SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

General Aviation Airport Air Monitoring Study: Follow-up Monitoring Campaign at the Santa Monica Airport

FINAL REPORT

April 2011

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SUMMARY REPORT

BACKGROUND AND OBJECTIVES

Between April 2006 and March 2007, the South Coast Air Quality Management District (AQMD) conducted a field study at the Santa Monica Municipal Airport (SMO) to characterize the impact of aircraft emissions and airport activities on the surrounding communities (AQMD, 2010). Ambient concentrations of total suspended particulate lead (from the leaded fuel used in piston-driven aircraft) and ultrafine particles (UFP; very small particles emitted from aircraft exhaust and other combustion processes) on-site and near SMO were found to be significantly higher than the corresponding levels present further away from the airport. Sharp and rapid increases in the concentrations of UFP occurred when jet aircraft are idling, taking off, and sometimes landing.

Recently, SMO underwent a "Pavement Rehabilitation Project" to comply with current Federal Aviation Administration (FAA) guidelines and planned airport operations. This led to a full closure of SMO between 8:00 PM, 09/19/10 and 6:00 AM, 09/24/10 to accommodate work on the runway within a restricted work area inside the airport perimeter. This temporary suspension of all airport activities presented a unique opportunity to measure the ambient concentrations of combustion-related pollutants such as UFP, black carbon (BC) and volatile organic compounds (VOC) before, during, and after the runway repaving project. Thus, a supplemental monitoring campaign was conducted by AQMD between 09/09/10 and 10/05/10 to study the short-term impact of aircraft emissions on communities surrounding SMO, and to complement the findings of our previous study more focused on long-term exposure (AQMD, 2010).

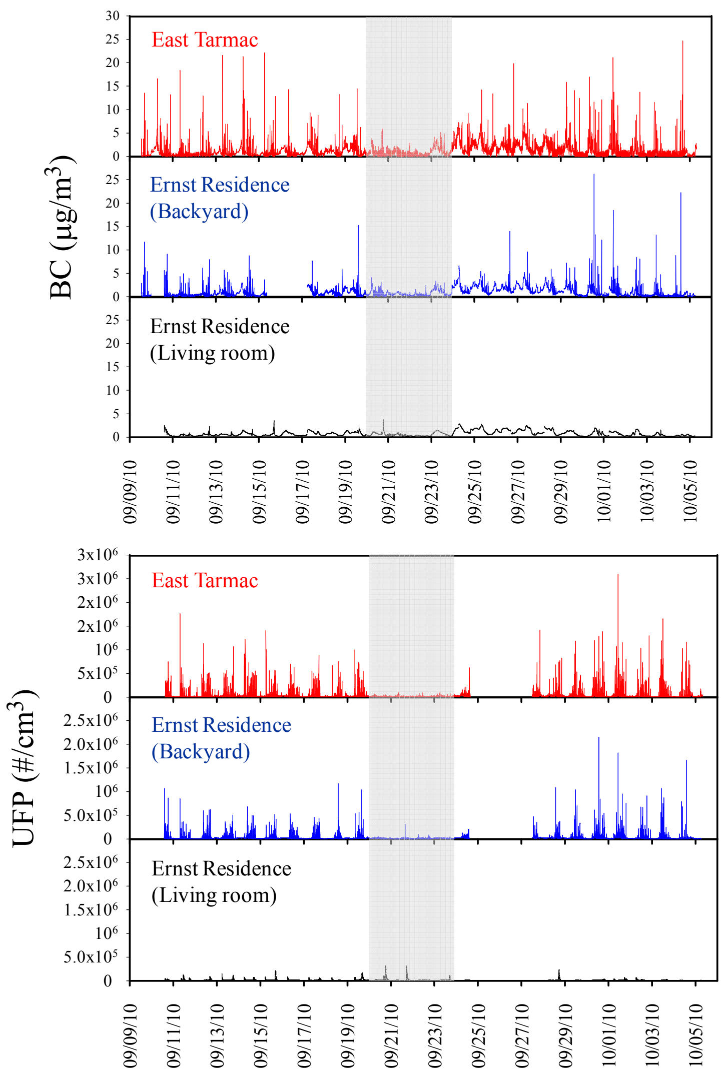
METHODS

Three monitoring stations were deployed at different distances and downwind of the airport's primary runway (# 21) on the north-east side of SMO. The East Tarmac site was about 35 m north of the end of the runway and in very close proximity to the blast-fence. The other two stations were located in the back yard of a private residence (Ernst Residence Backyard site) and in the living-room of the same home (Ernst Indoor site), at a lower elevation than the airport and approximately 100 m northeast of the end of the runway. Ultrafine particle number and BC concentration data were taken continuously at all three stations at one and five minute intervals, respectively, and complemented with measurements of ambient VOC levels. Time activity information for each departing jet and turbo-prop aircraft (i.e. registration number, model, type, weight, taxi start time, holding start time, and take-off time) were supplied by SMO and integrated in our data analysis.

RESULTS

Sharp peaks in UFP and BC caused by aircraft emissions right before and during take-off were present at both the East Tarmac and the Ernst Residence Backyard sites (Figure 1). The UFP and BC levels were typically higher near the Tarmac because of the close proximity to the aircraft point of departure. The concentrations of the same two pollutants inside Ms. Ernst's Residence were always substantially lower than those observed at the two outdoor sites, suggesting that the majority of combustion-related particles did not infiltrate indoors. Doors and windows at the Ernst Residence were kept closed for the majority of the study.

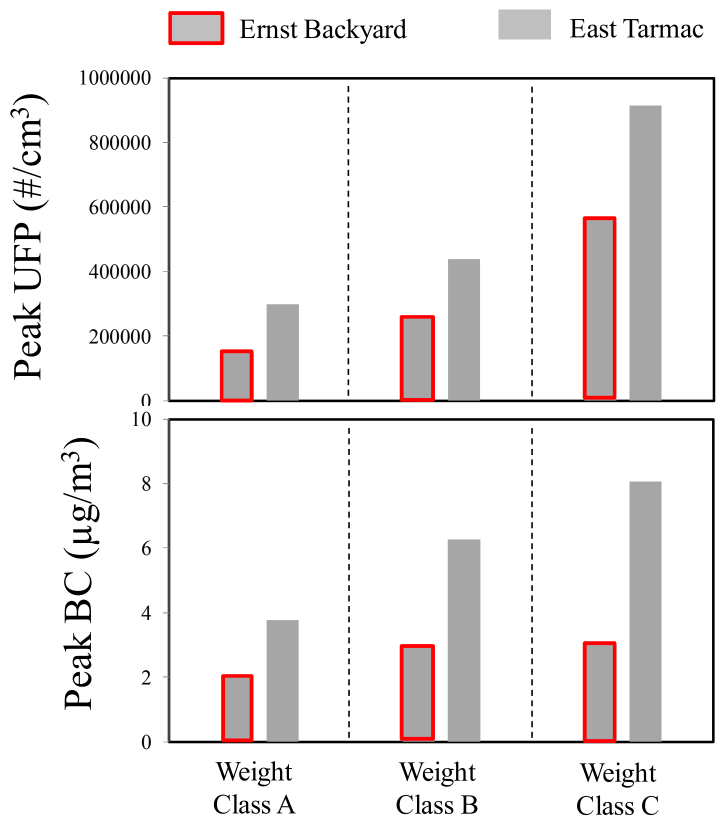
Figure 1 Ultrafine particle (UFP) and black carbon (BC) concentrations at the East Tarmac, Ernst Residence Backyard, and Ernst Residence Living room sites from 09/09/10 to 10/05/10. The shaded area corresponds to the time period when all airport activities were suspended because of the runway repaving project



The suspension of all airport activities from 09/19/10 to 09/24/10 resulted in a substantial decrease in measured UFP and BC levels at both outdoor stations. For example, the maximum UFP concentrations at the East Tarmac site before and after the repaving project were about 12 and 17 times more elevated than the highest UFP spike recorded when the airport was shut-down. Substantial reductions were also observed at the Ernst Residence Backyard site, where the maximum UFP levels measured at the Ernst Residence Backyard site before and after the runway maintenance work were approximately 4 and 7 times higher than the highest UFP peak observed when no airport activity was ongoing.

As expected, heavier aircraft (equipped with larger and more powerful engines) were found to emit the highest amounts of UFP and BC (Figure 2). In particular, the average peak UFP concentration measured for "large commuter" (>41,000 lb; weight class C), "medium commuter" (between 12,500 and 41,000 lb; weight class B) and "small equipment" (<12,500 lb; weight class A) aircraft at the East Tarmac site were about 72, 35 and 24 times higher than the average UFP level observed at the same monitoring site when SMO was shut-down. Similarly, the average peak UFP value measured for weight classes C, B and A at the Ernst Residence Backyard site were 50, 23 and 13 times higher than the average UFP concentration observed at the same monitoring station during the repaving project. A less substantial but still noticeable impact was observed for BC.

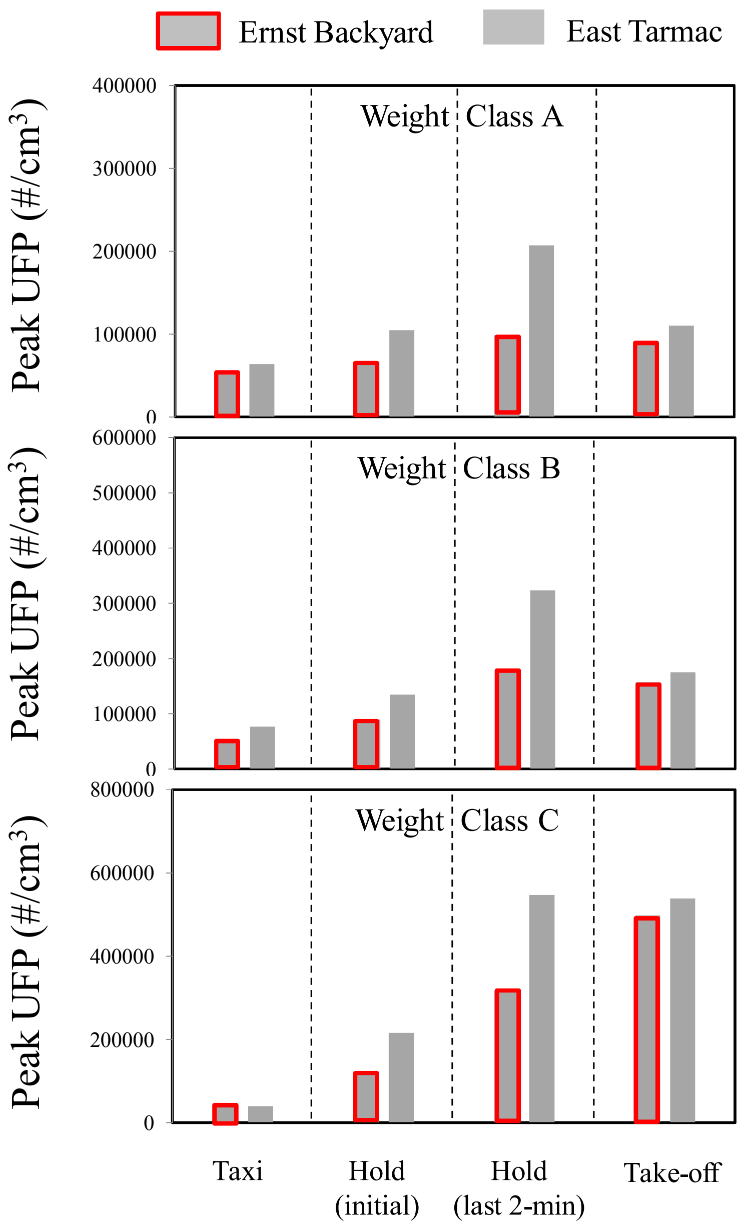
Figure 2 Bar chart showing the average peak UFP and BC concentrations for weight classes A, B, and C at the East Tarmac and Ernst Residence Backyard sites. Peak levels for each aircraft were only measured from the time the aircraft started taxing near the runway to the time of take-off



Weight Class A: < 12,500 lb
Weight Class B: 12,500 – 41,000 lb
Weight Class C: > 41000 lb

The highest UFP peaks at the East Tarmac and, to a lesser extent, at the Ernst Residence Backyard sites were typically observed within the last two minutes of the holding period and during take-off (Figure 3). An increase in UFP level right before take-off may be caused by aircraft movement from the holding area to the point of departure. During this turn, the engine thrust is increased and the combustion products are directly emitted toward the East Tarmac monitoring location. Pre-flight run-ups, a series of engine checks performed by pilots prior to take-off, may also be responsible for the observed UFP peaks. As reported on the Santa Monica Airport website, extended high power settings on run-up or departure can negatively impact air quality in the surrounding community (http://www.smgov.net/departments/airport/). These results are consistent with those obtained from our previous field study at SMO (AQMD, 2010) and during another measurement campaign conducted at the same airport by Hu et al. (2009). In all cases, when an aircraft was preparing for take-off (hence moving from the holding to the departing area) a loud noise was typically heard near the end of runway 21, followed by a smell of fuel vapor odors, and by elevated concentrations of UFP and BC.

Figure 3 Bar chart showing the average peak UFP concentration within each of the four time activity groups considered (i.e. taxi, hold "initial", hold "last 2-min", and take-off), and at both the East Tarmac and Ernst Residence Backyard sites. All data are grouped by weight classes



The VOC samples collected during the repaving project were characterized by elevated concentrations of acetylene, ethane, and ethylene. Higher levels of these non-toxic chemicals were probably associated with increased motor-vehicle traffic due to repaving activities. After the reopening of SMO, the concentrations of all measured VOC were similar to those observed in other parts of the South Coast Basin away from the immediate influence of any specific mobile sources. Unusually high levels of pentane (not an air toxic pollutant) were observed in one of the collected canister samples. It is possible that this solvent component was used during Phase III of the pavement rejuvenation project and/or stored along with other solvents and construction material in the parking area located about 15 m north of the East Tarmac station. One of the collected VOC samples contained a detectable amount of acrolein. While this is an air toxic that has been associated with jet exhaust, the level detected in this sample was not unusual for the South Coast Air Basin. However, because of recent technical issues regarding the accuracy of the current U.S. EPA-approved methods for acrolein measurements, this acrolein level remains unverified.

CONCLUSIONS AND RECOMMENDATIONS

The results obtained from this study and those from our previous measurement campaign in 2006-2007 (AQMD, 2010) seem to suggest that airport impacts on the atmospheric levels of UFP and BC are substantial on short time scales (e.g. 1 to 5-min), but become less significant when long-term averages (e.g. several days to few months) are considered. This is because sharp short-term peaks in concentrations of UFP and BC are emitted by jet aircraft right before and during take-off. Further health effect studies are needed to better characterize the short-term risk associated with exposure to these and other combustion-related emissions. Potential mitigation measures that might be effective in reducing risks associated with exposure to aircraft-related pollutants in communities surrounding SMO may include: increasing the width of the blast fence, reducing holding times for all jet aircraft, re-directing the exhaust from pre-flight run-up tests, and limiting traffic for “large commuter” (>41,000 lb) aircraft.

