AABC Commissioning Group

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Comparison of Laboratory Control Systems Testing Results

Course Number: CXENERGY1934

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Course Description

This presentation will identify key differences between various laboratory control systems. The test include: Static Tests: Differential pressure tests at constant volume and airflow accuracy at different static pressures and volumes. Twelve dynamic tests were conducted to evaluate supply and exhaust tracking capabilities.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand key differences between commonly used laboratory control systems.

2. Describe how static, dynamic, and differential pressure tests are conducted.

3. Understand how different status pressures and volumes affect testing.

4. Explain how dynamic tests permits evaluation of supply and exhaust tracking capability.

Laboratory Control Systems

This report summarizes testing of 6 different laboratory control systems of the 12 tested using setpoint and offset control. Engineered Air Balance Co. was contacted by an owner and two different engineering firms to develop a test that would compare all the different laboratory control system companies for their evaluation and determination if the specifications would be met.

To simplify this report covers six different systems that were tested:

Valve Type and Number	Attributes
Venturi 1	Mechanical Airflow Control
Venturi 2	Mechanical / Digital Airflow Control
Venturi 3	Mechanical Airflow Control
Venturi 4	Mechanical Airflow Control
Blade Damper	Butterfly Damper / Digital Airflow Control
Blade Damper	Airfoil Split Damper / Digital Airflow Control

Laboratory Control Systems Using Offset Control Testing Protocols

1. Static Pressure Performance
2. Airflow Accuracy With Variable Static Pressures
3. Dynamic Testing - Thermal Demand Override to Heating
4. Dynamic Testing – Hood Sash Change in Heating Mode
5. Dynamic Testing – Thermal Demand Override to Cooling
6. Dynamic Testing - Hood Sash Change in Cooling Mode
7. Dynamic Testing - Thermal Demand Override to Heating With Hood Sash Full Open
8. Dynamic Testing – Exhaust System Failure With Setpoint Control
9. Dynamic Testing – Exhaust System Failure With Offset Control
10. Dynamic Testing – Supply System Failure With Setpoint Control
11. Dynamic Testing – Supply Fan Failure With Offset Control
12. Unoccupied Mode and Occupancy Override
13. Dynamic Test – Change Hood Face Velocity Setpoint
14. Dynamic Testing – Terminal Valve Power Failure

Venturi Valve 1 System-						
1	Control Valve Static Pressure Performance					
3 Diameters of Straight Duct Entering and Leaving Each Valve						
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow
1 A	Supply	1.50	1.52	1.62	800	759
	General Exhaust	1.50	1.52	2.26	800	746
	Hood Exhaust	1.50	1.48	2.15	800	707
1 B	Supply	1.50	1.54	1.82	1300	1230
	General Exhaust	1.50	1.49	3.54	1300	1229
	Hood Exhaust	1.50	1.49	3.21	1300	1171
All pressures in inches WC, all airflow in CFM and duct static pressure (SP) taken in the main duct entering the valve for all test						

1A & 1B Test

1 C & D Inlet Connected 90° Directly Off a Plenum Tap and Discharge Has 3 Diameters of Straight Duct Leaving Each Valve							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1C	Supply	1.50	1.56	1.94	800	762	0.32
	General Exhaust	1.50	1.52	2.49	800	728	0.23
1D	Supply	1.50	1.48	2.35	1300	1231	0.53
	General Exhaust	1.50	1.51	3.97	1300	1198	0.43

1 E & F Discharge Connected 90° Directly Into a Plenum Tap and 3 Diameters of Straight Duct Entering Each Valve							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1E	Supply	1.50	1.48	1.96	800	754	0.34
	General Exhaust	1.50	1.52	2.56	800	739	0.30
1F	Supply	1.50	1.51	2.75	1300	1232	0.93
	General Exhaust	1.50	1.48	4.33	1300	1222	0.79

