			
OK	TULSA INTL	TUL	TULSA			
OK	WILL ROGERS WORLD	OKC	OKLAHOMA CITY			
OR	KLAMATH FALLS INTERNATIONAL	LMT	KLAMATH FALLS		Moderate <= 12.7ppm (P)	
OR	MAHLON SWEET FIELD	EUG	EUGENE			
OR	MCNARY FLD	SLE	SALEM	Incomplete (P)	Not Classified	
OR	MEDFORD-JACKSON COUNTY	MFR	MEDFORD		Moderate <= 12.7ppm (P)	
OR	NORTH BEND MUNI	OTH	NORTH BEND			
OR	PENDLETON MUNI	PDT	PENDLETON			
OR	PORTLAND INTL	PDX	PORTLAND	Marginal (P)	Moderate <= 12.7ppm (P)	
OR	ROBERTS FIELD	RDM	REDMOND			
PA	ALLENTOWN-BETHLEHEM-EASTON	ABE	ALLENTOWN	Marginal		X
PA	ALTOONA-BLAIR COUNTY	AOO	ALTOONA	Marginal		X
PA	BRADFORD REGIONAL	BFD	BRADFORD			X
PA	CHESS-LAMBERTON	FKL	FRANKLIN			X
PA	DU BOIS-JEFFERSON COUNTY	DUJ	DU BOIS			X
PA	ERIE INTL	ERI	ERIE	Marginal		X
PA	GREATER PITTSBURGH INTL	PIT	PITTSBURGH	Moderate	Not Classified (P)	X
PA	HARRISBURG INTERNATIONAL	MDT	HARRISBURG	Marginal		X
PA	JOHNSTOWN-CAMBRIA COUNTY	JST	JOHNSTOWN	Marginal		X
PA	LANCASTER	LNS	LANCASTER	Marginal		X
PA	PHILADELPHIA INTL	PHL	PHILADELPHIA	Severe-15	Moderate <= 12.7ppm (F	X
PA	READING REGIONAL/CARL A SPAATZ FIELD	RDG	READING	Moderate		X
PA	UNIVERSITY PARK	UNV	STATE COLLEGE			X

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
PA	WESTMORELAND COUNTY	LBE	LATROBE	Moderate		X
PA	WILKES-BARRE/SCRANTON INTL	AVP	WILKES-BARRE/SCRANTON	Marginal		X
PA	WILLIAMSPORT-LYCOMING COUNTY	IPT	WILLIAMSPORT			X
PA	WINGS FIELD	N67	PHILADELPHIA	Severe-15		X
RI	BLOCK ISLAND STATE	BID	BLOCK ISLAND	Serious		X
RI	THEODORE FRANCIS GREEN STATE	PVD	PROVIDENCE	Serious		X
RI	WESTERLY STATE	WST	WESTERLY	Serious		X
SC	CHARLESTON AFB/INTL	CHS	CHARLESTON			
SC	COLUMBIA METROPOLITAN	CAE	COLUMBIA			
SC	FLORENCE REGIONAL	FLO	FLORENCE			
SC	GREENVILLE-SPARTANBURG	GSP	GREER			
SC	HILTON HEAD	49J	HILTON HEAD ISLAND			
SC	RUSSELL	SC17	HOLLY HILL			
SD	ABERDEEN REGIONAL	ABR	ABERDEEN			
SD	BROOKINGS MUNI	BKX	BROOKINGS			
SD	CHAN GURNEY MUNI	YKN	YANKTON			
SD	HURON REGIONAL	HON	HURON			
SD	JOE FOSS FIELD	FSD	SIOUX FALLS			
SD	MITCHELL MUNI	MHE	MITCHELL			
SD	PIERRE MUNI	PIR	PIERRE			
SD	RAPID CITY REGIONAL	RAP	RAPID CITY			
SD	WATERTOWN MUNI	ATY	WATERTOWN			
TN	LOVELL FIELD	CHA	CHATTANOOGA			
TN	MC GHEE TYSON	TYS	KNOXVILLE			
TN	MC KELLAR-SIPES REGIONAL	MKL	JACKSON			
TN	MEMPHIS INTL	MEM	MEMPHIS			
TN	NASHVILLE INTERNATIONAL	BNA	NASHVILLE	Moderate		
TN	TRI-CITY REGIONAL	TRI	BRISTOL/JOHNSON/KINGSPORT			
TX	ABILENE REGIONAL	ABI	ABILENE			
TX	AMARILLO INTL	AMA	AMARILLO			
TX	BROWNSVILLE/SOUTH PADRE ISLAND INT'L	BRO	BROWNSVILLE			
TX	BROWNWOOD MUNI	BWD	BROWNWOOD			
TX	CORPUS CHRISTI INTL	CRP	CORPUS CHRISTI			
TX	COX FLD	PRX	PARIS			
TX	DALLAS LOVE FIELD	DAL	DALLAS	Moderate		
TX	DALLAS/FORT WORTH INTERNATIONAL	DFW	DALLAS-FORT WORTH	Moderate		
TX	EASTERWOOD FIELD	CLL	COLLEGE STATION			
TX	EL PASO INTL	ELP	EL PASO	Serious	Moderate <= 12.7ppm (P)	
TX	ELLINGTON FIELD	EFD	HOUSTON	Severe-17		
TX	FORT WORTH ALLIANCE	AFW	FORT WORTH	Moderate		
TX	FORT WORTH MEACHAM	FTW	FORT WORTH	Moderate		
TX	GREGG COUNTY	GGG	LONGVIEW			
TX	HOUSTON INTERCONTINENTAL	IAH	HOUSTON	Severe-17		
TX	JEFFERSON COUNTY	BPT	BEAUMONT/PORT ARTHUR	Serious		
TX	KILLEEN MUNI	ILE	KILLEEN			
TX	LAREDO INTL	LRD	LAREDO			
TX	LUBBOCK INTL	LBB	LUBBOCK			
TX	MATHIS FIELD	SJT	SAN ANGELO			
TX	MIDLAND INTERNATIONAL	MAF	MIDLAND			
TX	MILLER INTL	MFE	MC ALLEN			
TX	RIO GRANDE VALLEY INTL	HRL	HARLINGEN			
TX	ROBERT MUELLER MUNI	AUS	AUSTIN			
TX	SAN ANTONIO INTL	SAT	SAN ANTONIO			
TX	SHEPPARD AFB/WICHITA FALLS MUNI	SPS	WICHITA FALLS			
TX	VICTORIA REGIONAL	VCT	VICTORIA	Incomplete		
TX	WACO REGIONAL	ACT	WACO			
TX	WILLIAM P HOBBY	HOU	HOUSTON	Severe-17		
UT	CANYONLANDS FIELD	CNY	MOAB			
UT	CEDAR CITY MUNI	CDC	CEDAR CITY			
UT	OGDEN-HINCKLEY	OGD	OGDEN		Moderate <= 12.7ppm	
UT	SALT LAKE CITY INTL	SLC	SALT LAKE CITY	Moderate	Not Classified	
UT	ST GEORGE MUNI	SGU	ST GEORGE			
UT	VERNAL	VEL	VERNAL			
VA	ACCOMACK COUNTY	MFV	MELFA			
VA	CHARLOTTESVILLE-ALBEMARLE	CHO	CHARLOTTESVILLE			
VA	CHESTERFIELD COUNTY	W98	RICHMOND	Moderate		
VA	DANVILLE REGIONAL	DAN	DANVILLE			
VA	INGALLS FIELD	HSP	HOT SPRINGS			
VA	LYNCHBURG REGIONAL/PRESTON GLENN FIELD	LYH	LYNCHBURG			
VA	NEWPORT NEWS/WILLIAMSBURG INTERNATIONAL	PHF	NEWPORT NEWS	Moderate		
VA	NORFOLK INTL	ORF	NORFOLK	Moderate		
VA	RICHMOND INTL (BYRD FIELD)	RIC	RICHMOND	Moderate		
VA	ROANOKE REGIONAL/WOODRUM FIELD	ROA	ROANOKE			
VA	SHENANDOAH VALLEY REGIONAL	SHD	STAUNTON/WAYNESB/HARRISONB			
VT	BURLINGTON INTL	BTV	BURLINGTON			X
WA	ANACORTES	74S	ANACORTES			
WA	BELLINGHAM INTL	BLI	BELLINGHAM			
WA	BOEING FIELD/KING COUNTY INTL	BFI	SEATTLE	Marginal	Moderate > 12.7ppm (P)	
WA	GRANT COUNTY	MWH	MOSES LAKE			