ACKNOWLEDGEMENTS

AQMD would like to thank Virginia Ernst and the Santa Monica Airport for providing accessibility and support throughout this study

REFERENCES

Hu, S., Fruin, S., Kozawa, K., Mara, S., Winer, A.M., and Paulson S.E. (2009), Aircraft Emission Impacts in a Neighborhood Adjacent to a General Aviation Airport in Southern California. Environmental Science & Technology, 43: 8039–8045

South Coast Air Quality Management District (2010), General Aviation Airport Air Monitoring Study

APPENDIX A: Technical Analysis

INTRODUCTION

Background (General Aviation Study Report)

Between April 2006 and March 2007 the South Coast Air Quality Management District (AQMD) conducted two intensive field campaigns at the Santa Monica Municipal Airport (SMO) as part of the U.S. Environmental Protection Agency (U.S. EPA) "Community-Scale Air Toxics Grant" (AQMD, 2010). The concentrations of several gaseous and particle pollutants (i.e. particulate matter, black carbon, organic carbon, lead and other trace elements, volatile organic compounds and carbonyls) and some of their physical and chemical characteristics (e.g. number of ultrafine particles) were measured using real-time and time-integrated instruments at multiple monitoring stations set-up inside and at different distances from the airport perimeter. The resulting data were analyzed to determine if the study area and the surrounding communities experienced ambient air toxic concentrations or gradients that could be attributed to aircraft emissions/airport activities and/or to other potential sources of air pollution such as roadways.

Overall, the most significant airport-related impacts on air quality were observed for total suspended particulate (TSP) lead (from the leaded fuel used in piston-driven aircraft) and for ultrafine particles (UFP; particles with an aerodynamic diameter less than 100 nm, emitted primarily from combustion sources). Study-average concentrations of these two pollutants near SMO were found to be significantly higher than the corresponding levels present in background air or elsewhere in the Basin, and the concentration gradients indicated the runway take-off area as the source. Near-continuous measurements obtained during this and other field campaigns have shown that sharp and rapid increases (e.g. 1-min) in the concentrations of UFPs occur when jet aircraft are idling, taking off, and sometimes landing. At SMO in the spring/summer of 2006, overall average UFP levels recorded near the blast-fence were over six times higher than those in background air. Our analysis of aircraft activity data at SMO confirmed that short-term peaks in UFP concentration at the downwind sites were associated with jet aircraft take-off operations. These short-lived spikes in UFP levels were up to 2,000 times higher than background levels, and often extended into residential areas.

The mass concentrations of elemental carbon (EC; closely related to black carbon or BC) at all Santa Monica stations were at or below the corresponding South Coast Basin averages. Comparisons among sampling sites did not show any discernable spatial gradient that could be attributed to aircraft operations. However, the concentration of this important pollutant was measured from the analysis of integrated (24-hr) filter samples, and short-term variations due to aircraft emissions and other airport activities are more likely to be observed when using near-continuous BC monitors.

Repaving Project

Recently, SMO underwent a "Pavement Rehabilitation Project" to comply with current Federal Aviation Administration (FAA) guidelines and planned airport operations. The project consisted of various paving improvements in and around the runway area, including: a) rubber removal from the surface of the runway, b) removal of existing striping and pavement marking from all airside areas (e.g. runway and taxiways), c) removal of a delaminating slurry seal application in one of the infield areas, d) pavement rejuvenation of the existing grooved asphalt runway and Taxiway B, and e) restriping and remarking of all airside areas including the runway and taxiways. The initial preparatory work for the repaving project (Phase I) was conducted over a period of five consecutive nights preceding the suspension of all operation activities, from 9/14/10 to 9/19/10. During this initial phase, the airport was closed at night, but daytime operations continued as normal. Following this initial phase, a full closure of the airport for five consecutive days was required from 9/19/10 at 8:00 pm to 9/24/10 days 6:00 am (Phase II) to accommodate work on the runway and within the restricted work area (150 feet on either side of the runway centerline). Following the reopening of SMO, construction outside the restricted work perimeter was then completed over a period of ten consecutive days, from 9/25/10 to 10/5/10 (Phase III). During this final phase, the airport was closed again at night, but resumed normal operations during the day. To comply with FAA specifications, the second application of runway and airside markings was installed over a period of three consecutive nights, approximately one or two weeks after completion of all previous work. Table 1 shows a summary of the runway closure schedule. All time information here and elsewhere within this document are in Pacific Standard Time (PST)

Table 1 Runway closure schedule during the "Pavement Rehabilitation Project" conducted at SMO

Phase I – Airport Closures
09/14/2010 8:00 pm – 09/15/2010 6:00 am
09/15/2010 8:00 pm – 09/16/2010 6:00 am
09/16/2010 8:00 pm – 09/17/2010 6:00 am
09/17/2010 8:00 pm – 09/18/2010 6:00 am
09/18/2010 8:00 pm – 09/19/2010 6:00 am

Phase II – Airport Closures
09/19/2010 8:00 pm – 09/24/2010 6:00 am

Phase III – Taxiway & Infield Area Closures
09/25/2010 – 10/5/2010 (airport will remain open)

Objectives of the Present Study

This temporary suspension of all airport activities presented a unique opportunity to measure concentrations of important air toxics such as UFP, BC, and volatile organic compounds (VOC) both with and without aircraft activity. For this reason, a follow-up study was conducted by AQMD between 09/09/10 and 10/05/10 in order to better characterize the impact of aircraft emissions and airport activities on communities surrounding SMO, complementing the findings of our previous study that was more focused on long-term exposure. Furthermore, this follow-up field work was designed to characterize the short-term impacts of specific aircraft activities on nearby communities, and our measurements were complemented by detailed aircraft information (e.g. type, model, and weight) and traffic activity data (i.e. taxi, hold and departure times) taken by SMO personnel throughout the entire duration of the study. The recorded traffic information includes departing jet and turbo-prop aircraft only. Piston engine aircraft activities were not tracked, but previous studies have shown these aircraft emit considerably less BC and UFP than jets.

METHODS

Three monitoring stations were set-up at different distances and downwind of runway 21, on the north-east side of SMO (Figure 1). Runway 21 is the airport's primary runway, with aircraft landing and departing to the west. Runway 3 (on the south-west side of SMO) is used only a few days out of the year when the Los Angeles Basin is experiencing Santa Ana wind conditions. The East Tarmac site was approximately 35 m north of the end of runway 21, on the north-east perimeter of the airport and in very close proximity to the blast-fence. The other two sites were located in the back yard of a private residence (Ernst Residence Backyard site; 12130 Sardis Ave., Los Angeles) and in the living-room of the same home (Ernst Indoor site), directly under the fixed wing arrival/departure route, at a lower elevation than the airport, and approximately 100 m northeast of the end of the runway.

All three stations were equipped with a Continuous Particle Counter (CPC; TSI Model 3785) for UFP number measurements and with a portable Aethalometer for monitoring BC (Magee Scientific Model AE42). Both instruments were set-up inside a portable water-proof enclosure (i.e. East Tarmac and Ernst Backyard sites) or on a table away from any potential indoor PM sources such as the kitchen (i.e. Ernst Indoor site). Unlike the CPCs employed during the previous field campaign (TSI Model 3781, characterized by a detectable particle range between 0 and ~500,000 $\#/cm^3$) the CPCs used for this study are able to measure UFP number concentrations up to 10,000,000 $\#/cm^3$, and are more suited for measuring aircraft emissions near taxi and take-off areas.

In addition to these three "core" sites, two mobile measurement stations (MMS) were also deployed, one at the East Tarmac site and one in front of the same private residence (Ernst Front yard) (Figure 1). The two MMS were equipped with a Baseline-Mocon series 9000 NMHC monitor (Mocon, Inc.) to measure the atmospheric concentration of methane and non-methane hydrocarbons (NMHC) continuously. This, in conjunction with a Xontech 912 Multi-Canister sampling system (Xontech, Inc.), allowed for triggering the instantaneous collection of Silonite-Lined Canister samples that were then analyzed at the AQMD lab for the presence of the VOC most commonly found in urban areas using a Gas Chromatography (GC) - Mass Spectrometry (MS) or Flame Ionization Detection (FID) method (TO-15). The collection time for these canister samples was five minutes.

All meteorological data (i.e. wind speed, wind direction, temperature and relative humidity) were supplied by SMO along with time activity information for each aircraft departing from the airport during the entire duration of the study. This included: aircraft registration number, aircraft model and type (i.e. jet or turbo-prop), taxi start time, holding start time, and take-off time.

Figure 1 Map of the Santa Monica Airport (SMO) sampling sites. The measurement devices were set-up inside portable enclosures (sites 1 and 2), in the living room of a private residence (site 3), and inside two Mobile Measurement Stations (MMS; sites 4 and 5)

Site # / Type	Location
1 (Enclosure)	East Tarmac
2 (Enclosure)	Ernst Residence (Backyard)
3 (Indoors)	Ernst Residence (Living-room)
4 (MMA #1)	East Tarmac
5 (MMA #2)	Ernst Residence (Front yard)

The sampling campaign was conducted between 09/09/10 to 10/05/10 and was divided into three phases to study changes in the ambient levels of the monitored air pollutants before, during and after the completion of the repaving project: from 09/09/10 to 09/20/10 (Phase 1, before repaving), from 09/20/10 to 09/24/10 (Phase 2, during repaving), and from 09/24/10 to 10/05/10 (Phase 3, after repaving).

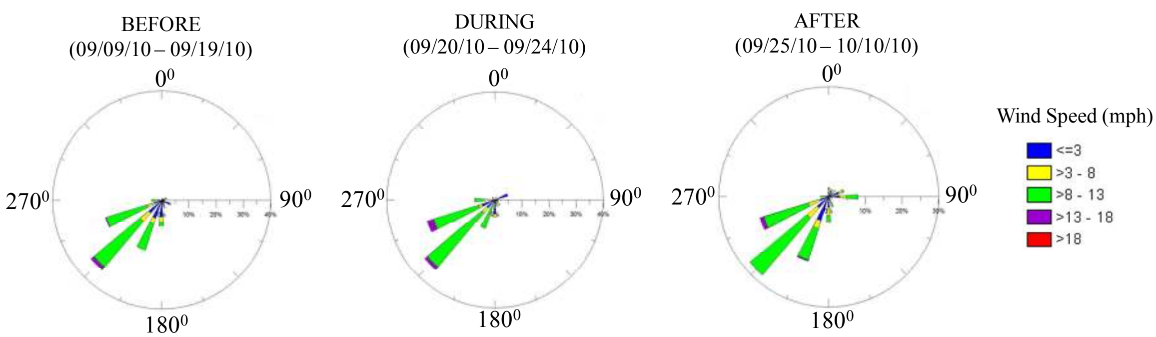
The atmospheric concentrations of UFP ($\#/cm^3$) and BC (mass; $\mu g/m^3$) were measured continuously at sites 1, 2 and 3 at one and five minute intervals, respectively. Continuous 1-min NMHC concentrations and 5-min canister samples for VOC analysis (collected only when the NMHC and/or methane levels were higher than 3 and 5 ppm, respectively) were obtained only at the two MMS (sites 4 and 5). The data files were periodically downloaded to a laptop computer and transferred to the AQMD’s central database.

RESULTS AND DISCUSSION

Meteorology

As expected, the wind data collected during this study show the presence of a distinct daytime sea breeze, characteristic of beach communities in the South Coast Air Basin. As shown in Figure 2, winds were from southwest before, during and after the completion of the repaving project, and sites 1 through 5 were predominantly downwind of runway 21.

Figure 2 Average wind speed and direction at the Santa Monica Airport (SMO) before, during and after the completion of the repaving project



Air Traffic and Time Activity Information

Typically, aircraft follow a series of procedures to move from the taxi area, located a few hundred meters away and north of runway 21, to the point of departure. Prior to engine start, pilots are requested to call Ground Control for clearance. If a departure delay is anticipated, the controller informs the pilot of the aircraft's expected departure release time. When Ground Control receives the release time from the Los Angeles International Airport (LAX), the release is forwarded to the pilot, and taxi and hold instructions are issued based on the anticipated delay. Due to proximity to a residential area, fixed-wing turbine aircraft are requested to hold approximately 70 m from the end of runway 21, while awaiting departure clearance. At this point, the aircraft is positioned parallel to the runway with the engine exhaust facing west towards the airport. When permission to take-off is granted, aircraft turn to the departure area (with the engine exhaust facing east towards the nearby residential community) and take-off shortly thereafter.

All air traffic and time activity information for jet and turbo-prop aircraft departing between 09/12/10 and 10/03/10 were provided by SMO and are summarized in Table 2 (see Appendix A for more details). No landing information was provided. Based on data from 18 measurement days (from 09/12/10 to 09/19/10 and between 09/24/10 and

10/03/10), there were a total of 371 take-offs from runway 21 and only one from runway 3. The majority (about 79%) of all departing airplanes was represented by small and medium size jet aircraft. As shown in Table 2 the average taxi time was about three minutes, much longer than the acceleration time on the runway during take-off (20 to 25 seconds). Because the jet flight path from SMO intersects LAX flight paths less than 20 km after take-off, aircraft departing from SMO must wait for permission from LAX, resulting in an additional waiting time. The total waiting time observed for an average airplane ("Grand Total" in Table 2) during our field campaign was between approximately two and 16 minutes (5^{th} and 95^{th} percentile, respectively; the median waiting time was about six minutes).

Table 2 Summary statistics of traffic activity data recorded at SMO from 09/12/10 to 10/03/10

	Taxi	**Hold**	**Grand Total (Taxi + Hold)**
Average	0:02:42	0:04:14	0:06:56
Median	0:02:32	0:02:57	0:05:43
5th %	0:01:22	0:00:25	0:02:28
95th %	0:04:21	0:12:43	0:15:31
Min	0:00:00	0:00:08	0:01:13
Max	0:18:21	0:44:05	0:45:51
Stdev	0:01:24	0:04:31	0:04:46
Valid N	372	372	372

Ultrafine Particle and Black Carbon Variations

The time series in Figure 3 shows that the UFP and BC data collected at the SMO stations were dynamic in range, with significant variability over very short temporal and spatial scales. Sharp peaks in the atmospheric levels of these two combustion products were present at both the East Tarmac and the Ernst Residence Backyard sites and were mostly related to aircraft emissions right before and during take-off, as will be described in more detail in a later section. The concentrations of UFP and BC at the two outdoor stations tracked each other well and were typically higher near the Tarmac because of the close proximity to the aircraft point of departure.

The highest UFP concentration observed during this study was about 2,600,000 $\#/cm^3$ (Table 3) and it was measured at the East Tarmac site on 10/01/10 at 10:27 am. One minute maxima between 1,500,000 and 2,000,000 $\#/cm^3$ were also observed at the Ernst Residence Backyard site, but were not as frequent. The UFP peaks measured inside Ms. Ernst's Residence were always substantially lower than those observed at the two outdoor sites, and the few 1-min peaks above 200,000 $\#/cm^3$ were caused by indoor afternoon activities such as cooking and cleaning, as noted by Ms. Ernst. Interestingly, the highest 5-min average BC concentration (26.2 $\mu g/m^3$; Table 3) observed during this study was recorded at the Ernst Residence Backyard site, about 100 m downwind from the runway but in close proximity to Bundy Dr. and National Blvd, two highly trafficked streets adjacent to the north-east side of the airport. However, BC maxima of 10 $\mu g/m^3$ or higher were more frequent at the East Tarmac site (Figure 3). As was the case for UFP, the BC concentration inside Mr. Ernst's Residence was substantially lower than that at the two outdoor sampling locations, suggesting that the majority of combustion-related particles did not infiltrate indoors. Doors and windows at the Ernst Residence were kept closed for the majority of the study.

