

## Appendix A

Figure A1 – Time-series of N1 fan speed (% of maximum) and exhaust gas temperature for experiments conducted (a) 4% load, (b) 7% (c) 30% and (d) 85% engine loads. Warm-up and chamber sampling periods are indicated by vertical grey bars.

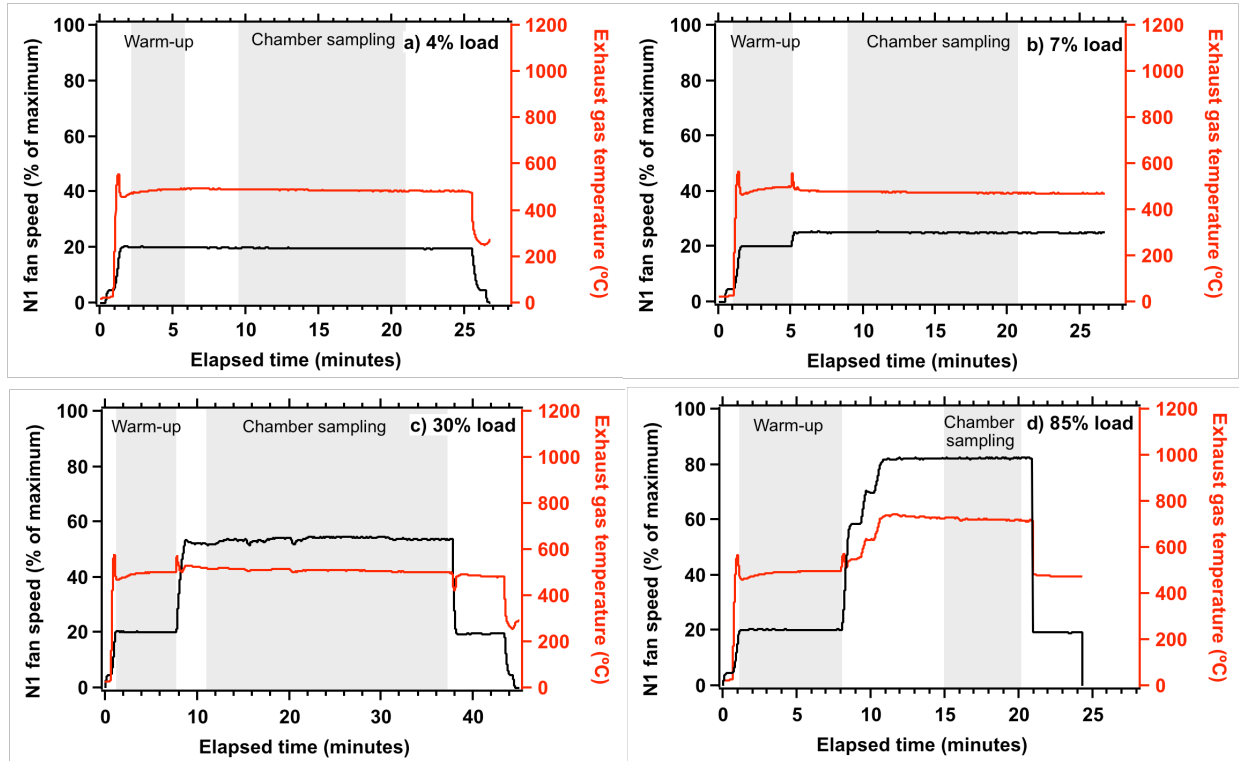


Figure A2 – Particle number concentrations for photo-oxidation at 30% engine load. Dashed line represents exponential fit to particle number data during primary characterization period. Particle number enhancement ratio is defined as ratio between particle number and exponential fit. Similar fits were performed for experiments at other engine loads.