AIRPORT DATABASE

State	Airport Name	Airport ID	City	Current Ozone Nonattainment Status	Current CO Nonattainment Status	Ozone Transport Region
WA	OAK HARBOR AIR PARK	76S	OAK HARBOR			
WA	PANGBORN MEMORIAL	EAT	WENATCHEE			
WA	PULLMAN/MOSCOW REGIONAL	PUW	PULLMAN/MOSCOW,ID			
WA	SEATTLE-TACOMA INTL	SEA	SEATTLE	Marginal	Moderate > 12.7ppm (P)	
WA	SEQUIM VALLEY	WN41	SEQUIM			
WA	SKAGIT REGIONAL/BAY VIEW	75S	BURLINGTON/MOUNT VERNON			
WA	SNOHOMISH COUNTY (PAINE FLD)	PAE	EVERETT	Marginal	Moderate > 12.7ppm (P)	
WA	SPOKANE INTL	GEG	SPOKANE		Moderate > 12.7ppm (P)	
WA	TRI-CITIES	PSC	PASCO			
WA	WALLA WALLA REGIONAL	ALW	WALLA WALLA			
WA	WILLIAM R FAIRCHILD INTL	CLM	PORT ANGELES			
WA	YAKIMA AIR TERMINAL	YKM	YAKIMA		Not Classified (P)	
WI	AUSTIN STRAUBEL INTERNATIONAL	GRB	GREEN BAY			
WI	CENTRAL WISCONSIN	CWA	MOSINEE			
WI	CHIPPEWA VALLEY REGIONAL	EAU	EAU CLAIRE			
WI	DANE COUNTY REGIONAL-TRUAX FIELD	MSN	MADISON			
WI	DOOR COUNTY CHERRYLAND	SUE	STURGEON BAY	Rural Trans.		
WI	EAGLE RIVER UNION	EGV	EAGLE RIVER			
WI	GENERAL MITCHELL INTERNATIONAL	MKE	MILWAUKEE	Severe-17		
WI	KENOSHA REGIONAL	ENW	KENOSHA	Severe-17		
WI	LA CROSSE MUNI	LSE	LA CROSSE			
WI	LAKELAND/NOBLE F. LEE MEMORIAL FIELD	ARV	MINOCQUA/WOODRUFF			
WI	MANITOWOC COUNTY	MTW	MANITOWOC	Moderate		
WI	OUTAGAMIE COUNTY	ATW	APPLETON			
WI	RHINELANDER-ONEIDA COUNTY	RHI	RHINELANDER			
WI	RICHLAND	93C	RICHLAND CENTER			
WI	ROCK COUNTY	JVL	JANESVILLE			
WI	WITTMAN REGIONAL	OSH	OSHKOSH			
WV	BENEDUM	CKB	CLARKSBURG			
WV	ELKINS-RANDOLPH CO-JENNINGS RANDOLPH FLD	EKN	ELKINS			
WV	GREENBRIER VALLEY	LWB	LEWISBURG	Marginal		
WV	MERCER COUNTY	BLF	BLUEFIELD			
WV	MORGANTOWN MUNI-WALTER L. BILL HART FLD	MGW	MORGANTOWN			
WV	RALEIGH COUNTY MEMORIAL	BKW	BECKLEY			
WV	TRI-STATE/MILTON J.FERGUSON FIELD	HTS	HUNTINGTON			
WV	WOOD COUNTY AIRPORT GILL ROBB WILSON FLD	PKB	PARKERSBURG			
WV	YEAGER	CRW	CHARLESTON			
WY	CHEYENNE	CYS	CHEYENNE			
WY	GILLETTE-CAMPBELL COUNTY	GCC	GILLETTE			
WY	JACKSON HOLE	JAC	JACKSON			
WY	LARAMIE REGIONAL	LAR	LARAMIE			
WY	NATRONA COUNTY INTL	CPR	CASPER			
WY	RIVERTON REGIONAL	RIW	RIVERTON			
WY	ROCK SPRINGS-SWEETWATER COUNTY	RKS	ROCK SPRINGS			
WY	SHERIDAN COUNTY	SHR	SHERIDAN			
WY	WORLAND MUNI	WRL	WORLAND			
WY	YELLOWSTONE REGIONAL	COD	CODY			

APPENDIX 3

U.S. COMMERCIAL AIRCRAFT EXAMPLE FLEET RANKINGS

Emissions Per LTO
* HC
* CO
* NOx
* HC + NOx

Emissions Per Seat Per LTO
* HC
* CO
* NOx
* HC + NOx

Emissions Per Engine Per LTO
* HC
* CO
* NOx
* HC + NOx

Emissions Per Dp/Foo
* HC
* CO
* NOx
* HC + NOx

EXAMPLE FLEET (ranked by HC/LTO)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	150	150
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	98	108
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	128	137
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	146	146
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	108	122
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	218	280
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	350	400
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	187	194
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	150	150
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	186	200
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	262	440
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	128	137
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	146	146
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	184	210
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	187	194
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	412	412
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	102	122
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	204	254
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	187	194
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	335	335
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	189	259
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	97	103
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	95	110
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	97	103
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	262	262
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	136	160
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	314	314
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	135	146
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	226	226
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	184	210
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	184	210
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	204	254
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	102	122
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	98	108
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	107	107
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	102	122
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	122	122
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	102	122
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	267	267
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	204	254
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	184	210
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	136	160
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	136	160
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	136	160
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	298	298
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	410	410
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	63	68
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	410	431
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	258	298
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	275	296
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	189	259