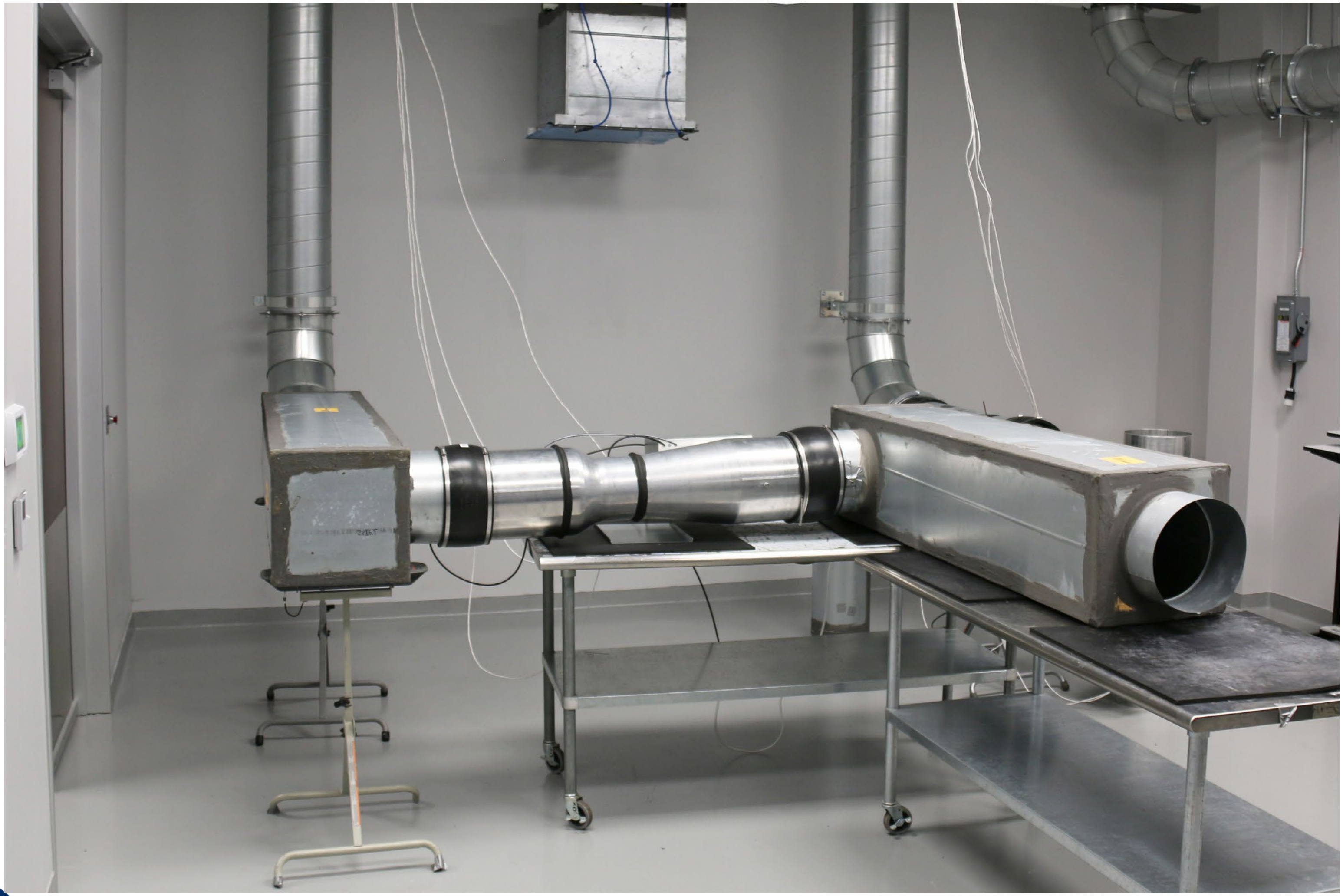
1C & 1D Test

1E & 1F Test

1 G & H Inlet Connected 90° Directly Off a Plenum Tap and Discharge Connected 90° Directly Into a Plenum Tap							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1G	Supply	1.50	1.48	1.70	800	751	0.08
	General Exhaust	1.50	1.52	2.23	800	734	-0.03
1H	Supply	1.50	1.52	2.22	1300	1239	0.40
	General Exhaust	1.50	1.48	3.69	1300	1208	0.15