The suspension of all airport activities from 09/19/10 at 8:00 pm to 09/24/10 at 6:00 am caused a substantial decrease in the measured 1-min UFP and 5-min BC peaks at all outdoor stations (see shaded area in Figure 3). For example, the maximum UFP concentrations measured at the Ernst Residence Backyard site before and after the runway maintenance work were 1,168,000 and 2,148,460 $\#/cm^3$, respectively (Table 3), 3.8 and 6.9 times higher than the highest UFP peak observed when no airport activity was ongoing (background). More significant reductions were observed at the East Tarmac site, where the maximum UFP concentrations before and after the repaving project were 11.7 and 17.2 times more elevated than the highest UFP spike recorded when the airport was shut-down.

It is worth noting that the full closure of SMO had a less substantial impact on the longer-term average UFP and BC levels observed at two outdoor sites. For instance, the mean UFP concentration measured both at the Ernst Residence Backyard and at the East Tarmac stations before the airport shut-down (20,861 and 23,825 $\#/cm^3$, respectively; Table 3) and after the runway repaving work (23,741 and 26,863, respectively) were only about two times higher than the corresponding average UFP count at the same stations (11,260 and 12,630, respectively) when no aircraft activity was occurring. Thus, the results from this study and those obtained during our previous measurement campaign in 2006-2007 (AQMD, 2010) seem to suggest that airport impacts on the atmospheric levels of UFP appear to be less when considering long-term averages (i.e. several days or a few months). However, impacts for the same pollutant are much more significant when shorter time scales (e.g. 1-min) are considered. Similar conclusions can be drawn for BC. Ultrafine particles and BC are currently not regulated pollutants, and further investigation is needed to characterize the short-term risk associated with exposure to these and other combustion-related emissions.

Figure 3 Ultrafine particle (UFP) number and black carbon (BC) mass concentrations at the East Tarmac, Ernst Residence Backyard, and Ernst Residence Living room stations from 09/09/10 to 10/05/10. Ultrafine particle and BC data were measured continuously at 1- and 5-min intervals, respectively. The shaded area corresponds to the time period when all airport activities were suspended to accommodate work on the runway and within the restricted work area (i.e. 9/19/10 at 8:00 pm to 9/24/10 days 6:00 am)

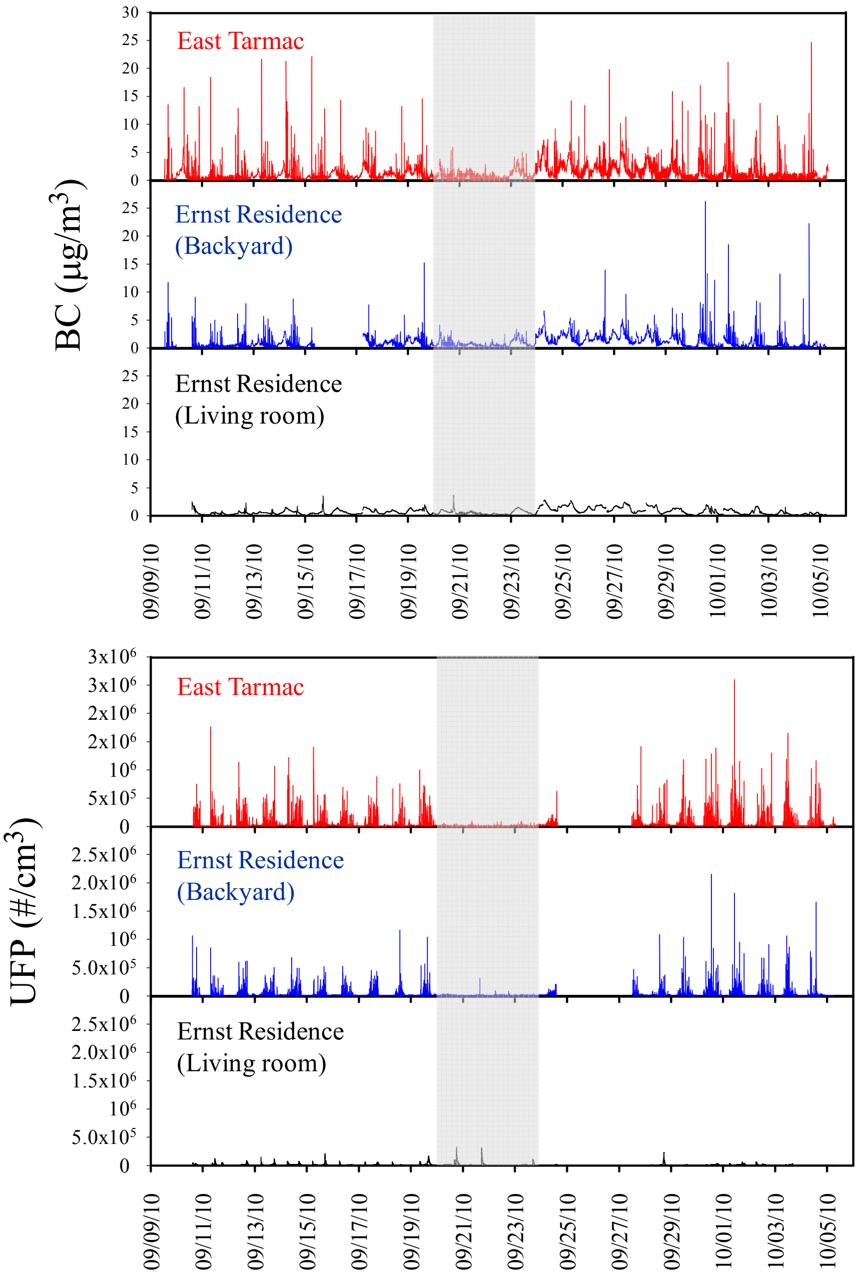


Table 3 Average and median ultrafine particle (UFP) number and black carbon (BC) mass concentrations measured at the East Tarmac, Ernst Residence Backyard, and Ernst Residence Living stations before, during and after the runway repaving project. Minimum (Min) and maximum (Max) values, standard deviations (SD), and total number of valid samples (Valid N) have also been included for each pollutant

	UFP (#/cm^3)								
	EAST TARMAC			ERNST RESIDENCE (BACKYARD)			ERNST RESIDENCE (INDOORS)		
	Before[1]	**During[2]**	**After[3]**	**Before[1]**	**During[2]**	**After[3]**	**Before[1]**	**During[2]**	**After[3]**
Average	23,825	12,630	26,863	20,861	11,260	23,741	11,217	12,173	7,933
Median	9,156	9,603	12,440	10,265	9,944	12,503	6,402	6,115	5,340
Min	1,205	1,543	833	981	1,232	1,088	301	826	315
Max	1,763,280	151,273	2,595,020	1,168,000	309,840	2,148,460	210,453	330,183	230,282
Stdev	62,869	11,059	75,243	44,126	8,954	61,138	17,188	26,796	11,926
Valid N	13,360	6,360	11,700	13,429	6,360	11,511	13,321	6,359	10,486

	BC (μg/m^3)								
	EAST TARMAC			ERNST RESIDENCE (BACKYARD)			ERNST RESIDENCE (INDOORS)		
	Before[1]	**During[2]**	**After[3]**	**Before[1]**	**During[2]**	**After[3]**	**Before[1]**	**During[2]**	**After[3]**
Average	0.98	1.06	1.47	0.79	0.93	1.22	0.63	0.66	0.91
Median	0.57	0.71	1.04	0.52	0.62	0.91	0.51	0.48	0.79
Min	0.00	0.00	0.00	0.01	0.01	0.01	0.14	0.14	0.14
Max	22.13	7.22	24.62	15.24	6.58	26.19	3.55	3.76	2.76
Stdev	1.51	1.13	1.77	0.91	0.91	1.32	0.39	0.51	0.60
Valid N	2,933	1,242	3,092	2,233	1,248	3,077	2,654	1,254	3,093

[1]From 09/09/10 to 09/19/10 8:00 pm; [2]Background: from 09/19/10 8:00 pm to 09/24/10 6:00 pm; [3]from 09/24/10 6:00 pm to 10/
All time information is in Pacific Standard Time (PST)

The effect of aircraft activity on the magnitude of the UFP number and BC mass concentrations measured at the East Tarmac and Ernst Residence Backyard sites is illustrated in Figure 4, which shows typical times series for these two pollutants on 10/01/10 from 8:00 am to 12:30 pm. As expected, measurements at the East Tarmac and Ernst Residence sites peaked when aircraft were taking-off or holding on the runway right before departure. These time periods (corresponding to the broken lines in Figure 4) are listed in Table 4, which also includes detailed information about the identification number, model type (jet or turbo-prop), weight, and time activity data for aircraft associated with these increases in UFP and BC levels. AQMD staff members operating at the East Tarmac and Ernst Residence Backyard sites reported that observations of particle count peaks right before and during take-offs corresponded with visual sightings of aircraft preparing for departure, with a short delay between the activity and the peak count recorded on the instrument (often accompanied by an odor of jet-fuel).

Figure 4 Impact of aircraft movements on the ultrafine particle (UFP) number and black carbon (BC) mass concentrations at the East Tarmac and Ernst Residence Backyard sites on 10/01/10

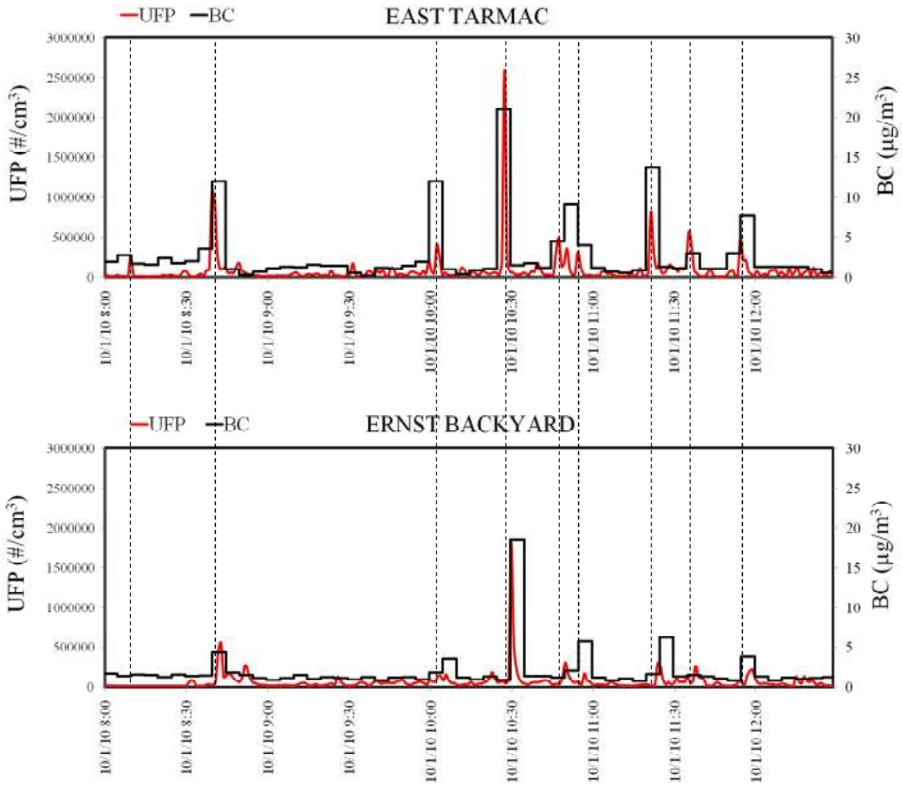


Table 4 Traffic activity data recorded at SMO on 10/01/10. The letters "J" and "T" designate jet and turbo-prop aircraft, respectively

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
417Q	Cessna 525 / J	9,800	8:05:12	8:09:56	8:10:14	0:04:44	0:00:18	0:05:02
642JL	Beechcraft 300 / T	14,000	8:27:23	8:31:10	8:40:55	0:03:47	0:09:45	0:13:32
122QS	Reytheon 400A / J	16,300	10:00:48	10:02:42	10:04:20	0:01:54	0:01:38	0:03:32
480QS	Gulfstream IV / J	58,500	10:21:09	10:25:31	10:28:21	0:04:22	0:02:50	0:07:12
852LX	Raytheon Hawker 800 / J	21,200	10:44:59	10:47:31	10:48:13	0:02:32	0:00:42	0:03:14
819AP	Gulfstream G200 / J	30,000	10:48:18	10:50:26	10:55:26	0:02:08	0:05:00	0:07:08
614BA	Bombardier CL600 / J	36,000	11:18:17	11:20:56	11:22:51	0:02:39	0:01:55	0:04:34
969WR	Gulfstrea G150 / J	26,250	11:25:38	11:28:05	11:36:47	0:02:27	0:08:42	0:11:09
409CS	Cessna 525B / J	9,800	11:53:06	11:55:12	11:55:45	0:02:06	0:00:33	0:02:39

Effect of Aircraft Weight on Measured Ultrafine Particle and Black Carbon Levels

To better identify which aircraft type contributed the most to the particulate pollutant emissions observed in and around SMO, the weights of each aircraft (retrieved from the FAA website; http://rgl.faa.gov) were segregated into the following three categories according to the Enhanced Traffic Management System (ETMS) Data Services guidelines: small equipment (<12,500 lb; weight class A), medium commuter (between 12,500 and 41,000 lb; weight class B) and large commuter (>41,000 lb; weight class C). The heaviest jet aircraft operated at SMO during this study was a Gulfstream 4 weighing about 58,500 lb. Heavier and larger airplanes are generally too big in size to land at or take-off from SMO. The weight of each aircraft in each weight class was then matched to the corresponding maximum UFP number and BC mass concentrations measured from the time the aircraft started taxing near the runway to the time of take-off. A box plot summarizing the distribution of the peak UFP and BC levels for weight classes A, B, and C at both the East Tarmac and the Ernst Residence Backyard sites is shown in Figure 5; the corresponding summary statistics can be found in Table 5.

As expected, the average peak UFP and BC values increased with increasing aircraft weight, both at the East Tarmac and Ernst Residence Backyard stations, suggesting that heavier aircraft (equipped with larger and more powerful engines) emit higher amounts of combustion particles (Figure 5). Specifically, the average peak BC concentration measured for weight classes C, B and A at the East Tarmac site were about 7.6, 5.9 and 3.5 times higher than the average BC concentration observed at the same monitoring site from 09/19/10 to 09/24/10 (1.06 $\mu g/m^3$; Table 3) when no airport / aircraft activity was ongoing. The average peak BC value measured for weight classes C, B and A at the Ernst Residence Backyard site were 3.3, 3.2 and 2.2 times higher than the average BC concentration observed at the same site during the repaving project (0.93 $\mu g/m^3$; Table 3), when particle contributions from aircraft emissions were absent. A more substantial impact was observed for UFP; in particular, the average peak UFP concentration measured for weight classes C, B and A at the East Tarmac site were about 72, 35 and 24 times higher than the average UFP concentration observed at the same monitoring site when no airport / aircraft activity was ongoing (12630 $\#/cm^3$; Table 3). Similarly, the average peak UFP value measured for weight classes C, B and A at the Ernst Residence Backyard site were 50, 23 and 13 times higher than the average UFP concentration observed at the same site during the repaving project (11260 $\#/cm^3$; Table 3).