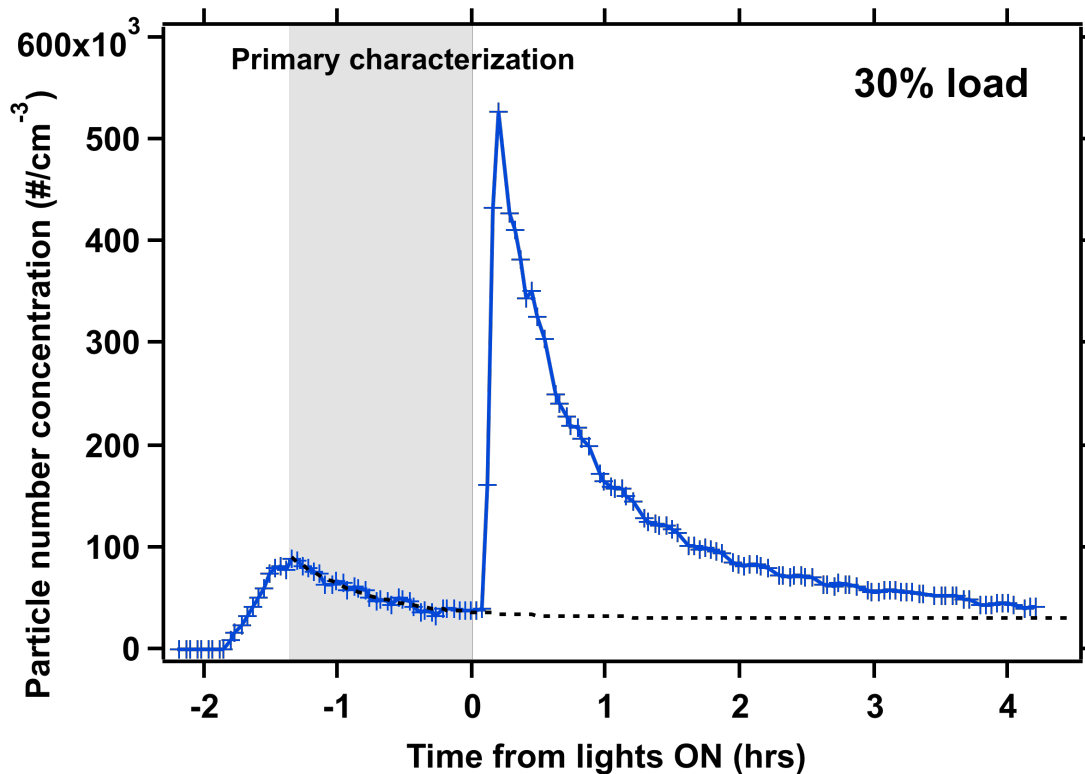


Table A1 – Summary of experiments conducted during this study. <sup>a</sup>No SO<sub>2</sub> data collected.

	Experiment date	Thrust setting	Fan Speed (N1)	UV light source	Average [OH] (molecules/cm <sup>3</sup> )
1	07/15/09	7%	24.8	Black lights	<sup>a</sup>
2	07/16/09	7%	24.5	Sunlight	<sup>a</sup>
3	07/17/09	30%	53.7	Black lights	1.3 x 10 <sup>6</sup>
4	07/20/09	4%	19.2	Black lights	1.4 x 10 <sup>7</sup>
5	07/21/09	4%	19.0	Sunlight	1.2 x 10 <sup>7</sup>
6	07/22/09	85%	82.2	Sunlight	1.9 x 10 <sup>6</sup>
7	07/23/09	7% (center port)	25.1	Black lights	1.9 x 10 <sup>6</sup>
8	07/24/09	4%	19.7	Black lights	1.0 x 10 <sup>7</sup>

Table A2 – Summary of criteria gas emissions for tests conducted with KC-135 Stratotanker  
<sup>a</sup>Gas-phase data not available <sup>b</sup>Exhaust gas analyzer not operated for this experiment; all measurements taken from chamber data

	Experiment date	Thrust setting	NO (g/kg-fuel <sup>-1</sup> )	NO <sub>x</sub> (g/kg-fuel <sup>-1</sup> )	CO (g/kg-fuel <sup>-1</sup> )	SO <sub>2</sub> (g/kg-fuel <sup>-1</sup> )	CO <sub>2</sub> at engine exit plane (%)
1	07/15/09	7%	a	a	a	a	a
2	07/16/09	7%	a	a	a	a	a
3	07/17/09	30%	8.74	8.74	7.52	1.32	3.00
4	07/20/09	4%	0.37	1.57	56.0	1.20	2.75
5	07/21/09	4%	0.35	1.86	66.5	1.14	2.76
6	07/22/09	85%	15.4	15.4	4.28	1.39	4.07
7	07/23/09	7% (center port)	1.27	2.46	60.4	1.17	2.83
8	07/24/09	4%	0.57	1.79	b	1.04	b

Table A3 – Fuel properties of jet fuel (JP-8) using for all tests during this study.