1 I & J Inlet Connected to a short radius elbow and Discharge Has 3 Diameters of Straight Duct Leaving Valve							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1I	Supply	1.50	1.52	1.63	800	753	0.01
	General Exhaust	1.50	1.47	2.31	800	748	0.05
1J	Supply	1.50	1.53	1.77	1300	1244	-0.05
	General Exhaust	1.50	1.53	3.80	1300	1220	0.26

1G & 1H Test



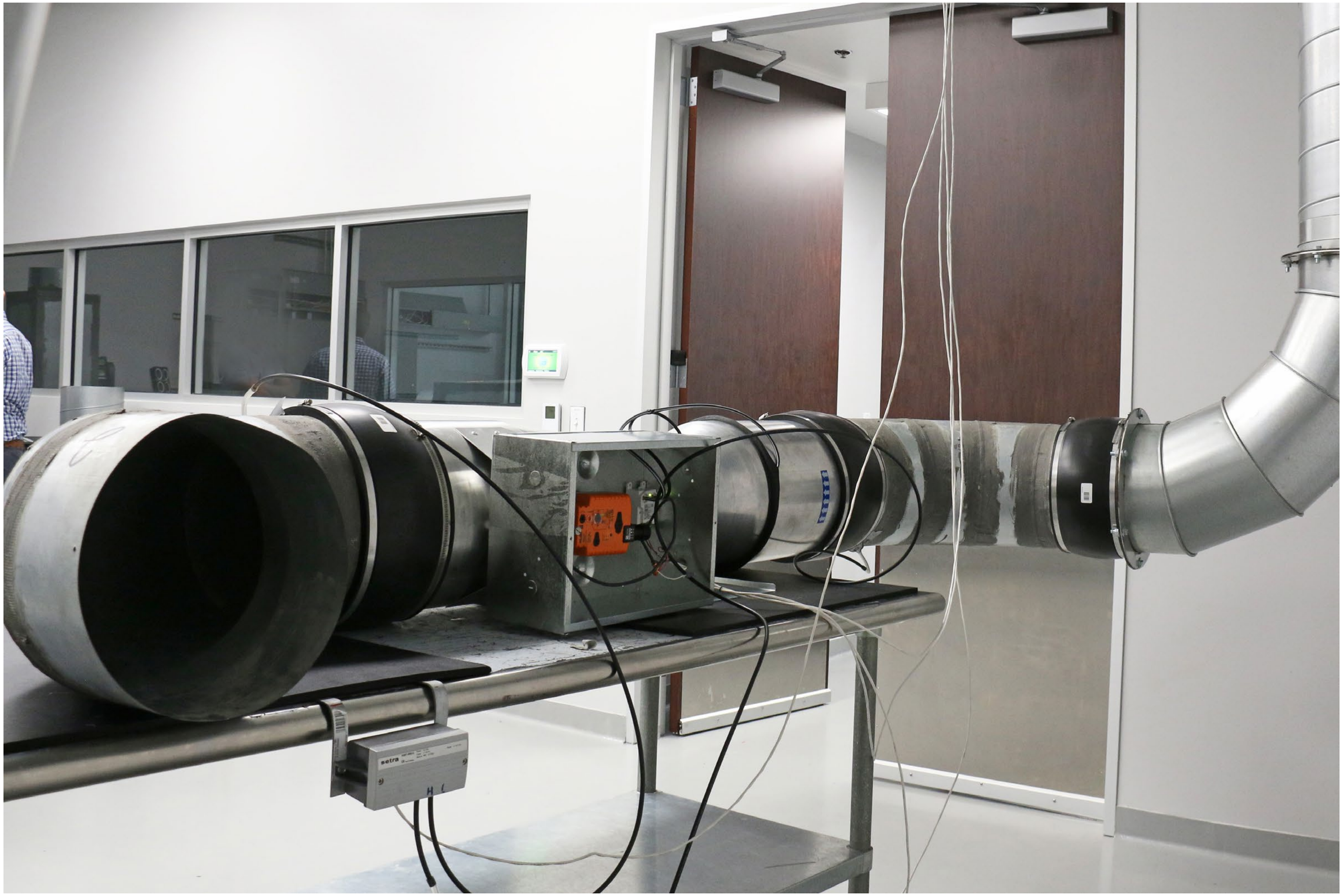
1I & 1J Test

Inlet Connected 90° Directly Off a Plenum Tap and Discharge Has 3 Diameters of Straight Duct Leaving Each Valve							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1K	Supply	1.50	1.48	1.55	800	754	-0.07
	General Exhaust	1.50	1.53	2.21	800	733	-0.05
1L	Supply	1.50	1.53	1.75	1300	1225	-0.07
	General Exhaust	1.50	1.53	3.40	1300	1209	-0.14
All pressures in inches WC, all airflow in CFM and duct static pressure (SP) taken in the main duct entering the valve							

Both Inlet and Discharge connected to a short Radius Elbow							
	Terminal Valve	Valve ΔP	Actual ΔP	Duct SP	Airflow Set Point	Actual Airflow	Fitting SP Increase
1M	Supply	1.50	1.51	1.55	800	752	-0.09
	General Exhaust	1.50	1.50	2.21	800	737	0.00
1N	Supply	1.50	1.52	1.75	1300	1232	-0.07
	General Exhaust	1.50	1.51	3.40	1300	1202	0.12
All pressures in inches WC, all airflow in CFM and duct static pressure (SP) taken in the main duct entering the valve							

1K & 1L Test

1M & 1N Test



2. Airflow Accuracy With Variable Static Pressure