EXAMPLE FLEET (ranked by CO/LTO)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	150	150
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	98	108
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	102	122
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	135	146
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	150	150
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	186	200
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	262	440
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	135	146
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	350	400
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	184	210
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	218	280
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	97	103
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	136	160
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	187	194
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	187	194
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	95	110
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	128	137
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	146	146
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	108	122
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	187	194
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	128	137
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	146	146
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	262	262
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	97	103
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	412	412
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	204	254
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	335	335
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	184	210
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	204	254
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	184	210
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	226	226
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	102	122
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	122	122
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	102	122
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	98	108
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	107	107
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	102	122
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	314	314
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	136	160
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	189	259
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	136	160
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	136	160
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	267	267
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	204	254
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	184	210
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	63	68
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	298	298
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	258	298
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	410	431
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	410	410
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	275	296
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	189	259

EXAMPLE FLEET (ranked by NOx/LTO)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	63	68
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	95	110
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	97	103
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	97	103
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	98	108
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	102	122
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	102	122
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	107	107
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	102	122
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	102	122
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	122	122
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	136	160
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	128	137
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	146	146
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	128	137
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	146	146
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	108	122
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	135	146
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	150	150
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	186	200
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	262	440
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	189	259
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	136	160
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	136	160
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	135	146
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	136	160
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	150	150
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	98	108
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	189	259
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	187	194
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	184	210
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	218	280
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	184	210
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	187	194
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	184	210
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	204	254
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	262	262
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	204	254
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	335	335
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	267	267
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	335	335
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	350	400
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	184	210
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	187	194
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	204	254
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	275	296
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	284	296
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	298	298
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	314	314
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	258	298
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	314	314
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	410	410
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	226	226
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	412	412
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	410	431

EXAMPLE FLEET (ranked by HC+NOx/LTO)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO CO	NOx	HC	HC+NOx	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	13.61	1	95	110
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	15.42	1	97	103
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	15.87	1	97	103
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	18.69	1	102	122
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	128	137
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	146	146
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	108	122
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	128	137
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	146	146
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	23.78	1	98	108
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	24.81	1	102	122
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	1	150	150
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	2	186	200
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	3	262	440
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	27.00	1	135	146
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	27.32	1	107	107
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	29.55	1	102	122
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	29.61	1	136	160
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	30.52	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	30.52	1	135	146
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	30.52	1	135	146
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	30.56	1	102	122
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	30.56	1	122	122
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	31.11	1	135	146
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	34.34	1	150	150
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	34.34	1	98	108
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	35.66	1	136	160
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	37.69	2	189	259
B-757-200	BOEING	PW2037	23.78	35.75	2.34	38.09	2	187	194
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	44.32	1	136	160
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	45.83	1	136	160
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	48.57	2	218	280
B-757-200	BOEING	PW2040	26.75	49.87	2.65	52.52	2	187	194
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	53.80	2	184	210
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	55.88	2	262	262
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	56.00	2	184	210
B-777-200	BOEING	PW4056	15.78	57.51	1.27	58.78	3	350	400
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	2	184	210
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	3	204	254
A-330	AIRBUS	PW4158	32.62	57.00	2.75	59.75	3	335	335
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	61.46	2	187	194
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	61.61	2	184	210
B-767-300	BOEING	PW4460	31.88	62.16	2.62	64.78	3	204	254
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	67.59	3	204	254
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	69.23	2	267	267
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	86.04	1	63	68
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	97.17	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	112.04	3	298	298
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296
B-747-400	BOEING	PW4056	31.55	115.02	2.54	117.56	3	412	412
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	118.17	3	226	226
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	149.38	3	410	410
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	176.89	3	258	298
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	207.04	3	410	431
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	226.28	3	275	296
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	244.00	2	189	259

EXAMPLE FLEET (ranked by HC/high # seats)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO CO	NOx	HC	HC+NOx	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS	HC / HIGH # SEATS
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	34.34	1	150	150	0.0021
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	34.34	1	98	108	0.0030
B-777-200	BOEING	PW4056	15.78	57.51	1.27	58.78	3	350	400	0.0032
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	3	262	440	0.0033
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	48.57	2	218	280	0.0043
B-747-400	BOEING	PW4056	31.55	115.02	2.54	117.56	3	412	412	0.0062
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	61.46	2	187	194	0.0070
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	2	186	200	0.0073
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	146	146	0.0081
A-330	AIRBUS	PW4158	32.62	57.00	2.75	59.75	3	335	335	0.0082
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	128	137	0.0086
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	1	150	150	0.0097
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	108	122	0.0097
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	61.61	2	184	210	0.0097
B-767-300	BOEING	PW4460	31.88	62.16	2.62	64.78	3	204	254	0.0103
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	37.69	2	189	259	0.0115
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	69.23	2	267	267	0.0012
B-757-200	BOEING	PW2037	23.78	35.75	2.34	38.09	2	187	194	0.0121
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	97.17	3	314	314	0.0125
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	146	146	0.0125
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	55.88	2	262	262	0.0133
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	128	137	0.0134
B-757-200	BOEING	PW2040	26.75	49.87	2.65	52.52	2	187	194	0.0137
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	18.69	1	102	122	0.0213
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	29.61	1	136	160	0.0224
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	118.17	3	226	226	0.0273
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	13.61	1	95	110	0.0282
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	30.52	1	135	146	0.0283
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	30.52	1	135	146	0.0283
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	30.52	1	135	146	0.0283
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	31.11	1	135	146	0.0287
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	3	204	254	0.0288
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	15.42	1	97	103	0.0292
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	15.87	1	97	103	0.0308
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	27.00	1	135	146	0.0316
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	56.00	2	184	210	0.0343
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	2	184	210	0.0349
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.0384
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.0384
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	67.59	3	204	254	0.0515
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.0658
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.0658
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	53.80	2	184	210	0.0715
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	24.81	1	102	122	0.0816
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	23.78	1	98	108	0.0945
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	30.56	1	102	122	0.0957
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	30.56	1	122	122	0.0957
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	35.66	1	136	160	0.0957
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	29.55	1	102	122	0.0980
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	149.38	3	410	410	0.0980
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	112.04	3	298	298	0.1012
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	27.32	1	107	107	0.1012
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	45.83	1	136	160	0.1094
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	44.32	1	136	160	0.1121
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.1301
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.1301
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	207.04	3	410	431	0.1853
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	176.89	3	258	298	0.2958
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	226.28	3	275	296	0.5426
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	244.00	2	189	259	0.8431
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	86.04	1	63	68	1.1126