Figure 5 Box plot summarizing the distribution of the peak (maximum) UFP and BC levels for weight classes A, B, and C at both the East Tarmac and Ernst Residence Backyard sites. The dotted black lines represent the corresponding average UFP and BC levels measured during the repaving project, when all airport/aircraft activities were suspended

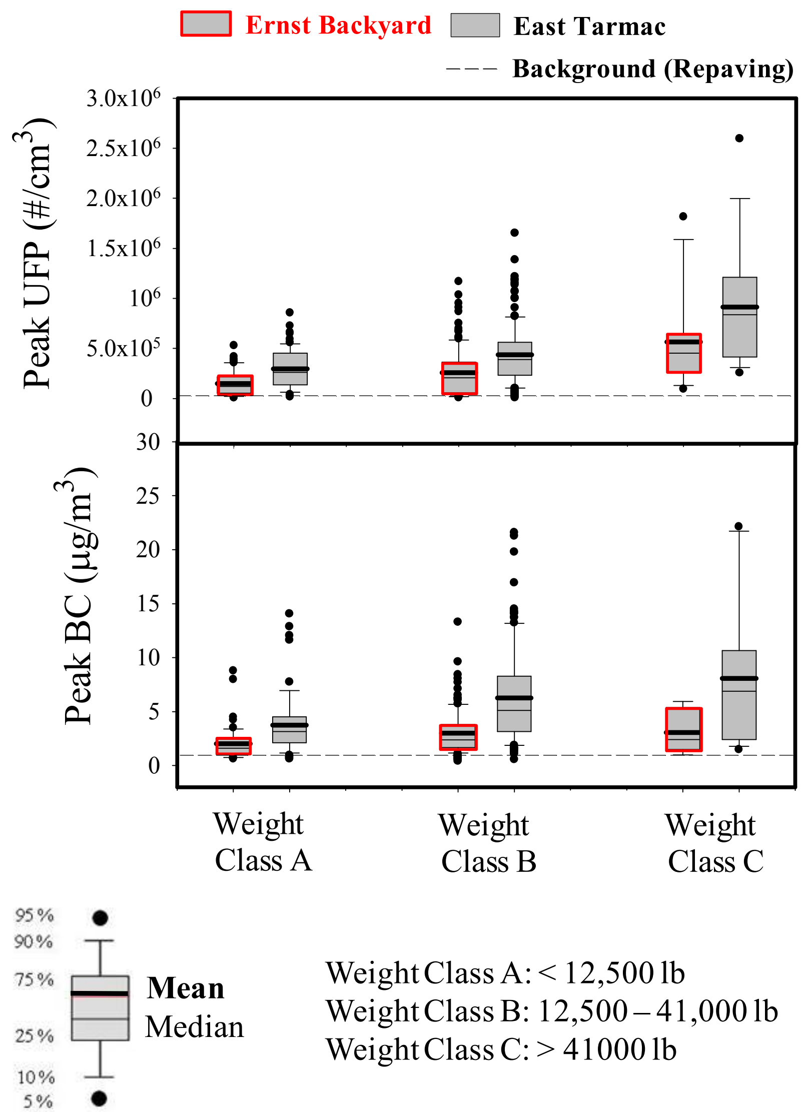


Table 5 Summary statistics for the peak (maximum) UFP and BC levels corresponding to weight classes A, B, and C at both the East Tarmac and Ernst Residence Backyard sites. Peak levels for each aircraft were measured from the time the aircraft started taxing near the runway to the time of take-off

	Peak UFP (#/cm³)					
	EAST TARMAC			ERNST RESIDENCE (BACKYARD)		
	Weight Class			*Weight Class*		
	A	*B*	*C*	*A*	*B*	*C*
Average	297,989	437,699	915,116	148,648	258,144	566,172
Median	261,073	390,383	837,467	120,138	207,655	452,250
5th %	31,647	69,608	325,568	14,232	14,627	162,046
95th %	600,698	1,067,395	1,820,110	370,665	685,429	1,401,906
Min	15,913	8,599	255,478	7,077	8,619	94,650
Max	856,817	1,652,720	2,595,020	529,518	1,168,000	1,815,330
Stdev	193,047	292,783	601,545	117,387	234,444	467,294
Valid N	78	155	14	76	153	12

	Peak BC (µg/m³)					
	EAST TARMAC			ERNST RESIDENCE (BACKYARD)		
	Weight Class			*Weight Class*		
	A	*B*	*C*	*A*	*B*	*C*
Average	3.75	6.27	8.06	2.03	3.00	3.04
Median	3.15	5.11	6.90	1.61	2.39	2.40
5th %	0.83	1.48	1.93	0.70	0.83	1.13
95th %	11.70	14.17	21.51	4.31	6.59	5.86
Min	0.62	0.57	1.48	0.62	0.41	0.99
Max	14.06	21.59	22.13	8.79	13.30	5.93
Stdev	2.91	4.31	6.75	1.54	2.02	1.96
Valid N	57	130	13	55	119	9

Effect of Aircraft Activity on Measured Ultrafine Particle Levels

To better characterize which type of aircraft activity contributed the most to the UFP emissions measured at the East Tarmac and Ernst Residence Backyard sites, time activity information for each aircraft monitored during the study period (listed in Table A1; see Appendix) was divided into the following groups: taxi (time period during which an aircraft was waiting near the runway), hold "initial" (from the beginning of the holding period and up to two minutes before departure), hold "last 2-min" (including only the last two minutes of holding time), and take-off. For each aircraft and within each time activity group the peak (maximum) UFP number concentration measured at the East Tarmac and Ernst Residence Backyard stations were then identified, categorized by weight classes, and summarized in a box plot as shown in Figure 6; the corresponding summary statistics can be found in Table 6. Because the taxi and hold time for most aircraft was typically between two and three minutes and due to the relatively lower time resolution of the BC mass concentration data (5-min vs 1-min for UFP), similar box plots could not be obtained for this carbonaceous component of PM.

Our results indicate that the highest UFP peaks at the East Tarmac and Ernst Residence Backyard sites were typically observed within the last two minutes of the holding period (particularly for aircraft weighing less than 41,000 lb) and during take-off (especially following the departure of a aircraft weighing more than 41,000) (Figure 6). An increase in UFP level right before take-off may be caused by aircraft movement from the holding area to the point of departure, for during this turn the engine thrust is increased and the combustion products are directly emitted towards the East Tarmac monitoring station. Measurements at the Ernst Backyard site are less subject to this very local directionality of emissions, but the higher peak UFP levels during the last 2-minutes of hold time vs. those at take-off are still discernable for Weight Classes A and B.

Pre-flight run-ups, a series of engine checks performed by pilots prior to take-off, may also be responsible for the observed UFP peaks. These often involve temporarily advancing the throttles to ensure that the engine is capable of producing enough take-off thrust. Run-up tests typically occur in two dedicated areas a few meters away from the runway end, in front of a sound attenuation wall, and not far from our East Tarmac sampling station (Figure 7). As reported on the Santa Monica Airport website extended high power settings on run-up or departure can negatively impact air quality in the surrounding community (http://www.smgov.net/departments/airport/).

These results are in line with those obtained from our previous field study at SMO (AQMD, 2010) and during another measurement campaign conducted at the same airport by Hu et al. (2009). In all cases, when an aircraft was preparing for take-off (hence moving from the holding to the departing area) a loud noise was typically heard near the end of runway 21, followed by a smell of fuel vapor odors, and by elevated concentrations of UFP and BC.

Figure 6 Box plot summarizing the distribution of the peak UFP levels for various time activity groups and weight classes at both the East Tarmac and Ernst Residence Backyard sites. The dotted lines represent the corresponding average UFP and BC levels measured during the repaving project, when all airport/aircraft activities were suspended

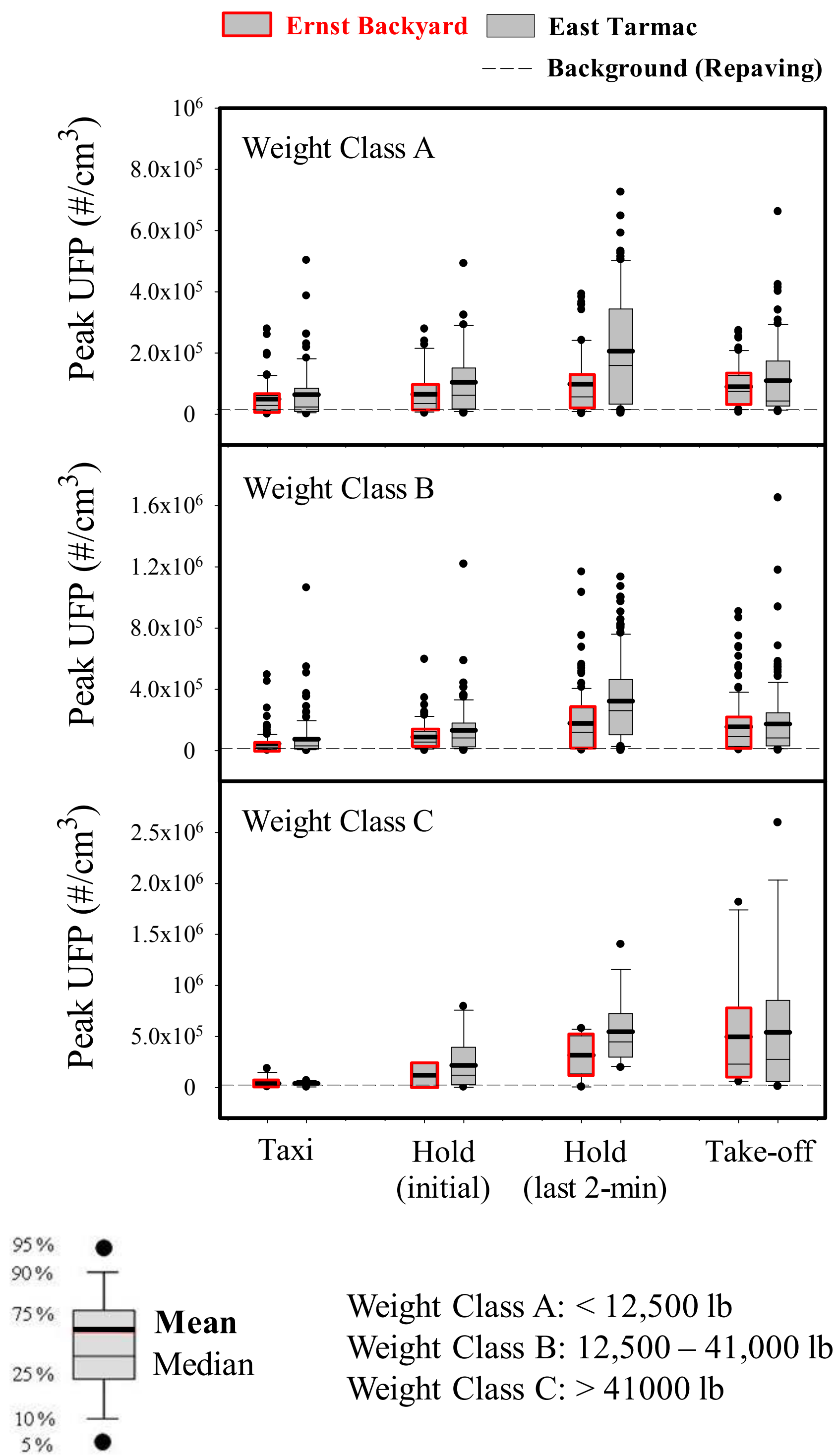


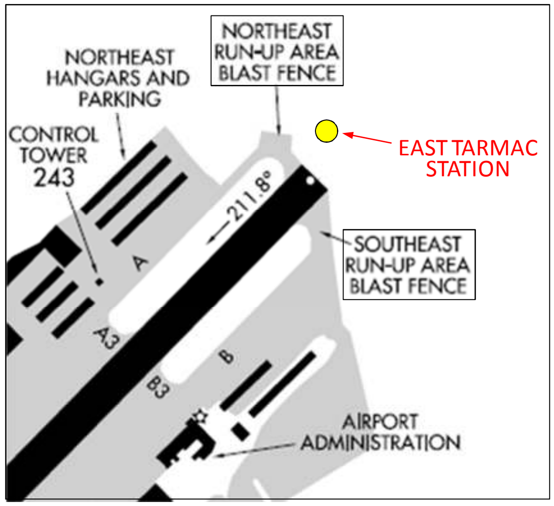
Table 6 Summary statistics for the peak (maximum) UFP levels corresponding to various time activity groups and weight classes at both the East Tarmac and Ernst Residence Backyard sites

	Peak UFP (#/cm^3) for Weight Class A							
	EAST TARMAC				ERNST RESIDENCE (BACKYARD)			
	Taxi	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*	*Taxi*	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*
Average	64,126	104,492	206,329	109,804	50,590	65,495	98,248	90,441
Median	23,667	62,935	159,478	43,959	28,608	35,820	57,148	74,253
5th %	4,025	8,371	12,997	11,252	5,971	6,419	5,394	13,728
95th %	245,900	298,698	529,434	371,621	164,720	232,643	358,230	234,682
Min	1,255	4,096	3,891	9,184	2,101	4,264	2,597	7,077
Max	503,139	492,813	726,262	662,367	278,850	279,183	393,433	274,050
Stdev	92,586	111,593	189,093	129,877	57,576	73,371	105,019	70,767
Valid N	71	37	71	71	70	33	70	70

	Peak UFP (#/cm^3) for Weight Class B							
	EAST TARMAC				ERNST RESIDENCE (BACKYARD)			
	Taxi	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*	*Taxi*	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*
Average	76,319	133,893	323,594	174,013	47,043	89,525	178,794	157,117
Median	32,380	84,288	261,310	84,282	22,652	57,412	121,083	93,103
5th %	5,027	9,434	14,165	8,916	6,427	11,887	8,937	11,881
95th %	288,755	363,862	851,932	547,516	152,257	253,583	536,424	552,887
Min	2,097	2,714	3,004	3,825	3,378	2,768	5,207	7,123
Max	1,065,010	1,219,400	1,134,990	1,652,720	496,133	598,000	1,168,000	909,633
Stdev	131,667	172,835	274,324	234,316	71,009	102,209	198,874	184,001
Valid N	125	82	124	125	125	61	123	125

	Peak UFP (#/cm^3) for Weight Class C							
	EAST TARMAC				ERNST RESIDENCE (BACKYARD)			
	Taxi	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*	*Taxi*	*Hold (initial)*	*Hold (last 2-min)*	*Takeoff*
Average	39,954	215,679	546,740	538,856	39,923	119,771	315,746	495,992
Median	40,910	121,155	446,900	275,495	24,474	118,635	305,745	230,346
5th %	6,789	3,477	210,552	23,844	8,476	16,069	6,542	74,368
95th %	67,147	630,016	1,081,750	1,750,778	117,348	224,268	567,121	1,477,074
Min	4,531	3,108	196,270	11,986	6,683	4,673	5,153	57,773
Max	67,848	794,060	1,402,850	2,595,020	186,250	236,005	577,973	1,815,330
Stdev	21,286	253,740	335,108	722,844	48,833	115,670	203,135	559,751
Valid N	13	10	14	13	12	3	13	10

Figure 7 Aerial view of SMO showing the location of the two run-up areas near runway 21 with respect to the East Tarmac monitoring station



Volatile Organic Compounds at the East Tarmac Station

A total of nine canister samples (collected automatically when the measured NMHC and/or Methane levels were higher than 3 and 5 ppm, respectively) were taken at the East Tarmac MMS during and after the repaving project. All of these samples were analyzed for more than 60 of the hydrocarbons typically monitored by AQMD at Photochemical Assessment Monitoring Station (PAMS) sites. Three of these samples were also analyzed for a series of additional VOC, selected because of their potential importance relative to toxic cancer risk in the South Coast Air Basin (Table 7). It should be noted that "PAMS hydrocarbons" and "Toxic VOC" were measured using two different analytical procedures and some of the volatile species categorized as "PAMS hydrocarbons" were also reported in the "Toxic VOC" list (i.e. benzene, ethylbenzene, m,p-xylene, o-xylene, pentane, styrene and toluene; highlighted in yellow in Table 7).