	Units	Value	ASTM Method
Hydrogen	Wt %	14.0	D3701
Aromatics	Vol %	14.1	D1319
Olefins	Vol %	1.4	D1319
Saturates	Vol %	84.5	D1319
Naphthalenes	Vol %	1.26	D1840
Sulfur	ppmw	608	D5453

Table A4 – List of SOA precursors and lumping used in SOAM-II model. VOC emission factors calculated from SUMMA canisters measurements (Presto et al., 2010). <sup>a</sup>Not detected.

SOAM II compound class	Precursor species	4% (mg kg fuel <sup>-1</sup> )	85% (mg kg fuel <sup>-1</sup> )
ALK4	propane	37.4	32.6
	isobutane	42.7	42.2
	butane	24.8	29.2
	isopentane	34.0	29.9
	pentane	12.0	15.6
	cyclopentane	12.6	1.8
	2,3-dimethylbutane	2.8	2.0
	2-methylpentane	50.2	1.0
	3-methylpentane	12.5	<sup>a</sup>
hexane	15.4	2.4	

	methylcyclopentane	11.2	a
ALK5	cyclopropane	2.9	a
	cyclohexane	51.9	a
	2-methylhexane/2,3-dimethylpentane	6.7	a
	3-methylhexane	24.5	a
	2,2-dimethylbutane	1.5	a
	heptane	5.9	a
	methylcyclohexane	14.4	a
	2,3,4-trimethylpentane	5.3	a
	2-methylheptane	7.1	a
	4-methylheptane	5.6	1.8
	3-methylheptane	5.7	2.9
	octane	7.5	0.9
	nonane	36.1	a
	decane	2.5	33.4
	undecane	93.7	15.8
	dodecane	108.3	16.1
	tridecane	47.4	1.9
tetradecane	4.9	0.9	
ARO1	ethylbenzene	3.9	1.0
	isopropylbenzene	4.8	0.8
	propylbenzene	16.6	1.4
	sec-butylbenzene	39.4	1.6
	butylbenzene	8.5	a
ARO2	p-xylene	4.8	3.8
	o-xylene	5.2	a
	3-ethyltoluene	15.8	a
	4-ethyltoluene	7.7	3.1
	1,3,5-trimethylbenzene	14.4	1.0
	2-ethyltoluene	12.6	34.2
	1,2,4-trimethylbenzene/tert-butylbenzene	41.9	7.4
	1,2,3-trimethylbenzene	47.0	1.7
	1,3-diethylbenzene	10.2	1.8
	1,4-diethylbenzene	46.7	1.9
	1,2-diethylbenzene	10.9	1.9
	hexylbenzene	16.6	a
	1,2,4,5-tetramethylbenzene	27.2	a
OLE1	propene	696.2	6.3
	1-butene	194.6	2.2
	1-pentene	91.2	10.8
	trans-2-pentene	15.7	a

	cis-2-pentene	8.4	a
	1-hexene	81.1	a
	cis-3-hexene	7.2	a
	trans-2-hexene	9.5	a
	2-methyl-2-pentene	2.1	0.6
	c-2-hexene	6.1	14.4
	1,3-hexadiene (trans)	6.3	a
	1-octene	5.9	1.2
	1-heptene and 2,2,4 - trimethylpentane	61.5	a
OLE2	iso-butene	71.7	5.5
	1,3-butadiene	230.3	a
	trans-2-butene	61.0	4.3
	cis-2-butene	11.7	0.9
	1,2-butadiene	6.4	a
	3-methyl-1-butene	29.5	a
	2-methyl-1-butene	30.3	1.0
	2-methyl-2-butene	6.0	a
	cyclopentene	95.5	a
	4-methyl-1-pentene and 3-methyl-1-pentene	27.2	0.7
	2-methyl-1-pentene	10.6	a
	cyclohexene	14.5	3.7
	2,3-dimethyl-2-pentene	7.5	1.0
styrene	8.2	a	
TOL	Toluene	84.7	3.0
BEN	Benzene	232.0	72.4
MXY	m-xylene	26.4	1.1
NAP	Napthalene	45.9	1.6