EXAMPLE FLEET (ranked by CO/high # seats)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO CO	NOx	HC	HC+NOx	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS	CO / HIGH # SEATS
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	3	262	440	0.0342
B-777-200	BOEING	PW4056	15.78	57.51	1.27	58.78	3	350	400	0.0395
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	34.34	1	150	150	0.0492
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	48.57	2	218	280	0.0590
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	34.34	1	98	108	0.0683
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	2	186	200	0.0752
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	61.61	2	184	210	0.0759
B-747-400	BOEING	PW4056	31.55	115.02	2.54	117.56	3	412	412	0.0766
A-330	AIRBUS	PW4158	32.62	57.00	2.75	59.75	3	335	335	0.0974
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	31.11	1	135	146	0.0975
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	30.52	1	135	146	0.0977
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	30.52	1	135	146	0.0977
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	30.52	1	135	146	0.0977
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	1	150	150	0.1002
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	27.00	1	135	146	0.1050
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	18.69	1	102	122	0.1107
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	55.88	2	262	262	0.1156
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	61.46	2	187	194	0.1162
B-757-200	BOEING	PW2037	23.78	35.75	2.34	38.09	2	187	194	0.1226
B-767-300	BOEING	PW4460	31.88	62.16	2.62	64.78	3	204	254	0.1255
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	3	204	254	0.1284
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	29.61	1	136	160	0.1308
B-757-200	BOEING	PW2040	26.75	49.87	2.65	52.52	2	187	194	0.1379
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	118.17	3	226	226	0.1469
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	97.17	3	314	314	0.1523
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	2	184	210	0.1553
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	56.00	2	184	210	0.1555
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	146	146	0.1781
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.1793
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.1793
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	128	137	0.1898
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	15.42	1	97	103	0.1901
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	146	146	0.2019
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	37.69	2	189	259	0.2071
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	108	122	0.2131
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	128	137	0.2152
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	13.61	1	95	110	0.2241
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	69.23	2	267	267	0.2307
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	67.59	3	204	254	0.2425
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	30.56	1	102	122	0.2891
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	30.56	1	122	122	0.2891
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	24.81	1	102	122	0.2898
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	15.87	1	97	103	0.2963
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.2973
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.2973
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	53.80	2	184	210	0.3138
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	29.55	1	102	122	0.3306
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	45.83	1	136	160	0.3307
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	23.78	1	98	108	0.3326
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	35.66	1	136	160	0.3368
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.3463
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.3463
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	27.32	1	107	107	0.3702
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	44.32	1	136	160	0.3781
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	207.04	3	410	431	0.3890
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	149.38	3	410	410	0.4290
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	112.04	3	298	298	0.4427
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	176.89	3	258	298	0.4973
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	226.28	3	275	296	0.8388
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	244.00	2	189	259	1.0144
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	86.04	1	63	68	1.1035

EXAMPLE FLEET (ranked by NOx/high # seats)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO CO	NOx	HC	HC+NOx	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS	NOx / HIGH # SEATS
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	3	262	440	0.0540
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	13.61	1	95	110	0.0955
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	244.00	2	189	259	0.0990
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	2	186	200	0.1188
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	15.42	1	97	103	0.1205
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	24.81	1	102	122	0.1218
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	15.87	1	97	103	0.1233
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	23.78	1	98	108	0.1256
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	35.66	1	136	160	0.1272
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	18.69	1	102	122	0.1319
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	37.69	2	189	259	0.1340
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	146	146	0.1410
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	146	146	0.1418
B-777-200	BOEING	PW4056	15.78	57.51	1.27	58.78	3	350	400	0.1438
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	29.55	1	102	122	0.1442
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	128	137	0.1503
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	128	137	0.1512
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	86.04	1	63	68	0.1526
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	27.00	1	135	146	0.1533
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	27.32	1	107	107	0.1541
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	30.56	1	102	122	0.1548
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	30.56	1	122	122	0.1548
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	1	150	150	0.1583
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	29.61	1	136	160	0.1627
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.1630
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.1630
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	44.32	1	136	160	0.1649
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	48.57	2	218	280	0.1691
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	108	122	0.1698
A-330	AIRBUS	PW4158	32.62	57.00	2.75	59.75	3	335	335	0.1701
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	45.83	1	136	160	0.1771
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	30.52	1	135	146	0.1808
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	30.52	1	135	146	0.1808
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	30.52	1	135	146	0.1808
B-757-200	BOEING	PW2037	23.78	35.75	2.34	38.09	2	187	194	0.1843
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	31.11	1	135	146	0.1844
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	53.80	2	184	210	0.1847
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	55.88	2	262	262	0.2000
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	3	204	254	0.2062
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	69.23	2	267	267	0.2103
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	67.59	3	204	254	0.2146
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	226.28	3	275	296	0.2219
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	34.34	1	150	150	0.2268
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	56.00	2	184	210	0.2323
B-767-300	BOEING	PW4460	31.88	62.16	2.62	64.78	3	204	254	0.2447
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	2	184	210	0.2494
B-757-200	BOEING	PW2040	26.75	49.87	2.65	52.52	2	187	194	0.2571
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.2595
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.2595
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.2611
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.2611
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	149.38	3	410	410	0.2663
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	112.04	3	298	298	0.2748
B-747-400	BOEING	PW4056	31.55	115.02	2.54	117.56	3	412	412	0.2792
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	61.61	2	184	210	0.2837
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	207.04	3	410	431	0.2951
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	97.17	3	314	314	0.2969
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	176.89	3	258	298	0.2978
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	61.46	2	187	194	0.3098
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	34.34	1	98	108	0.3150
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	118.17	3	226	226	0.4956