As shown in Figures 8a, the canister samples collected during the repaving project (when no aircraft activity was occurring) where characterized by increased acetylene, ethane and, to a lesser extent, ethylene concentrations. These elevated VOC are not considered air toxic chemicals, and other VOC detected in these samples were close to typical South Coast Air Basin levels. These VOC are often used as tracers for gasoline exhaust in the urban atmosphere, and they are probably associated with increased motor-vehicle traffic due to repaving activities on the runway and within the restricted work area. However, the relative contributions of these and other pollution sources (e.g. local surface streets) to the measured VOC levels cannot be assessed from the available data. Interestingly, all four canister samples collected between 09/21/10 and 09/24/10 were taken late in the afternoon or at night (Figure 8a).

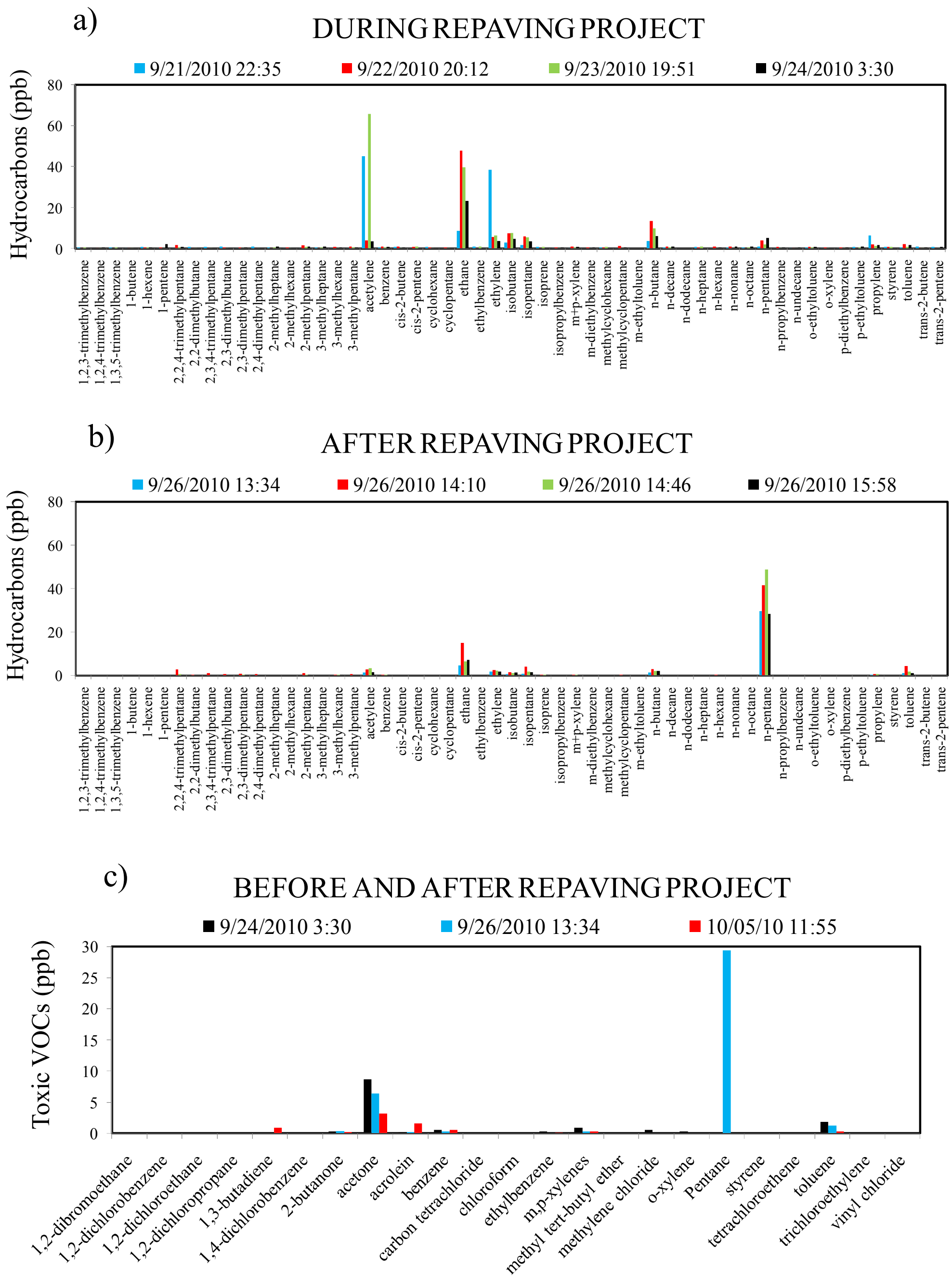
After the reopening of SMO, the concentrations of all measured "PAMS hydrocarbons" and "Toxic VOC" were similar to those observed in other parts of the South Coast Basin away from the immediate influence of any specific mobile sources. However, unusually high levels of pentane were observed in canister samples collected after 09/24/10 (Figures 8b and c). It is possible that this solvent component was used during the Phase III of the pavement rejuvenation project (construction outside the runway area was completed between 09/25/10 and 10/05/10; Table 1) and/or stored along with other solvents and construction material in the parking area located about 15 m north of the East Tarmac station. Note that pentane is not considered an air toxic chemical.

The October 5th sample contained a detectable amount of acrolein. While this is an air toxic that has been associated with jet exhaust, the level detected in this sample was not unusual for the South Coast Basin. Also note that there have been recent technical issues regarding the accuracy of the current U.S. EPA-approved methods for acrolein measurements, and the AQMD is working with U.S. EPA to resolve the issues. Therefore, this acrolein level remains unverified given the current method limitations.

Table 7 List of volatile organic compounds (VOC) analyzed on the canister samples collected at SMO during and after the repaving project. Only three of the eight collected samples were analyzed for all of the VOC listed below. The species highlighted in yellow are present as part of both the "PAMS HYDROCARBONS" and "Toxic VOC" list

PAMS HYDROCARBONS		
1,2,3-trimethylbenzene	cis-2-butene	n-hexane
1,2,4-trimethylbenzene	cis-2-pentene	n-nonane
1,3,5-trimethylbenzene	Cyclohexane	n-octane
1-butene	Cyclopentane	n-pentane
1-hexene	Ethane	n-propylbenzene
1-pentene	Ethylbenzene	n-undecane
2,2,4-trimethylpentane	Ethylene	o-ethyltoluene
2,2-dimethylbutane	Isobutene	o-xylene
2,3,4-trimethylpentane	Isopentane	p-diethylbenzene
2,3-dimethylbutane	Isoprene	p-ethyltoluene
2,3-dimethylpentane	isopropylbenzene	propylene
2,4-dimethylpentane	m,p-xylene	styrene
2-methylheptane	m-diethylbenzene	toluene
2-methylhexane	methylcyclohexane	trans-2-butene
2-methylpentane	methylcyclopentane	trans-2-pentene
3-methylheptane	m-ethyltoluene	
3-methylhexane	n-butane	
3-methylpentane	n-decane	
acetylene	n-dodecane	
benzene	n-heptane	
TOXIC VOC		
1,2-dibromoethane	carbon tetrachloride	tetrachloroethene
1,2-dichlorobenzene	Chloroform	toluene
1,2-dichloroethane	Ethylbenzene	trichloroethylene
1,2-dichloropropane	m,p-xylenes	vinyl chloride
1,3-butadiene	methyl tert-butyl ether	
1,4-dichlorobenzene	methylene chloride	
2-butanone	o-xylene	
acetone	Pentane	
acrolein	Propane	
benzene	Styrene	

Figure 8 "PAMS HYDROCARBONS" analyzed on eight canister samples collected at the East Tarmac Mobile Measurement Station (MMS) a) during and b) after the repaving project. Three of these samples were also analyzed for several "TOXIC VOC" (c)



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South Coast Air Quality Management District (2010), General Aviation Airport Air Monitoring Study

APPENDIX B: Traffic Activity Data

Table B Santa Monica Airport (SMO) traffic activity data from 09/12/10 and 10/03/10. The airport remained close from 09/19/10 to 09/24/10 due to a "Pavement Rehabilitation Project". The letters "J" and "T" designate Jet and Turboprop aircraft, respectively

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
321LH	PA42 / T	10,330	9/12/2010	7:38:00	7:40:00	7:43:00	0:02:00	0:03:00	0:05:00
332FX	CL60 / J	36,000	9/12/2010	9:01:00	9:03:00	9:06:00	0:02:00	0:03:00	0:05:00
904FL	E135 / J	40,785	9/12/2010	9:05:00	9:07:00	9:15:00	0:02:00	0:08:00	0:10:00
748QS	GALX / J	35,000	9/12/2010	9:19:00	9:21:00	9:27:00	0:02:00	0:06:00	0:08:00
428CS	C525 / J	9,800	9/12/2010	9:37:00	9:39:00	9:48:00	0:02:00	0:09:00	0:11:00
425KD	C425 / T	8,000	9/12/2010	11:48:00	11:49:00	12:05:00	0:01:00	0:16:00	0:17:00
646QS*	C560 / J	15,200	9/12/2010	12:57:14	12:59:41	13:00:38	0:02:27	0:00:57	0:03:24
441FX	LJ45 / J	19,200	9/12/2010	13:11:07	13:12:44	13:17:31	0:01:37	0:04:47	0:06:24
969WR	G150 / J	26,250	9/12/2010	13:36:51	13:39:17	13:56:29	0:02:26	0:17:12	0:19:38
697QS	C560 / J	15,200	9/12/2010	13:40:39	13:42:42	13:59:32	0:02:03	0:16:50	0:18:53
707AV	TBM700 / T	6,614	9/12/2010	14:55:05	14:57:29	14:57:48	0:02:24	0:00:19	0:02:43
64LG	MU-2B-25 / T	8,490	9/12/2010	14:59:28	15:01:35	15:02:42	0:02:07	0:01:07	0:03:14
618FX	LJ45 / J	19,200	9/12/2010	15:19:09	15:21:01	15:27:03	0:01:52	0:06:02	0:07:54
208BH	LJ60 / J	19,500	9/12/2010	15:25:05	15:26:12	15:32:42	0:01:07	0:06:30	0:07:37
308MJ	EMB-505 / J	18,100	9/12/2010	16:00:13	16:02:28	16:03:42	0:02:15	0:01:14	0:03:29
417C	C525 / J	9,800	9/12/2010	16:40:48	16:41:39	16:42:20	0:00:51	0:00:41	0:01:32
821QS	H800XP / J	21,200	9/12/2010	16:47:55	16:49:53	16:51:18	0:01:58	0:01:25	0:03:23
300TN	B300 / T	14,000	9/12/2010	17:05:42	17:06:53	17:07:01	0:01:11	0:00:08	0:01:19
532FX	CL30 / J	33,750	9/13/2010	7:29:30	7:31:30	7:44:55	0:02:00	0:13:25	0:15:25
122BX	LJ31 / J	15,300	9/13/2010	7:32:15	7:35:00	7:59:50	0:02:45	0:24:50	0:27:35
315QS	C680 / J	27,100	9/13/2010	9:15:25	9:20:30	9:22:45	0:05:05	0:02:15	0:07:20
646QS	C560 / J	15,200	9/13/2010	9:30:45	9:34:15	9:38:58	0:03:30	0:04:43	0:08:13
124PS	PC12 / J	9,039	9/13/2010	10:24:45	10:26:55	10:35:45	0:02:10	0:08:50	0:11:00
612FX	LJ45 / J	19,200	9/13/2010	10:58:30	11:01:10	11:05:15	0:02:40	0:04:05	0:06:45
557TC	EMB-500 / J	10,500	9/13/2010	11:16:15	11:18:55	11:19:55	0:02:40	0:01:00	0:03:40
448LX	BE40 / J	16,300	9/13/2010	13:14:29	13:18:29	13:19:50	0:04:00	0:01:21	0:05:21
700R	H800XP / J	21,200	9/13/2010	14:21:06	14:24:53	14:26:27	0:03:47	0:01:34	0:05:21
566QS	C560 / J	15,200	9/13/2010	14:59:28	15:02:50	15:06:45	0:03:22	0:03:55	0:07:17
307SH	C510 / J	8,730	9/13/2010	16:05:58	16:13:16	16:18:50	0:07:18	0:05:34	0:12:52
708GP	C525 / J	9,800	9/13/2010	16:50:05	16:53:45	16:55:32	0:03:40	0:01:47	0:05:27
610FX	LJ45 / J	19,200	9/13/2010	16:58:55	17:00:48	17:02:14	0:01:53	0:01:26	0:03:19
616QS	C560 / J	15,200	9/13/2010	17:35:50	17:38:17	17:42:31	0:02:27	0:04:14	0:06:41
550GL	B200 / T	12,500	9/13/2010	18:05:25	18:08:58	18:10:41	0:03:33	0:01:43	0:05:16
943QS	C750 / J	31,800	9/13/2010	18:17:55	18:20:37	18:21:23	0:02:42	0:00:46	0:03:28
805C	B200 / T	12,500	9/13/2010	18:43:11	18:46:32	18:46:43	0:03:21	0:00:11	0:03:32
560MR	C560 / J	15,200	9/14/2010	6:09:35	6:13:19	6:15:40	0:03:44	0:02:21	0:06:05
750LG	CL60 / J	36,000	9/14/2010	6:18:06	6:20:10	6:24:01	0:02:04	0:03:51	0:05:55
224MD	EMB-500 / J	10,500	9/14/2010	6:42:51	6:46:23	6:49:45	0:03:32	0:03:22	0:06:54
311AF	S550 / J	11,000	9/14/2010	6:52:45	6:54:25	7:03:40	0:01:40	0:09:15	0:10:55
522FX	CL30 / J	33,750	9/14/2010	7:04:09	7:07:17	7:19:19	0:03:08	0:12:02	0:15:10
417Q	C525 / J	9,800	9/14/2010	7:04:33	7:07:20	7:20:24	0:02:47	0:13:04	0:15:51
321GL	LJ31 / J	15,300	9/14/2010	7:15:19	7:17:49	7:21:49	0:02:30	0:04:00	0:06:30
650LG	CL60 / J	36,000	9/14/2010	7:36:42	7:40:01	7:41:16	0:03:19	0:01:15	0:04:34
307SH	C510 / J	8,730	9/14/2010	9:35:51	9:40:15	9:44:24	0:04:24	0:04:09	0:08:33
969WR	G150 / J	26,250	9/14/2010	9:45:53	9:51:51	9:55:46	0:05:58	0:03:55	0:09:53
168DJ	FA20 / J	26,000	9/14/2010	11:11:29	11:15:59	11:18:16	0:04:30	0:02:17	0:06:47
667QS	C560 / J	15,200	9/14/2010	11:22:51	11:26:23	11:39:37	0:03:32	0:13:14	0:16:46
7208N	EPIC LT / T	NA	9/14/2010	12:32:15	12:35:20	12:36:55	0:03:05	0:01:35	0:04:40
904PA	BE90 / T	9,168	9/14/2010	12:49:33	12:55:25	12:59:40	0:05:52	0:04:15	0:10:07
104HW	C550 / J	12,700	9/14/2010	12:57:05	12:58:40	12:59:43	0:01:35	0:01:03	0:02:38
877SD	C550 / J	12,700	9/14/2010	13:22:24	13:24:33	13:24:54	0:02:09	0:00:21	0:02:30
194SJ	C525 / J	9,800	9/14/2010	13:36:47	13:39:35	13:40:10	0:02:48	0:00:35	0:03:23
752MT	H800XP / J	21,200	9/14/2010	14:07:04	14:09:44	14:20:31	0:02:40	0:10:47	0:13:27
292CS	C680 / J	27,100	9/14/2010	14:07:46	14:10:05	14:22:30	0:02:19	0:12:25	0:14:44
510HS	C510 / J	8,730	9/14/2010	14:42:11	14:44:50	14:45:36	0:02:39	0:00:46	0:03:25
213GS	CL60 / J	36,000	9/14/2010	14:54:03	14:56:47	14:57:49	0:02:44	0:01:02	0:03:46
525NB	C525 / J	9,800	9/14/2010	14:59:45	15:02:21	15:06:45	0:02:36	0:04:24	0:07:00

