ADDITIONAL MATERIALS AVAILABLE ON THE HEI WEB SITE

Research Report 184

Advanced Collaborative Emissions Study (ACES): Lifetime Cancer and Non-Cancer Assessment in Rats Exposed to New-Technology Diesel Exhaust

Part 1. Assessment of Carcinogenicity and Biologic Responses in Rats after Lifetime Inhalation of New-Technology Diesel Exhaust in the ACES Bioassay

Appendix I. Characterization of Exposure Atmospheres in the ACES Bioassay

McDonald et al.

Additional Materials I.A. Engine and Dilution System

Additional Materials may appear in a different order from that in the original Investigators' Report, and some remnants of their original names may be apparent.

Additional Materials I.A was originally Appendix A.

The HEI Exposure Characterization Panel reviewed the draft of this appendix but not the final version. This appendix did not undergo the HEI scientific editing and production process but was proofread for spelling and grammar only.

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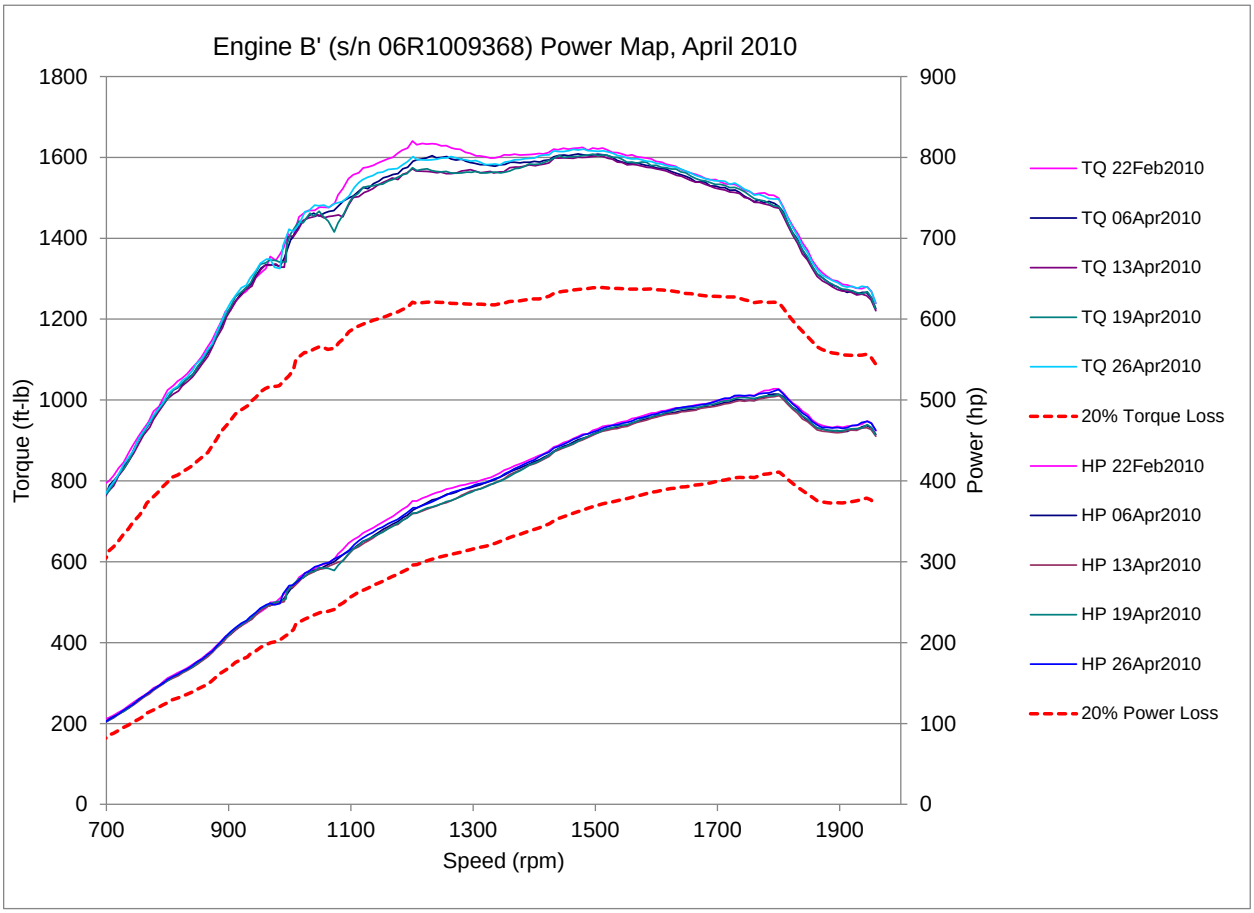
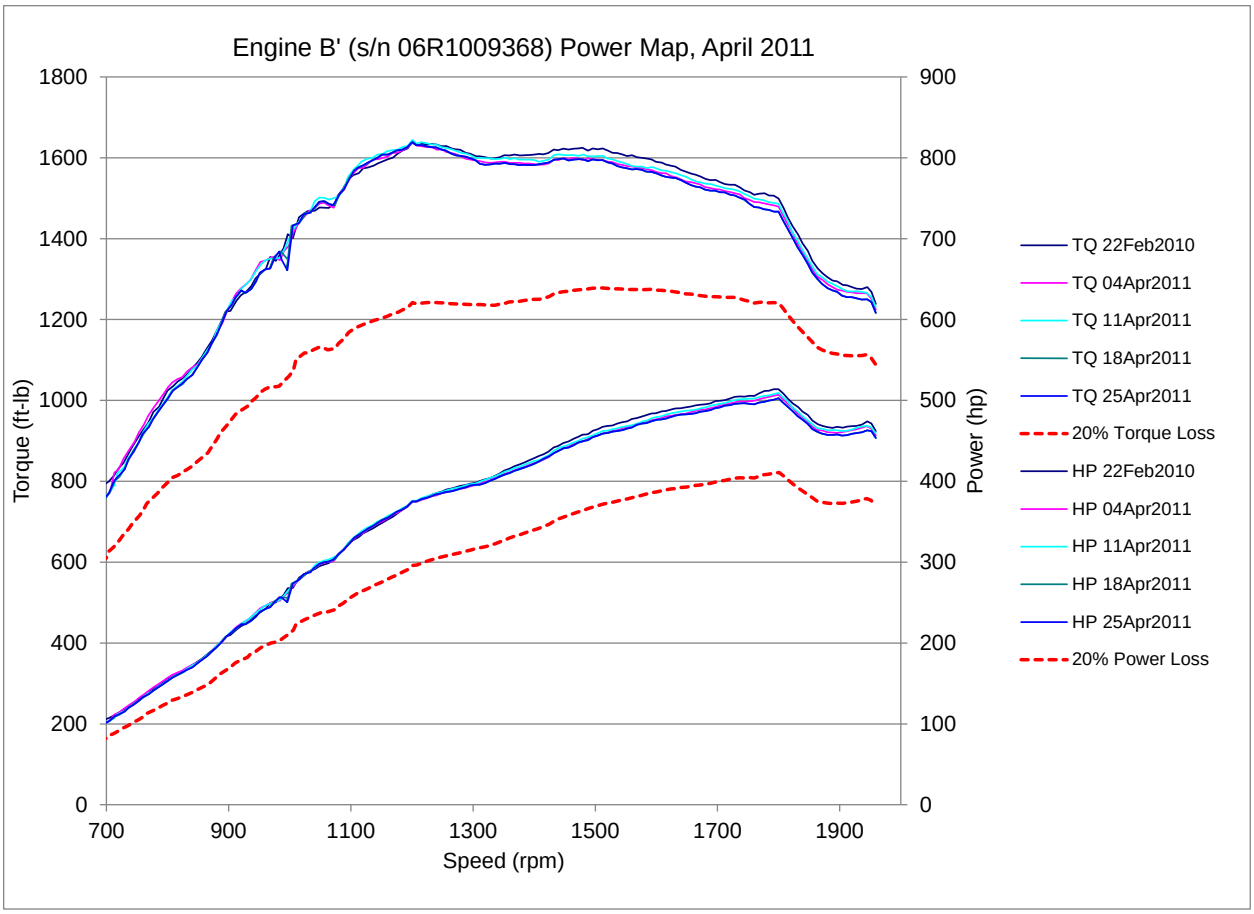
Although this document was produced with partial funding by the United States Department of Energy (DOE), under the terms of Contract/Award Number DE-AC26-05NT42429, and certain motor vehicle and engine manufacturers, the opinion expressed herein are those of the authors and do not necessarily reflect the views of the DOE or motor vehicle and engine manufacturers.