EXAMPLE FLEET (ranked by HC+NOx/high # seats)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	EMISSIONS PER LTO CO	NOx	HC	HC+NOx	AIRCRAFT CLASS	LOW # SEATS	HIGH # SEATS	NOx+HC / HIGH # SEATS
A-340	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	3	262	440	0.0573
BAE 146-200	BAE	ALF 502R-5	24.65	10.51	3.10	13.61	1	95	110	0.1237
A-321	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	2	186	200	0.1260
DC8-70	MCDONNELL DOUG	CFM56-2B	53.65	34.70	2.99	37.69	2	189	259	0.1455
B-777-200	BOEING	PW4056	15.78	57.51	1.27	58.78	3	350	400	0.1470
F100-100	FOKKER	TAY MK620-15	19.58	12.41	3.01	15.42	1	97	103	0.1497
B-737-400	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	146	146	0.1499
B-737-200	BOEING	JT8D-15A	13.51	16.09	2.60	18.69	1	102	122	0.1532
B-737-400	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	146	146	0.1536
F100-100	FOKKER	TAY MK650	30.52	12.70	3.17	15.87	1	97	103	0.1541
B-737-300	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	128	137	0.1598
B-737-300	BOEING	CFM56-3C	29.48	20.59	1.83	22.42	1	128	137	0.1636
A-320-100	AIRBUS	CFM56-5A1	15.03	23.75	1.45	25.20	1	150	150	0.1680
A-310-300	AIRBUS	PW4152	16.52	47.36	1.21	48.57	2	218	280	0.1735
A-330	AIRBUS	PW4158	32.62	57.00	2.75	59.75	3	335	335	0.1784
B-737-500	BOEING	CFM56-3B	26.00	20.71	1.18	21.89	1	108	122	0.1794
DC9-80	MCDONNELL DOUG	JT8D-209	15.33	22.38	4.62	27.00	1	135	146	0.1849
B-727-200	BOEING	JT8D-17A	20.93	26.03	3.58	29.61	1	136	160	0.1851
B-757-200	BOEING	PW2037	23.78	35.75	2.34	38.09	2	187	194	0.1963
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.2013
A-330	AIRBUS	CF6-80C2A1	60.08	54.60	12.85	67.45	3	335	335	0.2013
B-737-200	BOEING	JT8D-9A	35.36	14.86	9.95	24.81	1	102	122	0.2034
DC9-80	MCDONNELL DOUG	JT8D-217C	14.26	26.39	4.13	30.52	1	135	146	0.2090
DC9-80	MCDONNELL DOUG	JT8D-217A	14.26	26.39	4.13	30.52	1	135	146	0.2090
DC9-80	MCDONNELL DOUG	JT8D-217	14.26	26.39	4.13	30.52	1	135	146	0.2090
DC9-80	MCDONNELL DOUG	JT8D-219	14.24	26.92	4.19	31.11	1	135	146	0.2131
A-300B	AIRBUS	CF6-50C2	30.29	52.40	3.48	55.88	2	262	262	0.2133
DC9-30	MCDONNELL DOUG	JT8D-7B	35.92	13.57	10.21	23.78	1	98	108	0.2202
B-727-200	BOEING	JT8D-7B	53.88	20.35	15.31	35.66	1	136	160	0.2229
A-320-200	AIRBUS	IAE V2500	7.38	34.02	0.32	34.34	1	150	150	0.2289
B-767-300	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	3	204	254	0.2350
B-737-200	BOEING	JT8D-15	40.33	17.59	11.96	29.55	1	102	122	0.2422
B-737-200	BOEING	JT8D-17	35.27	18.89	11.67	30.56	1	102	122	0.2505
DC9-50	MCDONNELL DOUG	JT8D-17	35.27	18.89	11.67	30.56	1	122	122	0.2505
B-767-300	BOEING	PW4460	31.88	62.16	2.62	64.78	3	204	254	0.2550
DC9-40	MCDONNELL DOUG	JT8D-11	39.61	16.49	10.83	27.32	1	107	107	0.2553
B-767-200	BOEING	CF6-80C2B2	65.89	38.78	15.02	53.80	2	184	210	0.2562
A-300-600	AIRBUS	CF6-80C2A5	61.60	56.15	13.08	69.23	2	267	267	0.2593
B-767-300	BOEING	CF6-80C2B6	61.60	54.51	13.08	67.59	3	204	254	0.2661
B-767-200	BOEING	CF6-80A	32.66	48.79	7.21	56.00	2	184	210	0.2667
B-757-200	BOEING	PW2040	26.75	49.87	2.65	52.52	2	187	194	0.2707
B-727-200	BOEING	JT8D-15	60.49	26.38	17.94	44.32	1	136	160	0.2770
B-767-200	BOEING	CF6-80A2	32.62	52.37	7.32	59.69	2	184	210	0.2842
B-747-400	BOEING	PW4056	31.55	115.02	2.54	117.56	3	412	412	0.2853
B-727-200	BOEING	JT8D-17	52.91	28.33	17.50	45.83	1	136	160	0.2864
B-767-200	BOEING	JT9D-7R4D	15.93	59.57	2.04	61.61	2	184	210	0.2934
MD11-11	MCDONNELL DOUG	PW4460	47.83	93.24	3.93	97.17	3	314	314	0.3095
B-757-200	BOEING	RB211-535E4	22.55	60.11	1.35	61.46	2	187	194	0.3168
DC-9-30	MCDONNELL-DOUG	IAE V2500	7.38	34.02	0.32	34.34	1	98	108	0.3180
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.3269
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	93.35	81.99	20.65	102.64	3	314	314	0.3269
B-747-200	BOEING	JT9D-7Q	175.89	109.18	40.20	149.38	3	410	410	0.3643
DC10-40	MCDONNELL DOUG	JT9D-59	131.92	81.89	30.15	112.04	3	298	298	0.3760
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.3895
DC10-10	MCDONNELL DOUG	CF6-6D	102.49	76.80	38.50	115.30	3	284	296	0.3895
B-747-100	BOEING	JT9D-7A (MOD V)	167.66	127.19	79.85	207.04	3	410	431	0.4804
L-1011-500	LOCKHEED	RB211-524B4	33.20	112.00	6.17	118.17	3	226	226	0.5229
DC10-30	MCDONNELL DOUG	CF6-50C2	148.19	88.75	88.14	176.89	3	258	298	0.5936
L-1011-50	LOCKHEED	RB211-22B	248.27	65.68	160.60	226.28	3	275	296	0.7645
DC8-60	MCDONNELL DOUG	JT3D-7	262.74	25.65	218.35	244.00	2	189	259	0.9421
F-28	FOKKER	SPEY MK555	75.04	10.38	75.66	86.04	1	63	68	1.2653

EXAMPLE FLEET (ranked by LTO HC/engine)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LTO EMISSIONS PER ENGINE CO	NOx	HC
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	8.26	23.68	0.61
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	7.89	28.76	0.64
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	7.89	28.76	0.64
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	11.28	30.06	0.68
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	7.52	11.88	0.73
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	7.52	11.88	0.73
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	7.52	11.88	0.73
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	13.41	8.68	0.75
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	6.16	2.63	0.78
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	7.97	29.79	1.02
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	11.89	17.88	1.17
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	6.98	8.68	1.19
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	6.76	8.05	1.30
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	15.94	31.08	1.31
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	15.94	31.08	1.31
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	13.38	24.94	1.33
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	16.31	28.50	1.38
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	9.79	6.21	1.51
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	15.26	6.35	1.59
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	15.15	26.20	1.74
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	11.07	37.33	2.06
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	7.12	13.46	2.10
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	7.67	11.19	2.31
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	16.33	24.40	3.61
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	16.31	26.19	3.66
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	16.31	26.19	3.66
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	17.68	7.43	4.98
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	17.96	6.78	5.10
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	17.96	6.79	5.11
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	19.81	8.25	5.42
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	17.64	9.44	5.83
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	20.16	8.79	5.98
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	20.17	8.80	5.98
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	30.80	27.26	6.54
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	30.80	28.08	6.54
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	32.95	19.39	7.51
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	43.97	27.30	10.05
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	43.97	27.30	10.05
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	41.92	31.80	19.96
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	49.40	29.58	29.38
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	37.52	5.19	37.83
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	82.76	21.89	53.53
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	65.69	6.41	54.59