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
904PA	BE90 / T	9,168	9/14/2010	16:10:56	16:13:12	16:13:45	0:02:16	0:00:33	0:02:49
74PT	LJ45 / J	19,200	9/14/2010	16:18:28	16:20:36	16:24:07	0:02:08	0:03:31	0:05:39
90RT	BE90 / T	9,168	9/14/2010	16:19:53	16:23:40	16:25:01	0:03:47	0:01:21	0:05:08
25FS	C550 / J	12,700	9/14/2010	16:37:05	16:38:50	16:39:20	0:01:45	0:00:30	0:02:15
969WR	G150 / J	26,250	9/14/2010	16:41:09	16:43:23	16:43:51	0:02:14	0:00:28	0:02:42
4YS	B300 / T	14,000	9/14/2010	16:42:30	16:44:44	16:45:23	0:02:14	0:00:39	0:02:53
125BP	PC12 / T	9,039	9/14/2010	16:46:01	16:47:35	16:47:43	0:01:34	0:00:08	0:01:42
708GP	C525 / J	9,800	9/14/2010	17:16:07	17:18:15	17:18:54	0:02:08	0:00:39	0:02:47
612FX	LJ45 / J	19,200	9/14/2010	18:14:52	18:18:06	18:19:27	0:03:14	0:01:21	0:04:35
5NG	GLF4 / J	58,500	9/15/2010	6:13:19	6:17:01	6:17:59	0:03:42	0:00:58	0:04:40
9NG	C750 / J	31,800	9/15/2010	6:16:18	6:19:21	6:22:55	0:03:03	0:03:34	0:06:37
22NG	C750 / J	31,800	9/15/2010	6:28:04	6:32:07	6:33:31	0:04:03	0:01:24	0:05:27
888WG	PC12 / T	9,039	9/15/2010	10:01:32	10:03:21	10:05:59	0:01:49	0:02:38	0:04:27
1871R	C560 / J	15,200	9/15/2010	10:03:40	10:05:56	10:06:57	0:02:16	0:01:01	0:03:17
542FX	CL30 / J	33,750	9/15/2010	12:16:49	12:20:32	12:23:14	0:03:43	0:02:42	0:06:25
816CS	C560 / J	15,200	9/15/2010	12:27:02	12:29:55	12:34:55	0:02:53	0:05:00	0:07:53
778TC	EA500 / J	5,800	9/15/2010	13:03:25	13:05:19	13:06:06	0:01:54	0:00:47	0:02:41
510GG	C510 / J	8,730	9/15/2010	13:51:15	13:54:19	13:54:53	0:03:04	0:00:34	0:03:38
574BP	C560 / J	15,200	9/15/2010	14:15:13	14:18:36	14:22:20	0:03:23	0:03:44	0:07:07
10XQ	G200 / J	30,000	9/15/2010	15:05:16	15:07:20	15:12:00	0:02:04	0:04:40	0:06:44
297MC	CL30 / J	33,750	9/15/2010	15:41:09	15:43:45	15:48:24	0:02:36	0:04:39	0:07:15
916GR	G200 / J	30,000	9/15/2010	15:56:52	15:58:44	16:03:34	0:01:52	0:04:50	0:06:42
311AF	S550 / J	11,000	9/15/2010	16:15:00	16:16:39	16:17:26	0:01:39	0:00:47	0:02:26
260DP	SF260 / T	NA	9/15/2010	16:17:00	16:18:20	16:20:15	0:01:20	0:01:55	0:03:15
151KV	C560 / J	15,200	9/15/2010	16:22:40	16:25:08	16:27:48	0:02:28	0:02:40	0:05:08
942TW	PC12 / T	9,039	9/15/2010	16:55:57	16:57:13	16:57:35	0:01:16	0:00:22	0:01:38
708GP	C525 / J	9,800	9/15/2010	16:58:00	17:00:18	17:10:58	0:02:18	0:10:40	0:12:58
574BP	C560 / J	15,200	9/15/2010	18:25:13	18:27:39	18:30:30	0:02:26	0:02:51	0:05:17
700NW	HS 125-700A / J	21,200	9/16/2010	8:56:45	8:58:15	9:00:41	0:01:30	0:02:26	0:03:56
350BV	C525 / J	9,800	9/16/2010	8:57:01	8:59:52	9:02:55	0:02:51	0:03:03	0:05:54
338FX	CL60 / J	36,000	9/16/2010	9:10:52	9:14:00	9:15:16	0:03:08	0:01:16	0:04:24
298AG	E 125 SERIES 800A	27,500	9/16/2010	9:20:00	9:23:10	9:24:50	0:03:10	0:01:40	0:04:50
442FL	BE40 / J	16,300	9/16/2010	9:30:57	9:34:26	9:35:55	0:03:29	0:01:29	0:04:58
842QS	H800XP / J	21,200	9/16/2010	9:37:32	9:40:41	9:43:09	0:03:09	0:02:28	0:05:37
224MD	EMB-500 / J	10,500	9/16/2010	9:54:11	9:57:38	9:58:39	0:03:27	0:01:01	0:04:28
722SR	TBM700 / T	6,614	9/16/2010	11:26:09	11:28:32	11:30:45	0:02:23	0:02:13	0:04:36
25LZ	C525 / J	9,800	9/16/2010	11:28:39	11:31:47	11:33:54	0:03:08	0:02:07	0:05:15
702DR	E135 / J	40,785	9/16/2010	11:37:45	11:39:15	11:49:30	0:01:30	0:10:15	0:11:45
877SD	C550 / J	12,700	9/16/2010	12:19:02	12:20:51	12:28:45	0:01:49	0:07:54	0:09:43
354EF	LJ35 / J	15,300	9/16/2010	12:22:32	12:26:10	12:30:50	0:03:38	0:04:40	0:08:18
456TM	BE40 / J	16,300	9/17/2010	8:11:47	8:13:48	8:17:44	0:02:01	0:03:56	0:05:57
814TB	PC12 / T	9,039	9/17/2010	8:12:46	8:14:16	8:19:12	0:01:30	0:04:56	0:06:26
679QS	C560 / J	15,200	9/17/2010	8:56:12	8:58:48	8:59:20	0:02:36	0:00:32	0:03:08
165BC	690C / T	10,375	9/17/2010	9:09:08	9:11:13	9:14:37	0:02:05	0:03:24	0:05:29
123GF	C550 / J	12,700	9/17/2010	9:17:52	9:20:36	9:21:20	0:02:44	0:00:44	0:03:28
316AM	B200 / T	12,500	9/17/2010	10:10:38	10:12:26	10:14:49	0:01:48	0:02:23	0:04:11
523FX	CL30 / J	33,750	9/17/2010	10:41:30	10:43:17	10:47:02	0:01:47	0:03:45	0:05:32
510GG	C510 / J	8,730	9/17/2010	11:07:52	11:10:49	11:15:09	0:02:57	0:04:20	0:07:17
808QS	C560 / J	15,200	9/17/2010	11:25:04	11:27:51	11:28:15	0:02:47	0:00:24	0:03:11
188PC	PC12 / T	9,039	9/17/2010	13:01:04	13:03:59	13:07:06	0:02:55	0:03:07	0:06:02
83KA	B200 / T	12,500	9/17/2010	13:16:38	13:18:23	13:20:48	0:01:45	0:02:25	0:04:10
303CP	C560 / J	15,200	9/17/2010	13:18:13	13:21:59	13:30:02	0:03:46	0:08:03	0:11:49
93SF	B100 / T	11,875	9/17/2010	13:37:22	13:41:10	13:43:10	0:03:48	0:02:00	0:05:48
35ET	C550 / J	12,700	9/17/2010	14:10:37	14:13:24	14:14:14	0:02:47	0:00:50	0:03:37
219L	C525 / J	9,800	9/17/2010	14:21:18	14:22:37	14:33:13	0:01:19	0:10:36	0:11:55
646QS	C560 / J	15,200	9/17/2010	15:09:55	15:12:31	15:18:02	0:02:36	0:05:31	0:08:07
554MB	C550 / J	12,700	9/17/2010	15:26:16	15:30:03	15:37:50	0:03:47	0:07:47	0:11:34

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
634QS	C560 / J	15,200	9/17/2010	15:37:25	15:40:32	15:51:10	0:03:07	0:10:38	0:13:45
722SR	TBM700 / T	6,614	9/17/2010	16:07:37	16:09:03	16:15:20	0:01:26	0:06:17	0:07:43
461QS	GLF4 / J	58,500	9/17/2010	16:22:13	16:25:32	16:31:09	0:03:19	0:05:37	0:08:56
573G	SA227-AT / T	14,000	9/17/2010	16:39:20	16:41:15	16:56:51	0:01:55	0:15:36	0:17:31
816CS	C560 / J	15,200	9/17/2010	17:09:25	17:12:02	17:17:55	0:02:37	0:05:53	0:08:30
904DJ	BE90 / T	9,168	9/17/2010	17:12:36	17:14:36	17:20:16	0:02:00	0:05:40	0:07:40
187EA	EA500 / J	5,800	9/17/2010	17:16:04	17:18:24	17:27:02	0:02:20	0:08:38	0:10:58
247CH	BE90 / T	9,168	9/17/2010	17:16:55	17:18:38	17:35:25	0:01:43	0:16:47	0:18:30
533FX	CL30 / J	33,750	9/17/2010	17:32:50	17:36:08	17:42:57	0:03:18	0:06:49	0:10:07
525LM	C525 / J	9,800	9/18/2010	7:17:17	7:19:58	7:25:26	0:02:41	0:05:28	0:08:09
224MD	EMB-500 / J	10,500	9/18/2010	8:34:21	8:36:18	8:39:55	0:01:57	0:03:37	0:05:34
850CA	TBM700 / T	6,614	9/18/2010	11:20:00	11:22:47	11:27:11	0:02:47	0:04:24	0:07:11
816CS	C560 / J	15,200	9/18/2010	12:45:55	12:47:22	12:52:37	0:01:27	0:05:15	0:06:42
961QS	C750 / J	31,800	9/18/2010	13:50:37	13:52:31	13:54:21	0:01:54	0:01:50	0:03:44
417C	C525 / J	9,800	9/18/2010	14:10:32	14:12:40	14:14:51	0:02:08	0:02:11	0:04:19
247CH	BE90 / T	9,168	9/18/2010	14:14:14	14:15:52	14:22:09	0:01:38	0:06:17	0:07:55
610FX	LJ45 / J	19,200	9/18/2010	14:22:44	14:25:01	14:26:57	0:02:17	0:01:56	0:04:13
7UF	GLF4 / J	58,500	9/18/2010	15:37:08	15:38:55	15:41:03	0:01:47	0:02:08	0:03:55
843QS	C560 / J	15,200	9/18/2010	16:12:04	16:12:04	16:13:20	0:00:00	0:01:16	0:01:16
108QS	C560 / J	15,200	9/18/2010	18:05:40	18:05:40	18:11:05	0:00:00	0:05:25	0:05:25
568TT	B200 / T	12,500	9/19/2010	7:26:31	7:28:29	7:29:27	0:01:58	0:00:58	0:02:56
253QS	F2TH / J	33,000	9/19/2010	8:03:21	8:07:41	8:09:33	0:04:20	0:01:52	0:06:12
695GL	LJ45 / J	19,200	9/19/2010	9:16:41	9:20:01	9:20:53	0:03:20	0:00:52	0:04:12
722SR	TBM700 / T	6,614	9/19/2010	10:32:02	10:33:41	10:41:39	0:01:39	0:07:58	0:09:37
224MD	EMB-500 / J	10,500	9/19/2010	11:25:33	11:27:29	11:28:14	0:01:56	0:00:45	0:02:41
360HS	C560 / J	15,200	9/19/2010	12:02:50	12:05:31	12:10:47	0:02:41	0:05:16	0:07:57
829QS	C560 / J	15,200	9/19/2010	12:43:49	12:47:03	12:53:05	0:03:14	0:06:02	0:09:16
421LT	C560 / J	15,200	9/19/2010	13:14:14	13:17:11	13:27:21	0:02:57	0:10:10	0:13:07
100WP	C560 / J	15,200	9/19/2010	13:27:29	13:29:45	13:33:37	0:02:16	0:03:52	0:06:08
739LN	C525 / J	9,800	9/19/2010	13:58:00	14:00:41	14:03:35	0:02:41	0:02:54	0:05:35
188PC	PC12 / T	9,039	9/19/2010	14:11:23	14:13:18	14:13:47	0:01:55	0:00:29	0:02:24
739QS	G200 / J	30,000	9/19/2010	14:46:39	14:49:23	14:50:06	0:02:44	0:00:43	0:03:27
403QS	GLF4 / J	58,500	9/19/2010	15:06:17	15:09:03	15:15:57	0:02:46	0:06:54	0:09:40
664QS	C560 / J	15,200	9/19/2010	15:18:29	15:20:38	15:31:37	0:02:09	0:10:59	0:13:08
123GF	C550 / J	12,700	9/19/2010	16:46:53	16:48:34	16:49:32	0:01:41	0:00:58	0:02:39
316AM	B200 / T	12,500	9/19/2010	16:58:31	17:01:47	17:02:40	0:03:16	0:00:53	0:04:09
323QS	C680 / J	27,100	9/19/2010	17:19:05	17:21:24	17:27:08	0:02:19	0:05:44	0:08:03
83KA	B200 / T	12,500	9/19/2010	18:13:08	18:14:57	18:16:57	0:01:49	0:02:00	0:03:49
778TC	EA500 / J	5,800	9/24/2010	8:46:40	8:49:26	8:54:45	0:02:46	0:05:19	0:08:05
165BC	690C / T	10,375	9/24/2010	9:55:44	9:57:45	9:58:59	0:02:01	0:01:14	0:03:15
46FD	PA42 / T	10,330	9/24/2010	12:11:41	12:13:41	12:21:25	0:02:00	0:07:44	0:09:44
999VK	CL60 / J	36,000	9/24/2010	13:22:15	13:26:41	13:39:01	0:04:26	0:12:20	0:16:46
207DB	B200 / T	12,500	9/24/2010	13:34:22	13:38:27	13:40:06	0:04:05	0:01:39	0:05:44
525LM	C525 / J	9,800	9/24/2010	14:09:44	14:12:57	14:18:35	0:03:13	0:05:38	0:08:51
711SW	GLF4 / J	58,500	9/24/2010	14:26:43	14:29:01	14:37:52	0:02:18	0:08:51	0:11:09
542CS	C560 / J	15,200	9/24/2010	16:09:36	16:13:10	16:19:02	0:03:34	0:05:52	0:09:26
123AC	LJ45 / J	19,200	9/24/2010	16:37:43	16:41:38	16:44:03	0:03:55	0:02:25	0:06:20
644SD	PC12 / T	9,039	9/24/2010	16:46:31	16:47:51	16:53:35	0:01:20	0:05:44	0:07:04
550LG	CL60 / J	36,000	9/24/2010	17:03:15	17:05:01	17:08:45	0:01:46	0:03:44	0:05:30
904FL	E135 / J	40,785	9/24/2010	17:24:50	17:33:12	17:33:58	0:08:22	0:00:46	0:09:08
888MN	PRM1 / T	12,590	9/24/2010	18:08:23	18:10:25	18:16:06	0:02:02	0:05:41	0:07:43
242NA	B200 / T	12,500	9/24/2010	19:03:09	19:05:37	19:06:49	0:02:28	0:01:12	0:03:40
53PE	C560 / J	15,200	9/25/2010	8:01:17	8:04:20	8:08:38	0:03:03	0:04:18	0:07:21
812GJ	H25B / J	27,520	9/25/2010	8:50:27	8:53:38	8:56:07	0:03:11	0:02:29	0:05:40
224MD	EMB500 / J	10,500	9/25/2010	9:52:39	9:54:19	10:01:12	0:01:40	0:06:53	0:08:33
311AF	C550 / J	12,700	9/25/2010	10:44:52	10:47:01	10:54:11	0:02:09	0:07:10	0:09:19
405TM	H800XP / J	21,200	9/25/2010	12:25:30	12:27:48	12:35:14	0:02:18	0:07:26	0:09:44