Appendix A.

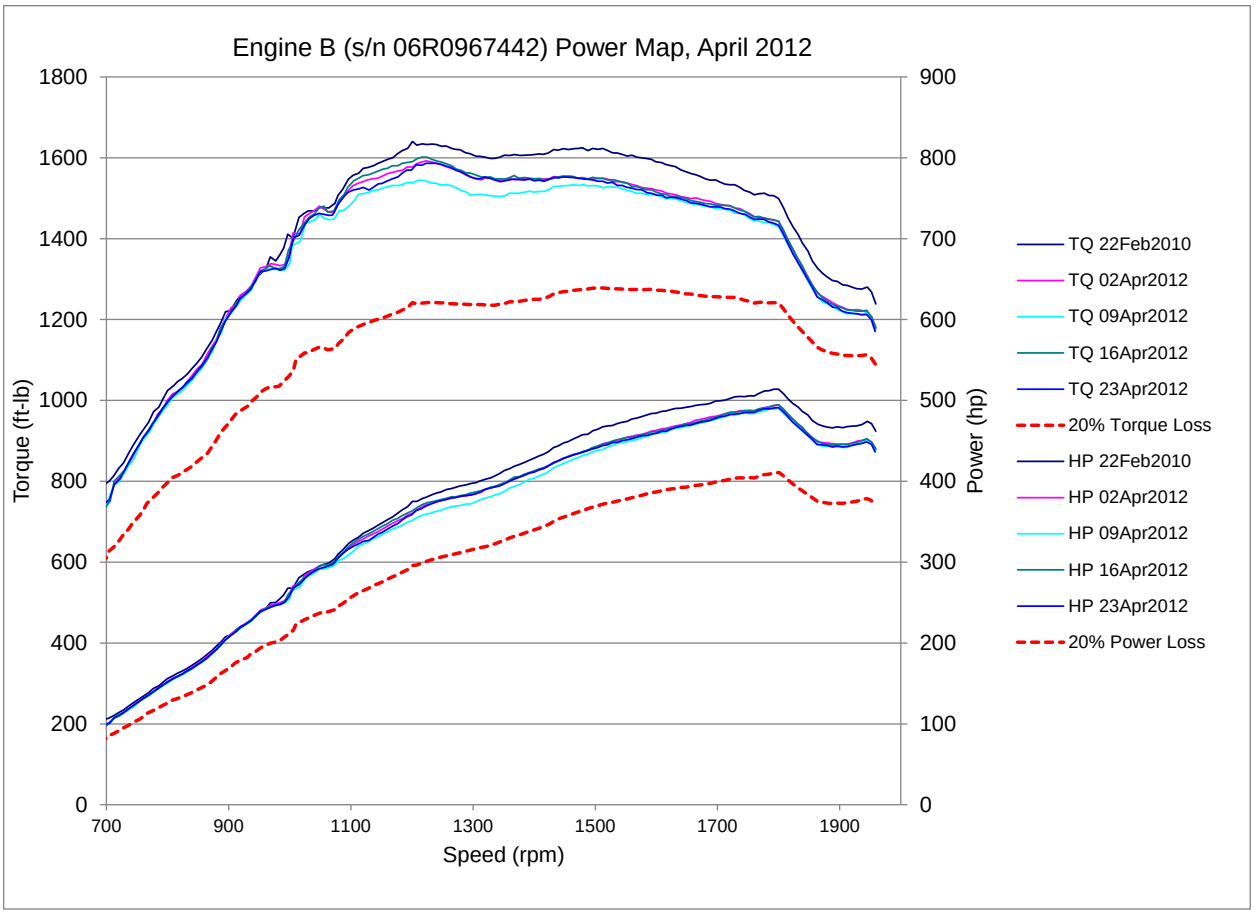
Engine and Dilution System



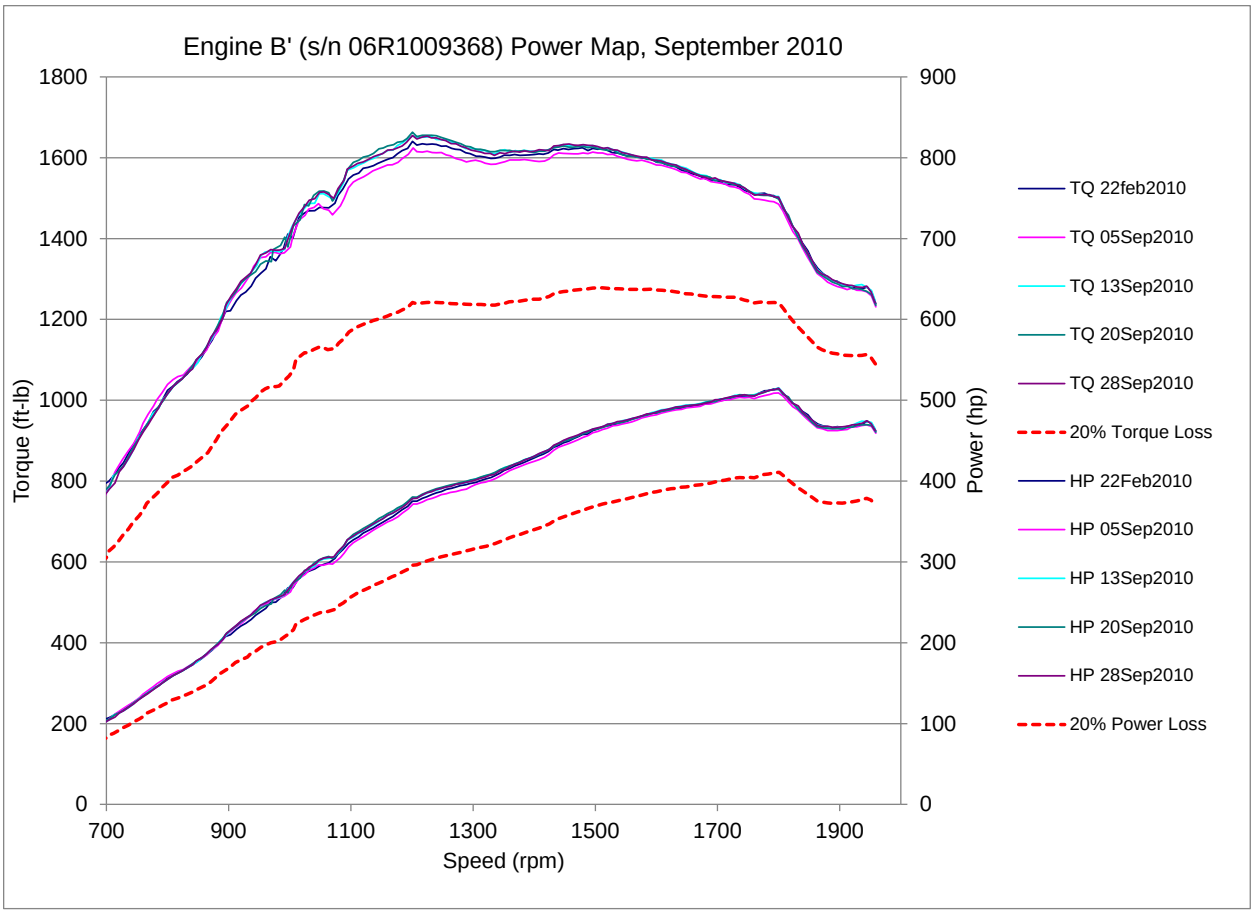
April 2010 Engine Power Map



April 2011 Engine Power Map



April 2012 Engine Power Map



September 2010 Engine Power Map

Engine and Dilution System

Dilution Ratios

Engine Parameters (16 hr cycle avg)