EXAMPLE FLEET (ranked by LTO CO/engine)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LTO EMISSIONS PER ENGINE CO	NOx	HC
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	6.16	2.63	0.78
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	6.76	8.05	1.30
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	6.98	8.68	1.19
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	7.12	13.46	2.10
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	7.13	13.20	2.07
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	7.52	11.88	0.73
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	7.52	11.88	0.73
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	7.52	11.88	0.73
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	7.67	11.19	2.31
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	7.89	28.76	0.64
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	7.89	28.76	0.64
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	7.97	29.79	1.02
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	8.26	23.68	0.61
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	9.79	6.21	1.51
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	11.07	37.33	2.06
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	11.28	30.06	0.68
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	11.89	17.88	1.17
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	13.38	24.94	1.33
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	13.41	8.68	0.75
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	15.15	26.20	1.74
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	15.26	6.35	1.59
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	15.94	31.08	1.31
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	15.94	31.08	1.31
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	16.31	28.50	1.38
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	16.31	26.19	3.66
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	16.31	26.19	3.66
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	16.33	24.40	3.61
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	17.64	9.44	5.83
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	17.68	7.43	4.98
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	17.96	6.78	5.10
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	17.96	6.79	5.11
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	19.81	8.25	5.42
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	20.16	8.79	5.98
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	20.17	8.80	5.98
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	30.80	27.26	6.54
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	30.80	28.08	6.54
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	32.95	19.39	7.51
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	37.52	5.19	37.83
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	41.92	31.80	19.96
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	43.97	27.30	10.05
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	43.97	27.30	10.05
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	49.40	29.58	29.38
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	65.69	6.41	54.59
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	82.76	21.89	53.53

EXAMPLE FLEET (ranked by LTO NOx/engine)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	LTO EMISSIONS PER ENGINE CO	NOx	HC
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	6.16	2.63	0.78
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	37.52	5.19	37.83
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	9.79	6.21	1.51
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	15.26	6.35	1.59
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	65.69	6.41	54.59
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	17.96	6.78	5.10
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	17.96	6.79	5.11
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	17.68	7.43	4.98
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	6.76	8.05	1.30
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	19.81	8.25	5.42
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	13.41	8.68	0.75
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	6.98	8.68	1.19
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	20.16	8.79	5.98
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	20.17	8.80	5.98
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	17.64	9.44	5.83
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	7.67	11.19	2.31
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	7.52	11.88	0.73
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	7.52	11.88	0.73
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	7.52	11.88	0.73
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	7.13	13.20	2.07
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	7.12	13.46	2.10
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	11.89	17.88	1.17
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	32.95	19.39	7.51
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	82.76	21.89	53.53
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	8.26	23.68	0.61
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	16.33	24.40	3.61
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	13.38	24.94	1.33
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	16.31	26.19	3.66
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	16.31	26.19	3.66
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	15.15	26.20	1.74
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	30.80	27.26	6.54
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	43.97	27.30	10.05
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	43.97	27.30	10.05
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	30.80	28.08	6.54
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	16.31	28.50	1.38
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	7.89	28.76	0.64
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	7.89	28.76	0.64
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	49.40	29.58	29.38
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	7.97	29.79	1.02
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	11.28	30.06	0.68
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	15.94	31.08	1.31
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	15.94	31.08	1.31
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	41.92	31.80	19.96
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	11.07	37.33	2.06

EXAMPLE FLEET (ranked by LTO HC+NOx/engine)

AIRCRAFT	AIRCRAFT	ENGINE	#	EMISSIONS PER LTO			AIRCRAFT	LTO EMISSIONS PER ENGINE			
NAME	MANUFACTURER	NAME	ENGINES	CO	NOx	HC	CLASS	CO	NOx	HC	HC+NOx
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	6.16	2.63	0.78	3.40
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	9.79	6.21	1.51	7.71
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	15.26	6.35	1.59	7.94
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	6.76	8.05	1.30	9.35
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	13.41	8.68	0.75	9.42
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	6.98	8.68	1.19	9.87
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59	10.95
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59	10.95
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	13.00	10.36	0.59	10.95
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92	11.21
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	14.74	10.30	0.92	11.21
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	17.96	6.78	5.10	11.89
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	17.96	6.79	5.11	11.89
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	17.68	7.43	4.98	12.41
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	7.52	11.88	0.73	12.60
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	7.52	11.88	0.73	12.60
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	7.52	11.88	0.73	12.60
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	7.67	11.19	2.31	13.50
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	19.81	8.25	5.42	13.66
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	20.16	8.79	5.98	14.77
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	20.17	8.80	5.98	14.78
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	7.13	13.20	2.07	15.26
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	7.13	13.20	2.07	15.26
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	7.13	13.20	2.07	15.26
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	17.64	9.44	5.83	15.28
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84	15.28
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	17.64	9.45	5.84	15.28
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	7.12	13.46	2.10	15.56
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16	17.17
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	3.69	17.01	0.16	17.17
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	11.89	17.88	1.17	19.05
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	8.26	23.68	0.61	24.29
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	13.38	24.94	1.33	26.26
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	32.95	19.39	7.51	26.90
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	15.15	26.20	1.74	27.94
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	16.33	24.40	3.61	28.00
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	7.89	28.76	0.64	29.39
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	7.89	28.76	0.64	29.39
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	16.31	26.19	3.66	29.85
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	16.31	26.19	3.66	29.85
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	16.31	28.50	1.38	29.88
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	11.28	30.06	0.68	30.73
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	7.97	29.79	1.02	30.81
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	15.94	31.08	1.31	32.39
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	15.94	31.08	1.31	32.39
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43	33.73
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	30.04	27.30	6.43	33.73
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	30.80	27.26	6.54	33.80
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88	34.21
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	31.12	27.33	6.88	34.21
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	30.80	28.08	6.54	34.62
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	43.97	27.30	10.05	37.35
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	43.97	27.30	10.05	37.35
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83	38.43
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	34.16	25.60	12.83	38.43
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	11.07	37.33	2.06	39.39
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	37.52	5.19	37.83	43.02
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	41.92	31.80	19.96	51.76
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	49.40	29.58	29.38	58.96
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	65.69	6.41	54.59	61.00
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	82.76	21.89	53.53	75.43

EXAMPLE FLEET (ranked by HC Dp/Foo)