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
242NA	B200 / T	12,500	9/25/2010	13:22:51	13:24:14	13:25:11	0:01:23	0:00:57	0:02:20
311AF	C550 / J	12,700	9/25/2010	15:04:53	15:06:46	15:09:54	0:01:53	0:03:08	0:05:01
1776C	H25B / J	28,120	9/25/2010	15:32:05	15:32:05	15:34:07	0:00:00	0:02:02	0:02:02
620FX	LJ45 / J	19,200	9/26/2010	9:53:01	9:54:28	10:12:22	0:01:27	0:17:54	0:19:21
357QS	C680 / J	27,100	9/26/2010	10:56:10	10:57:55	11:01:11	0:01:45	0:03:16	0:05:01
278SW	BE90 / T	9,168	9/26/2010	13:07:07	13:08:42	13:14:55	0:01:35	0:06:13	0:07:48
707SG	G200 / J	30,000	9/26/2010	13:22:20	13:24:20	13:25:59	0:02:00	0:01:39	0:03:39
894C	C525 / J	9,800	9/26/2010	13:22:35	13:24:33	13:35:22	0:01:58	0:10:49	0:12:47
925FL	E135 / J	40,785	9/26/2010	13:23:18	13:25:02	13:38:56	0:01:44	0:13:54	0:15:38
732LH	LJ60 / J	19,500	9/26/2010	13:29:11	13:37:29	13:42:53	0:08:18	0:05:24	0:13:42
101AR	B400 / J	15,100	9/26/2010	13:40:42	13:42:57	13:47:58	0:02:15	0:05:01	0:07:16
468LX	B400 / J	15,100	9/26/2010	14:29:55	14:32:21	14:39:58	0:02:26	0:07:37	0:10:03
512TB	C525 / J	9,800	9/26/2010	15:06:16	15:10:28	15:11:15	0:04:12	0:00:47	0:04:59
387HA	LJ35 / J	15,300	9/26/2010	15:23:46	15:25:40	15:26:21	0:01:54	0:00:41	0:02:35
711SW	GLF4 / J	58,500	9/26/2010	18:18:48	18:20:04	18:22:41	0:01:16	0:02:37	0:03:53
732LH	LJ60 / J	19,500	9/26/2010	19:39:48	19:41:19	19:42:19	0:01:31	0:01:00	0:02:31
311AF	C550 / J	12,700	9/27/2010	6:16:33	6:19:20	6:20:08	0:02:47	0:00:48	0:03:35
525LM	C525 / J	9,800	9/27/2010	6:39:22	6:42:07	6:44:15	0:02:45	0:02:08	0:04:53
360DA	PC12 / T	9,039	9/27/2010	7:21:42	7:23:15	7:24:20	0:01:33	0:01:05	0:02:38
421LT	C560 / J	15,200	9/27/2010	8:02:59	8:08:05	8:09:59	0:05:06	0:01:54	0:07:00
462LX	BE40 / J	16,300	9/27/2010	8:07:42	8:10:22	8:11:17	0:02:40	0:00:55	0:03:35
699QS	C560 / J	15,200	9/27/2010	8:59:01	9:01:24	9:04:50	0:02:23	0:03:26	0:05:49
427CS	C525 / J	9,800	9/27/2010	9:08:28	9:11:38	9:15:00	0:03:10	0:03:22	0:06:32
888QS	H900-XP / J	28,120	9/27/2010	9:09:59	9:12:42	9:16:30	0:02:43	0:03:48	0:06:31
154SC	C501 / J	12,000	9/27/2010	9:28:00	9:30:09	9:35:22	0:02:09	0:05:13	0:07:22
643QS	C560 / J	15,200	9/27/2010	9:52:08	9:54:12	9:55:02	0:02:04	0:00:50	0:02:54
165BC	690C / J	10,375	9/27/2010	9:55:59	9:57:30	10:01:17	0:01:31	0:03:47	0:05:18
542FX	CL30 / J	33,750	9/27/2010	11:05:09	11:08:36	11:10:16	0:03:27	0:01:40	0:05:07
812LX	H800XP / J	21,200	9/27/2010	11:15:35	11:18:46	11:24:23	0:03:11	0:05:37	0:08:48
594M	C560 / J	15,200	9/27/2010	12:35:02	12:39:07	12:47:39	0:04:05	0:08:32	0:12:37
909PM	F900 / J	42,000	9/27/2010	13:15:43	13:18:52	13:20:14	0:03:09	0:01:22	0:04:31
888MN	PRM1 / J	12,590	9/27/2010	16:29:08	16:31:59	16:37:18	0:02:51	0:05:19	0:08:10
113BG	C525 / J	9,800	9/27/2010	17:05:33	17:07:51	17:09:31	0:02:18	0:01:40	0:03:58
708GP	C525 / J	9,800	9/27/2010	17:13:19	17:16:37	17:17:05	0:03:18	0:00:28	0:03:46
350WA	BE90 / T	9,168	9/27/2010	19:10:16	19:14:15	19:14:40	0:03:59	0:00:25	0:04:24
894C	C525 / J	9,800	9/28/2010	6:33:41	6:37:06	6:43:33	0:03:25	0:06:27	0:09:52
987QS	C750 / J	31,800	9/28/2010	6:52:24	6:55:03	6:59:04	0:02:39	0:04:01	0:06:40
904PA	BE90 / T	9,168	9/28/2010	6:56:38	6:57:53	6:58:01	0:01:15	0:00:08	0:01:23
888QS	H900XP / J	28,120	9/28/2010	7:28:26	7:31:55	7:33:49	0:03:29	0:01:54	0:05:23
151KV	C560 / J	15,200	9/28/2010	7:50:10	7:52:27	7:56:18	0:02:17	0:03:51	0:06:08
414TR	F2TH / J	33,000	9/28/2010	10:50:46	10:53:56	10:57:37	0:03:10	0:03:41	0:06:51
713FL	C750 / J	31,800	9/28/2010	11:02:51	11:07:01	11:09:02	0:04:10	0:02:01	0:06:11
818QS	C560 / J	15,200	9/28/2010	12:20:10	12:24:05	12:30:05	0:03:55	0:06:00	0:09:55
405QS	GLF4 / J	58,500	9/28/2010	13:26:08	13:29:12	13:31:18	0:03:04	0:02:06	0:05:10
529FD	TBM700 / T	6,614	9/28/2010	13:45:23	13:47:28	13:50:00	0:02:05	0:02:32	0:04:37
999JD	C510 / J	8,730	9/28/2010	14:05:32	14:07:44	14:13:29	0:02:12	0:05:45	0:07:57
151KV	C560 / J	15,200	9/28/2010	15:05:23	15:08:16	15:16:39	0:02:53	0:08:23	0:11:16
144AL	C525 / J	9,800	9/28/2010	15:39:53	15:42:43	15:47:22	0:02:50	0:04:39	0:07:29
417C	C525 / J	9,800	9/28/2010	15:53:23	15:55:07	16:01:02	0:01:44	0:05:55	0:07:39
7UF	GLF4 / J	58,500	9/28/2010	15:58:09	15:59:15	16:08:12	0:01:06	0:08:57	0:10:03
469MA	MU-2B-60 / T	9,970	9/28/2010	16:00:53	16:03:28	16:05:31	0:02:35	0:02:03	0:04:38
350TP	SF.260TP / T	NA	9/28/2010	16:06:07	16:09:22	16:11:54	0:03:15	0:02:32	0:05:47
419TM	BE40 / J	16,300	9/28/2010	16:31:31	16:34:16	16:35:26	0:02:45	0:01:10	0:03:55
904PA	BE90 / T	9,168	9/28/2010	16:45:10	16:46:29	16:46:54	0:01:19	0:00:25	0:01:44
708GP	C525 / J	9,800	9/28/2010	17:05:39	17:07:49	17:08:29	0:02:10	0:00:40	0:02:50
927LT	C680 / J	27,100	9/28/2010	17:08:23	17:11:19	17:16:56	0:02:56	0:05:37	0:08:33
888QS	H900-XP / J	28,120	9/28/2010	18:12:51	18:16:15	18:20:36	0:03:24	0:04:21	0:07:45

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
N200VT	C550 / J	12,700	9/28/2010	18:48:37	18:50:30	18:58:29	0:01:53	0:07:59	0:09:52
N542FX	CL30 / J	33,750	9/28/2010	19:10:38	19:12:26	19:14:02	0:01:48	0:01:36	0:03:24
462LX	BE40 / J	16,300	9/29/2010	6:41:01	6:44:12	6:46:26	0:03:11	0:02:14	0:05:25
904PA	BE40 / J	16,300	9/29/2010	6:48:40	6:50:43	6:50:59	0:02:03	0:00:16	0:02:19
575JS	EMB500 / J	10,500	9/29/2010	7:46:25	7:49:40	7:58:19	0:03:15	0:08:39	0:11:54
700ER	TBM700 / T	6,614	9/29/2010	8:15:48	8:27:41	8:30:09	0:11:53	0:02:28	0:14:21
423SJ	H800XP / J	21,200	9/29/2010	8:47:39	8:49:52	8:51:25	0:02:13	0:01:33	0:03:46
722SR	TBM700 / T	6,614	9/29/2010	9:24:11	9:25:51	9:29:11	0:01:40	0:03:20	0:05:00
204PT	B200 / T	12,500	9/29/2010	9:36:10	9:37:44	9:41:34	0:01:34	0:03:50	0:05:24
308QS	C680 / J	27,100	9/29/2010	10:00:31	10:04:17	10:08:23	0:03:46	0:04:06	0:07:52
642JC	F900 / J	42,000	9/29/2010	10:47:13	10:51:14	10:52:30	0:04:01	0:01:16	0:05:17
350TP	SF.260TP / T	NA	9/29/2010	11:05:47	11:07:31	11:12:28	0:01:44	0:04:57	0:06:41
908QS	C750 / J	31,800	9/29/2010	11:17:48	11:20:27	11:25:12	0:02:39	0:04:45	0:07:24
952QS	C750 / J	31,800	9/29/2010	13:00:32	13:05:47	13:07:49	0:05:15	0:02:02	0:07:17
204PT	B200 / T	12,500	9/29/2010	13:01:52	13:05:52	13:12:09	0:04:00	0:06:17	0:10:17
700ER	TBM700 / T	6,614	9/29/2010	14:30:46	14:32:22	14:36:06	0:01:36	0:03:44	0:05:20
485FL	B400 / J	15,100	9/29/2010	15:32:07	15:35:44	15:37:47	0:03:37	0:02:03	0:05:40
XA-PVR	C525 / J	9,800	9/29/2010	16:11:10	16:15:24	16:24:42	0:04:14	0:09:18	0:13:32
151KV	C560 / J	15,200	9/29/2010	16:14:50	16:18:07	16:32:40	0:03:17	0:14:33	0:17:50
1BS	C750 / J	31,800	9/29/2010	16:21:08	16:23:13	16:36:57	0:02:05	0:13:44	0:15:49
904PA	BE90 / T	9,168	9/29/2010	16:31:49	16:33:26	16:33:44	0:01:37	0:00:18	0:01:55
708GP	C525 / J	9,800	9/29/2010	16:44:59	16:47:51	16:50:26	0:02:52	0:02:35	0:05:27
828QS	H800XP / J	21,200	9/29/2010	16:45:48	16:48:00	16:51:50	0:02:12	0:03:50	0:06:02
350BV	C525 / J	9,800	9/29/2010	17:09:18	17:10:34	17:10:43	0:01:16	0:00:09	0:01:25
423SJ	H25B / J	27,500	9/29/2010	17:46:07	17:48:57	17:53:32	0:02:50	0:04:35	0:07:25
241CW	B100 / T	11,875	9/29/2010	18:51:00	18:53:11	18:53:57	0:02:11	0:00:46	0:02:57
673DC	EMB500 / J	10,500	9/30/2010	6:29:14	6:30:49	6:31:44	0:01:35	0:00:55	0:02:30
575JS	EMB500 / J	10,500	9/30/2010	7:02:30	7:04:07	7:07:17	0:01:37	0:03:10	0:04:47
650LG	CL60 / J	36,000	9/30/2010	7:05:12	7:08:47	7:14:07	0:03:35	0:05:20	0:08:55
188PC	PC12 / T	9,039	9/30/2010	7:34:08	7:36:07	7:36:45	0:01:59	0:00:38	0:02:37
256FX	LJ60 / J	19,500	9/30/2010	8:12:12	8:14:59	8:15:42	0:02:47	0:00:43	0:03:30
888QS	H900-XP / J	28,120	9/30/2010	8:13:02	8:15:37	8:16:16	0:02:35	0:00:39	0:03:14
999YB	BE40 / J	16,300	9/30/2010	9:03:02	9:06:52	9:09:54	0:03:50	0:03:02	0:06:52
581JS	EMB500 / J	10,500	9/30/2010	9:18:31	9:20:23	9:20:43	0:01:52	0:00:20	0:02:12
134LJ	LJ31 / J	15,300	9/30/2010	10:10:44	10:12:39	10:13:37	0:01:55	0:00:58	0:02:53
311AF	C550 / J	12,700	9/30/2010	10:20:46	10:22:29	10:24:53	0:01:43	0:02:24	0:04:07
542BA	CL60 / J	36,000	9/30/2010	10:53:27	10:55:38	11:04:12	0:02:11	0:08:34	0:10:45
722SR	TBM700 / T	6,614	9/30/2010	11:31:00	11:32:05	11:42:30	0:01:05	0:10:25	0:11:30
608DC	ASTRA SPX / J	24,800	9/30/2010	11:34:25	11:36:34	11:41:31	0:02:09	0:04:57	0:07:06
420EH	C525 / J	9,800	9/30/2010	12:29:14	12:31:25	12:32:40	0:02:11	0:01:15	0:03:26
469MA	MU-2B-60 / T	9,970	9/30/2010	13:07:20	13:09:33	13:11:16	0:02:13	0:01:43	0:03:56
486QS	GLF4 / J	58,500	9/30/2010	13:09:36	13:12:01	13:15:13	0:02:25	0:03:12	0:05:37
575JS	EMB500 / J	10,500	9/30/2010	13:11:56	13:13:38	13:16:20	0:01:42	0:02:42	0:04:24
564RM	1124A / J	23,650	9/30/2010	13:17:52	13:21:06	13:21:34	0:03:14	0:00:28	0:03:42
188PC	PC12 / T	9,039	9/30/2010	13:19:21	13:21:57	13:22:28	0:02:36	0:00:31	0:03:07
417C	C525 / J	9,800	9/30/2010	13:33:14	13:35:09	13:37:31	0:01:55	0:02:22	0:04:17
54NW	LJ55 / J	18,000	9/30/2010	14:42:45	14:45:46	14:49:15	0:03:01	0:03:29	0:06:30
222MC	CL60 / J	36,000	9/30/2010	14:43:49	14:45:54	14:50:25	0:02:05	0:04:31	0:06:36
731PS	BE40 / J	16,300	9/30/2010	14:55:34	14:58:55	15:01:14	0:03:21	0:02:19	0:05:40
125BP	PC12 / T	9,039	9/30/2010	15:59:39	16:02:19	16:02:33	0:02:40	0:00:14	0:02:54
942TW	PC12 / T	9,039	9/30/2010	16:04:06	16:06:10	16:07:19	0:02:04	0:01:09	0:03:13
428LX	BE40 / J	16,300	9/30/2010	16:38:35	16:41:44	16:44:58	0:03:09	0:03:14	0:06:23
946QS	C750 / J	31,800	9/30/2010	17:08:17	17:11:23	17:16:29	0:03:06	0:05:06	0:08:12
312CC	LJ31 / J	15,300	9/30/2010	17:10:00	17:11:39	17:28:31	0:01:39	0:16:52	0:18:31
583QS	C560 / J	15,200	9/30/2010	18:28:20	18:34:36	18:40:13	0:06:16	0:05:37	0:11:53
599QS	C560 / J	15,200	9/30/2010	18:35:04	18:37:31	18:41:29	0:02:27	0:03:58	0:06:25
118MT	CL60 / J	36,000	9/30/2010	19:00:55	19:03:49	19:04:38	0:02:54	0:00:49	0:03:43