12-Apr-2010

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 6.2	16.08	32.15	**16.07**	3.43	5.89	**2.46**	50.0%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**5.5**	**6.5**	
					NO_x	NO_2	
				Total Dil Ratio:	**33.7**	**40.3**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
347	93	640	2652	0.337	311	247

13-Apr-2010

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 6.2	17.47	35.78	**18.32**	4.59	8.10	**3.51**	51.2%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**4.4**	**5.2**	
					NO_x	NO_2	
				Total Dil Ratio:	**27.3**	**32.4**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
347	93	645	2683	0.338	305	242

14-Apr-2010

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 5.8	13.42	28.11	**14.71**	4.54	8.33	**3.80**	52.3%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**3.4**	**3.9**	
					NO_x	NO_2	
				Total Dil Ratio:	**19.7**	**22.6**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
347	93	652	2682	0.333	293	238

Engine and Dilution System

Dilution Ratios

Engine Parameters (16 hr cycle avg)

18-Apr-2011

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio	Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
Primary Dil Ratio 4.9	22.20	41.56	**19.41**	6.71	10.73	**4.02**	46.7%							
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**3.9**	**4.8**		347	93	640	2761	0.316	295	209
					NO_x	NO_2								
				Total Dil Ratio:	**19.0**	**23.7**								

19-Apr-2011

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio	Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
Primary Dil Ratio 5.2	21.76	42.85	**21.07**	6.16	10.91	**4.75**	49.2%							
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**3.9**	**4.4**		347	93	617	2817	0.314	287	207
					NO_x	NO_2								
				Total Dil Ratio:	**20.3**	**22.9**								

20-Apr-2011

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio	Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
Primary Dil Ratio 5.0	23.32	41.01	**17.66**	6.49	10.12	**3.63**	43.1%							
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**4.1**	**4.9**		347	93	612	2823	0.319	294	208
					NO_x	NO_2								
				Total Dil Ratio:	**20.2**	**24.3**								

Engine and Dilution System

Dilution Ratios

Engine Parameters (16 hr cycle avg)

16-Apr-2012

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 12.2	20.76	32.63	**11.85**	9.44	13.08	**3.64**	36.3%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**2.5**	**3.3**	
					NO_x	NO_2	
				Total Dil Ratio:	**30.5**	**39.8**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
336	91	424	3056	0.313	308	239

17-Apr-2012

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 11.8	19.67	35.90	**16.23**	8.78	13.88	**5.11**	45.2%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**2.6**	**3.2**	
					NO_x	NO_2	
				Total Dil Ratio:	**30.6**	**37.5**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
336	91	427	3010	0.308	300	239

18-Apr-2012

	Tunnel NO (ppm)	Tunnel NO_x (ppm)	Tunnel NO_2 (ppm)	High NO (ppm)	High NO_x (ppm)	High NO_2 (ppm)	NO_2/ NO_x ratio
Primary Dil Ratio 11.9	22.06	34.23	**12.19**	10.49	14.38	**3.89**	35.6%
Secondary Dil Ratio (Tunnel NO_2/ Chamber NO_2):					**2.4**	**3.1**	
					NO_x	NO_2	
				Total Dil Ratio:	**28.3**	**37.2**	

Torque (ft-lb)	Power (HP)	Combustion Air Flow (kg/hr)	Dilution Air Flow (kg/hr)	Fuel Flow (kg/min)	Diesel Particle Filter Pre Exh Temp (°C)	Diesel Particle Filter Post Exh Temp (°C)
336	91	425	2985	0.303	297	241