AIRCRAFT	AIRCRAFT	ENGINE	#	EMISSIONS PER LTO			AIRCRAFT	Dp/Foo (Average) (g/kN)			
NAME	MANUFACTURER	NAME	ENGINES	CO	NOx	HC	CLASS	CO	NOx	HC	HC+NOx
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	0.000	0.000	0.000	0.000
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	0.000	0.000	0.000	0.000
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	0.000	0.000	0.000	0.000
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	0.000	0.000	0.000	0.000
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	0.000	0.000	0.000	0.000
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	14.200	51.700	1.200	52.900
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	14.200	51.700	1.200	52.900
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	17.000	46.700	1.300	48.000
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	28.600	76.900	1.690	78.590
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	15.300	61.900	2.200	64.100
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	27.100	52.700	2.200	54.900
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	27.100	52.700	2.200	54.900
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	28.700	50.200	2.400	52.600
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	32.000	48.100	3.160	51.260
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	60.920	44.280	3.480	47.760
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	22.900	77.300	4.250	81.550
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	43.800	55.100	6.600	61.700
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	46.800	51.400	7.200	58.600
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	34.200	55.500	7.580	63.080
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	34.200	55.500	7.580	63.080
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	35.500	53.100	7.840	60.940
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	33.500	63.300	9.900	73.200
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	69.300	45.600	10.700	56.300
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	102.900	42.800	10.700	53.500
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	52.360	46.260	11.120	57.380
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	52.350	49.250	11.120	60.370
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	40.600	59.300	12.200	71.500
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	97.800	34.800	13.600	48.400
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	64.670	38.080	14.750	52.830
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	87.700	54.400	20.000	74.400
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	87.700	54.400	20.000	74.400
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	93.700	61.800	33.500	95.300
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	124.300	52.300	35.000	87.300
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	134.700	56.100	36.800	92.900
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	130.900	49.500	37.200	86.700
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	130.900	49.500	37.200	86.700
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	112.500	60.200	37.200	97.400
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	130.600	57.900	39.300	97.200
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	130.600	57.900	39.300	97.200
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	91.400	69.400	43.600	113.000
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	205.300	54.300	132.800	187.100
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	388.000	50.750	392.000	442.750

EXAMPLE FLEET (ranked by CO Dp/Foo)

AIRCRAFT NAME	AIRCRAFT MANUFACTURER	ENGINE NAME	# ENGINES	EMISSIONS PER LTO CO	NOx	HC	AIRCRAFT CLASS	Dp/Foo (Average) (g/kN) CO	NOx	HC	HC+NOx
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	0.000	0.000	0.000	0.000
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	0.000	0.000	0.000	0.000
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	0.000	0.000	0.000	0.000
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	0.000	0.000	0.000	0.000
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	0.000	0.000	0.000	0.000
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	14.200	51.700	1.200	52.900
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	14.200	51.700	1.200	52.900
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	15.300	61.900	2.200	64.100
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	17.000	46.700	1.300	48.000
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	22.900	77.300	4.250	81.550
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	27.100	52.700	2.200	54.900
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	27.100	52.700	2.200	54.900
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	28.600	76.900	1.690	78.590
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	28.700	50.200	2.400	52.600
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	32.000	48.100	3.160	51.260
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	33.500	63.300	9.900	73.200
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	34.200	55.500	7.580	63.080
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	34.200	55.500	7.580	63.080
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	35.500	53.100	7.840	60.940
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	40.600	59.300	12.200	71.500
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	43.800	55.100	6.600	61.700
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	46.800	51.400	7.200	58.600
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	52.350	49.250	11.120	60.370
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	52.360	46.260	11.120	57.380
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	60.920	44.280	3.480	47.760
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	64.670	38.080	14.750	52.830
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	69.300	45.600	10.700	56.300
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	87.700	54.400	20.000	74.400
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	87.700	54.400	20.000	74.400
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	91.400	69.400	43.600	113.000
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	93.700	61.800	33.500	95.300
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	97.800	34.800	13.600	48.400
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	102.900	42.800	10.700	53.500
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	112.500	60.200	37.200	97.400
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	124.300	52.300	35.000	87.300
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	130.600	57.900	39.300	97.200
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	130.600	57.900	39.300	97.200
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	130.900	49.500	37.200	86.700
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	130.900	49.500	37.200	86.700
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	134.700	56.100	36.800	92.900
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	205.300	54.300	132.800	187.100
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	388.000	50.750	392.000	442.750

EXAMPLE FLEET (ranked by NOx Dp/Foo)

AIRCRAFT	AIRCRAFT	ENGINE	#	EMISSIONS PER LTO			AIRCRAFT	Dp/Foo (Average) (g/kN)			
NAME	MANUFACTURER	NAME	ENGINES	CO	NOx	HC	CLASS	CO	NOx	HC	HC+NOx
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	0.000	0.000	0.000	0.000
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	0.000	0.000	0.000	0.000
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	0.000	0.000	0.000	0.000
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	0.000	0.000	0.000	0.000
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	0.000	0.000	0.000	0.000
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	97.800	34.800	13.600	48.400
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	64.670	38.080	14.750	52.830
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	102.900	42.800	10.700	53.500
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	60.920	44.280	3.480	47.760
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	69.300	45.600	10.700	56.300
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	52.360	46.260	11.120	57.380
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	17.000	46.700	1.300	48.000
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	32.000	48.100	3.160	51.260
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	52.350	49.250	11.120	60.370
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	130.900	49.500	37.200	86.700
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	130.900	49.500	37.200	86.700
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	28.700	50.200	2.400	52.600
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	388.000	50.750	392.000	442.750
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	46.800	51.400	7.200	58.600
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	14.200	51.700	1.200	52.900
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	14.200	51.700	1.200	52.900
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	124.300	52.300	35.000	87.300
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	27.100	52.700	2.200	54.900
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	27.100	52.700	2.200	54.900
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	35.500	53.100	7.840	60.940
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	205.300	54.300	132.800	187.100
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	87.700	54.400	20.000	74.400
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	87.700	54.400	20.000	74.400
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	43.800	55.100	6.600	61.700
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	34.200	55.500	7.580	63.080
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	34.200	55.500	7.580	63.080
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	134.700	56.100	36.800	92.900
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	130.600	57.900	39.300	97.200
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	130.600	57.900	39.300	97.200
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	40.600	59.300	12.200	71.500
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	112.500	60.200	37.200	97.400
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	93.700	61.800	33.500	95.300
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	15.300	61.900	2.200	64.100
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	33.500	63.300	9.900	73.200
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	91.400	69.400	43.600	113.000
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	28.600	76.900	1.690	78.590
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	22.900	77.300	4.250	81.550

EXAMPLE FLEET (ranked by HC+NOx Dp/Foo)