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
288MB	H900XP / J	28,120	9/30/2010	19:33:57	19:36:01	19:36:50	0:02:04	0:00:49	0:02:53
904PA	BE90 / T	9,168	10/1/2010	6:09:15	6:10:03	6:10:28	0:00:48	0:00:25	0:01:13
821LX	H800XP / J	21,200	10/1/2010	7:06:15	7:08:46	7:12:48	0:02:31	0:04:02	0:06:33
904FL	E135 / J	40,785	10/1/2010	7:15:49	7:18:31	7:20:44	0:02:42	0:02:13	0:04:55
888QS	H900XP / J	28,120	10/1/2010	7:21:02	7:24:05	7:25:33	0:03:03	0:01:28	0:04:31
417Q	C525 / J	9,800	10/1/2010	8:05:12	8:09:56	8:10:14	0:04:44	0:00:18	0:05:02
642JL	B300 / T	14,000	10/1/2010	8:27:23	8:31:10	8:40:55	0:03:47	0:09:45	0:13:32
OY-LPU	C510 / J	8,730	10/1/2010	9:57:33	10:00:07	10:00:44	0:02:34	0:00:37	0:03:11
122QS	BE40 / J	16,300	10/1/2010	10:00:48	10:02:42	10:04:20	0:01:54	0:01:38	0:03:32
480QS	GLF4 / J	58,500	10/1/2010	10:21:09	10:25:31	10:28:21	0:04:22	0:02:50	0:07:12
852LX	H800XP / J	21,200	10/1/2010	10:44:59	10:47:31	10:48:13	0:02:32	0:00:42	0:03:14
819AP	G200 / J	30,000	10/1/2010	10:48:18	10:50:26	10:55:26	0:02:08	0:05:00	0:07:08
614BA	CL60 / J	36,000	10/1/2010	11:18:17	11:20:56	11:22:51	0:02:39	0:01:55	0:04:34
969WR	G150 / J	26,250	10/1/2010	11:25:38	11:28:05	11:36:47	0:02:27	0:08:42	0:11:09
409CS	C525 / J	9,800	10/1/2010	11:53:06	11:55:12	11:55:45	0:02:06	0:00:33	0:02:39
49CL	B300 / T	14,000	10/1/2010	11:57:18	11:59:04	12:43:09	0:01:46	0:44:05	0:45:51
802QS	C560 / J	15,200	10/1/2010	12:47:57	12:50:00	12:53:15	0:02:03	0:03:15	0:05:18
807SM	B200 / T	12,500	10/1/2010	12:48:12	12:50:15	12:54:19	0:02:03	0:04:04	0:06:07
814TB	PC12 / T	9,039	10/1/2010	12:53:11	12:55:04	12:59:49	0:01:53	0:04:45	0:06:38
510HS	C510 / J	8,730	10/1/2010	13:09:01	13:27:22	13:41:43	0:18:21	0:14:21	0:32:42
300TN	B300 / T	14,000	10/1/2010	13:19:54	13:25:10	13:25:19	0:05:16	0:00:09	0:05:25
830QS	C560 / J	15,200	10/1/2010	13:59:36	14:03:25	14:28:05	0:03:49	0:24:40	0:28:29
526FX	CL30 / J	33,750	10/1/2010	14:00:20	14:03:39	14:11:11	0:03:19	0:07:32	0:10:51
707AV	TBM700 / T	6,614	10/1/2010	14:15:47	14:17:18	14:22:57	0:01:31	0:05:39	0:07:10
56RJ	PC12 / T	9,039	10/1/2010	14:23:30	14:25:07	14:26:54	0:01:37	0:01:47	0:03:24
360DA	PC12 / T	9,039	10/1/2010	14:29:09	14:31:29	14:35:47	0:02:20	0:04:18	0:06:38
311QS	C680 / J	27,100	10/1/2010	14:51:49	14:54:34	15:03:46	0:02:45	0:09:12	0:11:57
910LX	E135 / J	40,785	10/1/2010	15:02:24	15:05:26	15:08:35	0:03:02	0:03:09	0:06:11
525LM	C525 / J	9,800	10/1/2010	15:04:00	15:05:41	15:10:09	0:01:41	0:04:28	0:06:09
673DC	EMB500 / J	10,500	10/1/2010	15:21:02	15:23:36	15:40:25	0:02:34	0:16:49	0:19:23
421LT	C560 / J	15,200	10/1/2010	15:23:38	15:26:48	15:38:05	0:03:10	0:11:17	0:14:27
10655	B100 / T	11,875	10/1/2010	15:34:39	15:38:43	15:41:11	0:04:04	0:02:28	0:06:32
OY-LPU	C510 / J	8,730	10/1/2010	15:43:24	15:45:31	15:46:15	0:02:07	0:00:44	0:02:51
181SG	C560 / J	15,200	10/1/2010	15:45:20	15:47:54	15:49:31	0:02:34	0:01:37	0:04:11
510HS	C510 / J	8,730	10/1/2010	15:49:02	15:54:10	15:54:22	0:05:08	0:00:12	0:05:20
650LG	CL60 / J	36,000	10/1/2010	16:17:23	16:19:30	16:19:56	0:02:07	0:00:26	0:02:33
731PS	BE40 / J	16,300	10/1/2010	16:22:48	16:25:34	16:26:43	0:02:46	0:01:09	0:03:55
420EH	C525 / J	9,800	10/1/2010	16:35:22	16:38:38	16:48:16	0:03:16	0:09:38	0:12:54
708GP	C525 / J	9,800	10/1/2010	16:58:53	17:01:57	17:02:32	0:03:04	0:00:35	0:03:39
7UF	GLF4 / J	58,500	10/1/2010	18:34:40	18:37:39	18:39:27	0:02:59	0:01:48	0:04:47
288MB	H900XP / J	28,120	10/1/2010	18:35:59	18:38:43	18:40:41	0:02:44	0:01:58	0:04:42
982QS	C750 / J	31,800	10/1/2010	19:08:21	19:11:31	19:13:31	0:03:10	0:02:00	0:05:10
453GS	CL60 / J	36,000	10/2/2010	7:42:15	7:45:12	7:56:39	0:02:57	0:11:27	0:14:24
828VV	PC12 / T	9,039	10/2/2010	7:52:07	7:54:40	7:57:22	0:02:33	0:02:42	0:05:15
246GS	C525 / J	9,800	10/2/2010	8:59:59	9:02:15	9:06:07	0:02:16	0:03:52	0:06:08
360AV	G150 / J	26,250	10/2/2010	9:05:17	9:07:50	9:13:04	0:02:33	0:05:14	0:07:47
842FL	H800XP / J	21,200	10/2/2010	10:29:19	10:31:51	10:34:07	0:02:32	0:02:16	0:04:48
600QS	C560 / J	15,200	10/2/2010	10:48:01	10:51:14	10:54:51	0:03:13	0:03:37	0:06:50
117WR	GLF4 / J	58,500	10/2/2010	11:24:31	11:28:17	11:30:06	0:03:46	0:01:49	0:05:35
85ER	C525 / J	9,800	10/2/2010	12:02:46	12:06:10	12:11:38	0:03:24	0:05:28	0:08:52
583QS	C560 / J	15,200	10/2/2010	12:03:22	12:05:55	12:12:12	0:02:33	0:06:17	0:08:50
101AR	BE40 / J	16,300	10/2/2010	12:36:58	12:39:36	12:46:11	0:02:38	0:06:35	0:09:13
897QS	H900-XP / J	28,120	10/2/2010	13:18:25	13:21:33	13:22:38	0:03:08	0:01:05	0:04:13
929QS	C750 / J	31,800	10/2/2010	13:23:20	13:25:24	13:31:55	0:02:04	0:06:31	0:08:35
580QS	C560 / J	15,200	10/2/2010	13:35:11	13:37:20	13:38:44	0:02:09	0:01:24	0:03:33
300TN	B300 / T	14,000	10/2/2010	13:44:21	13:45:13	13:45:38	0:00:52	0:00:25	0:01:17
536FX	CL30 / J	33,750	10/2/2010	14:12:12	14:14:38	14:16:20	0:02:26	0:01:42	0:04:08

Aircraft No.	Aircraft Model / Type	Aircraft Weight	Date	Taxi Begins (a)	Hold Begins (b)	Departure Time (c)	Total Taxi (b-a)	Total Hold (c-b)	Grand Total (c-a)
417C	C525 / J	9,800	10/2/2010	14:24:02	14:25:40	14:26:11	0:01:38	0:00:31	0:02:09
399QS	C560 / J	15,200	10/2/2010	16:08:30	16:10:44	16:14:27	0:02:14	0:03:43	0:05:57
41VP	C560 / J	15,200	10/2/2010	16:43:00	16:45:06	16:50:00	0:02:06	0:04:54	0:07:00
972MS	GLF4 / J	58,500	10/2/2010	17:06:00	17:08:42	17:11:31	0:02:42	0:02:49	0:05:31
888QS	H900-XP / J	28,120	10/2/2010	18:01:27	18:03:42	18:05:21	0:02:15	0:01:39	0:03:54
7UF	GLF4 / J	58,500	10/2/2010	19:48:16	19:51:31	19:54:05	0:03:15	0:02:34	0:05:49
599QS	C56X / J	20,200	10/2/2010	19:55:44	19:57:40	19:58:30	0:01:56	0:00:50	0:02:46
755PA	GALX / J	35,000	10/3/2010	8:05:56	8:08:31	8:11:39	0:02:35	0:03:08	0:05:43
215QS	F2TH / J	33,000	10/3/2010	8:57:39	9:00:02	9:00:38	0:02:23	0:00:36	0:02:59
8096U	BE90 / T	9,168	10/3/2010	9:36:34	9:39:18	9:43:02	0:02:44	0:03:44	0:06:28
902DW	F900 / J	42,000	10/3/2010	9:50:51	9:53:57	9:55:15	0:03:06	0:01:18	0:04:24
682QS	C560 / J	15,200	10/3/2010	9:55:07	9:57:09	10:02:21	0:02:02	0:05:12	0:07:14
486QS	GLF4 / J	58,500	10/3/2010	10:24:09	10:27:32	10:30:24	0:03:23	0:02:52	0:06:15
134LJ	LJ31 / J	15,300	10/3/2010	11:06:23	11:08:44	11:09:13	0:02:21	0:00:29	0:02:50
805LX	H800XP / J	21,200	10/3/2010	11:09:57	11:12:14	11:16:43	0:02:17	0:04:29	0:06:46
904FL	E135 / J	40,785	10/3/2010	11:14:15	11:16:31	11:18:07	0:02:16	0:01:36	0:03:52
11BV	F2TH / J	33,000	10/3/2010	11:45:38	11:48:27	11:51:29	0:02:49	0:03:02	0:05:51
453GS	CL60 / J	36,000	10/3/2010	12:13:01	12:16:13	12:18:41	0:03:12	0:02:28	0:05:40
708GP	C525 / J	9,800	10/3/2010	12:26:50	12:29:33	12:40:51	0:02:43	0:11:18	0:14:01
888QS	H900XP / J	28,120	10/3/2010	12:54:55	12:57:23	13:02:27	0:02:28	0:05:04	0:07:32
312CC	LJ31 / J	15,300	10/3/2010	13:20:26	13:23:02	13:24:49	0:02:36	0:01:47	0:04:23
525KR	C525 / J	9,800	10/3/2010	13:56:08	13:59:14	13:59:36	0:03:06	0:00:22	0:03:28
466MW	B200 / T	12,500	10/3/2010	14:42:18	14:44:06	14:45:42	0:01:48	0:01:36	0:03:24
417TM	H800XP / J	21,200	10/3/2010	15:07:27	15:10:28	15:30:12	0:03:01	0:19:44	0:22:45
602LP	F2TH / J	33,000	10/3/2010	16:04:50	16:07:31	16:08:36	0:02:41	0:01:05	0:03:46
22UL	S550 / J	11,000	10/3/2010	16:24:11	16:28:37	16:34:39	0:04:26	0:06:02	0:10:28
512TB	C525 / J	9,800	10/3/2010	16:47:27	16:51:07	16:52:08	0:03:40	0:01:01	0:04:41
673DC	EMB500 / J	10,500	10/3/2010	18:12:08	18:14:43	18:16:00	0:02:35	0:01:17	0:03:52
645PC	PC12 / T	9,039	10/3/2010	18:27:43	18:30:12	18:40:08	0:02:29	0:09:56	0:12:25
246GS	C525 / J	9,800	10/3/2010	18:52:45	18:56:00	18:57:15	0:03:15	0:01:15	0:04:30