Chamber Temperatures During Detailed Characterization Dates (°C)

12-Apr-2010	**control**	**low**	**mid**	**high**	**room**
Max	23.7	24.4	24.5	25.3	23.8
Min	22.2	23.1	22.4	23.5	21.7
Average	23.1	23.6	23.8	24.7	22.4
13-Apr-2010					
Max	23.6	23.9	24.3	25.2	22.9
Min	21.7	21.9	22.0	23.0	20.5
Average	22.7	22.9	23.2	24.2	21.8
14-Apr-2010					
Max	23.7	23.9	24.2	25.2	22.8
Min	22.1	22.7	22.7	23.5	20.9
Average	22.8	23.3	23.3	24.4	21.7

18-Apr-2011	**control ch 2**	**control ch 3**	**control ch 4**	**low ch 5**	**low ch 6**	**low ch 7**	**mid ch 8**	**mid ch 9**	**mid ch 10**	**high ch 11**	**high ch 12**	**high ch 13**	**room**
Max	24.5	24.8	24.5	23.6	25.4	24.8	24.4	25.8	27.0	27.4	28.5	26.6	22.2
Min	22.1	22.6	22.2	21.5	22.6	22.7	21.9	23.4	24.4	23.2	23.2	23.8	20.2
Average	23.0	23.5	23.1	22.4	24.1	23.7	23.2	24.8	25.8	25.4	25.6	25.3	21.3
19-Apr-2011													
Max	23.9	24.2	23.7	23.5	25.0	24.2	23.7	26.4	26.8	26.9	27.8	26.3	22.0
Min	22.2	20.1	22.2	21.9	23.0	21.0	22.3	23.8	23.8	22.5	23.8	23.8	20.3
Average	23.1	23.3	23.1	22.5	24.3	23.3	22.9	24.7	26.0	25.5	26.1	25.3	20.8
20-Apr-2011													
Max	23.8	24.3	24.2	25.4	25.6	24.6	24.2	26.1	27.0	27.7	28.2	26.2	22.2
Min	22.3	22.2	22.1	19.3	23.0	22.4	22.0	23.7	21.4	23.4	23.4	23.6	20.1
Average	22.9	23.2	23.1	23.2	24.3	23.4	22.8	24.8	25.7	25.7	26.0	25.1	20.7

16-Apr-2012	**control ch 2**	**control ch 3**	**control ch 4**	**low ch 5**	**low ch 6**	**low ch 7**	**mid ch 8**	**mid ch 9**	**mid ch 10**	**high ch 11**	**high ch 12**	**high ch 13**	**room**
Max	22.6	23.1	23.3	23.2	23.2	23.3	22.5	23.2	24.3	27.2	23.6	23.9	21.8
Min	20.6	21.4	20.0	21.5	20.9	21.3	20.3	20.6	20.0	20.3	18.2	20.5	18.5
Average	21.4	22.1	21.1	22.3	21.8	22.1	21.3	21.7	22.7	24.0	20.8	21.8	19.8
17-Apr-2012													
Max	23.4	24.0	22.9	24.2	24.3	24.4	23.6	23.9	24.9	27.3	24.1	23.7	22.8
Min	20.7	19.0	19.8	21.6	20.8	21.2	20.5	17.8	20.2	20.9	18.1	20.5	18.4
Average	21.6	21.5	21.0	22.6	22.2	22.5	21.7	21.5	23.2	24.5	21.3	22.1	20.3
18-Apr-2012													
Max	24.6	24.0	24.2	25.3	25.5	25.4	24.4	24.9	25.7	28.1	25.0	25.4	24.3
Min	20.6	20.3	18.2	21.4	20.8	21.4	21.1	20.5	19.3	21.8	18.7	20.8	18.9
Average	22.3	21.7	21.4	23.1	22.9	23.1	22.3	22.4	23.5	25.0	21.9	22.8	21.1