AIRCRAFT	AIRCRAFT	ENGINE	#	EMISSIONS PER LTO			AIRCRAFT	Dp/Foo (Average) (g/kN)			
NAME	MANUFACTURER	NAME	ENGINES	CO	NOx	HC	CLASS	CO	NOx	HC	HC+NOx
B-737-400	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
B-737-300	BOEING	CFM56-3C	2	29.48	20.59	1.83	1	0.000	0.000	0.000	0.000
A-340	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	3	0.000	0.000	0.000	0.000
A-321	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	2	0.000	0.000	0.000	0.000
A-320-100	AIRBUS	CFM56-5A1	2	15.03	23.75	1.45	1	0.000	0.000	0.000	0.000
A-320-200	AIRBUS	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
DC-9-30	MCDONNELL-DOUG	IAE V2500	2	7.38	34.02	0.32	1	0.000	0.000	0.000	0.000
B-757-200	BOEING	PW2040	2	26.75	49.87	2.65	2	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
MD11-11	MCDONNELL DOUG	CF6-80C2D1F	3	93.35	81.99	20.65	3	0.000	0.000	0.000	0.000
DC10-30	MCDONNELL DOUG	CF6-50C2	3	148.19	88.75	88.14	3	0.000	0.000	0.000	0.000
DC8-60	MCDONNELL DOUG	JT3D-7	4	262.74	25.65	218.35	2	0.000	0.000	0.000	0.000
DC8-70	MCDONNELL DOUG	CFM56-2B	4	53.65	34.70	2.99	2	60.920	44.280	3.480	47.760
A-310-300	AIRBUS	PW4152	2	16.52	47.36	1.21	2	17.000	46.700	1.300	48.000
BAE 146-200	BAE	ALF 502R-5	4	24.65	10.51	3.10	1	97.800	34.800	13.600	48.400
B-737-400	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-300	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-737-500	BOEING	CFM56-3B	2	26.00	20.71	1.18	1	59.170	48.210	2.960	51.170
B-757-200	BOEING	PW2037	2	23.78	35.75	2.34	2	32.000	48.100	3.160	51.260
A-330	AIRBUS	PW4158	2	32.62	57.00	2.75	3	28.700	50.200	2.400	52.600
B-767-200	BOEING	CF6-80C2B2	2	65.89	38.78	15.02	2	64.670	38.080	14.750	52.830
B-747-400	BOEING	PW4056	4	31.55	115.02	2.54	3	14.200	51.700	1.200	52.900
B-777-200	BOEING	PW4056	2	15.78	57.51	1.27	3	14.200	51.700	1.200	52.900
F100-100	FOKKER	TAY MK650	2	30.52	12.70	3.17	1	102.900	42.800	10.700	53.500
B-767-300	BOEING	PW4460	2	31.88	62.16	2.62	3	27.100	52.700	2.200	54.900
MD11-11	MCDONNELL DOUG	PW4460	3	47.83	93.24	3.93	3	27.100	52.700	2.200	54.900
F100-100	FOKKER	TAY MK620-15	2	19.58	12.41	3.01	1	69.300	45.600	10.700	56.300
B-767-300	BOEING	CF6-80C2B6	2	61.60	54.51	13.08	3	52.360	46.260	11.120	57.380
B-737-200	BOEING	JT8D-15A	2	13.51	16.09	2.60	1	46.800	51.400	7.200	58.600
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
A-330	AIRBUS	CF6-80C2A1	2	60.08	54.60	12.85	3	53.040	48.120	11.320	59.440
A-300-600	AIRBUS	CF6-80C2A5	2	61.60	56.15	13.08	2	52.350	49.250	11.120	60.370
B-767-200	BOEING	CF6-80A	2	32.66	48.79	7.21	2	35.500	53.100	7.840	60.940
B-727-200	BOEING	JT8D-17A	3	20.93	26.03	3.58	1	43.800	55.100	6.600	61.700
B-767-300	BOEING	CF6-80A2	2	32.62	52.37	7.32	3	34.200	55.500	7.580	63.080
B-767-200	BOEING	CF6-80A2	2	32.62	52.37	7.32	2	34.200	55.500	7.580	63.080
B-767-200	BOEING	JT9D-7R4D	2	15.93	59.57	2.04	2	15.300	61.900	2.200	64.100
DC9-80	MCDONNELL DOUG	JT8D-209	2	15.33	22.38	4.62	1	40.600	59.300	12.200	71.500
DC9-80	MCDONNELL DOUG	JT8D-219	2	14.24	26.92	4.19	1	33.500	63.300	9.900	73.200
B-747-200	BOEING	JT9D-7Q	4	175.89	109.18	40.20	3	87.700	54.400	20.000	74.400
DC10-40	MCDONNELL DOUG	JT9D-59	3	131.92	81.89	30.15	3	87.700	54.400	20.000	74.400
DC9-80	MCDONNELL DOUG	JT8D-217C	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217A	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
DC9-80	MCDONNELL DOUG	JT8D-217	2	14.26	26.39	4.13	1	34.800	64.600	10.100	74.700
B-757-200	BOEING	RB211-535E4	2	22.55	60.11	1.35	2	28.600	76.900	1.690	78.590
L-1011-500	LOCKHEED	RB211-524B4	3	33.20	112.00	6.17	3	22.900	77.300	4.250	81.550
B-727-200	BOEING	JT8D-7B	3	53.88	20.35	15.31	1	130.900	49.500	37.200	86.700
DC9-30	MCDONNELL DOUG	JT8D-7B	2	35.92	13.57	10.21	1	130.900	49.500	37.200	86.700
B-737-200	BOEING	JT8D-9A	2	35.36	14.86	9.95	1	124.300	52.300	35.000	87.300
DC9-40	MCDONNELL DOUG	JT8D-11	2	39.61	16.49	10.83	1	134.700	56.100	36.800	92.900
A-300B	AIRBUS	CF6-50C2	2	30.29	52.40	3.48	2	93.700	61.800	33.500	95.300
B-727-200	BOEING	JT8D-15	3	60.49	26.38	17.94	1	130.600	57.900	39.300	97.200
B-737-200	BOEING	JT8D-15	2	40.33	17.59	11.96	1	130.600	57.900	39.300	97.200
B-727-200	BOEING	JT8D-17	3	52.91	28.33	17.50	1	112.500	60.200	37.200	97.400
B-737-200	BOEING	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
DC9-50	MCDONNELL DOUG	JT8D-17	2	35.27	18.89	11.67	1	112.500	60.200	37.200	97.400
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
DC10-10	MCDONNELL DOUG	CF6-6D	3	102.49	76.80	38.50	3	88.700	66.400	33.300	99.700
B-747-100	BOEING	JT9D-7A (MOD V)	4	167.66	127.19	79.85	3	91.400	69.400	43.600	113.000
L-1011-50	LOCKHEED	RB211-22B	3	248.27	65.68	160.60	3	205.300	54.300	132.800	187.100
F-28	FOKKER	SPEY MK555	2	75.04	10.38	75.66	1	388.000	50.750	392.000	442.750