The terminal control valves will be tested for pressure independence and the ability to maintain airflow setpoint across a range of operating static pressures. The valves must maintain the airflow setpoint within 1.5 seconds of the change in static pressure. The test will be conducted at 800 CFM respectively at each system static pressure.

With the terminal control valves installed with three diameters of straight duct entering and leaving the valves, adjust each fan system static pressure to achieve the minimum operating valve differential pressure at an 800 CFM airflow setpoint for each valve.

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2A	Supply	0.00	0.71	0.00	0.60	0	746	800
	General Exhaust	0.00	1.42	0.00	0.60	0	729	800
	Hood Exhaust	0.00	1.37	0.00	0.60	0	774	800
2B	Supply	0.71	1.71	0.60	1.61	746	751	800
	General Exhaust	1.42	2.42	0.60	1.57	729	735	800
	Hood Exhaust	1.37	2.37	0.60	1.61	774	771	800
2C	Supply	1.71	2.71	1.61	2.59	751	776	800
	General Exhaust	2.42	3.42	1.57	2.50	735	759	800
	Hood Exhaust	2.37	3.37	1.61	2.56	771	793	800

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2D	Supply	2.71	3.71	2.59	3.61	776	767	800
	General Exhaust	3.42	4.42	2.50	3.55	759	755	800
	Hood Exhaust	3.37	4.37	2.56	3.57	793	794	800
2E	Supply	3.71	7.71	3.61	4.63	767	776	800
	General Exhaust	*	*	*	*	*	*	800
	Hood Exhaust	*	*	*	*	*	*	800
2F	Supply	4.71	3.71	4.63	3.61	776	740	800
	General Exhaust	*	*	*	*	*	*	800
	Hood Exhaust	*	*	*	*	*	*	800
2G	Supply	3.71	2.71	3.61	2.60	740	743	800
	General Exhaust	4.42	3.42	3.55	2.54	755	745	800
	Hood Exhaust	4.37	3.37	3.57	2.60	794	769	800

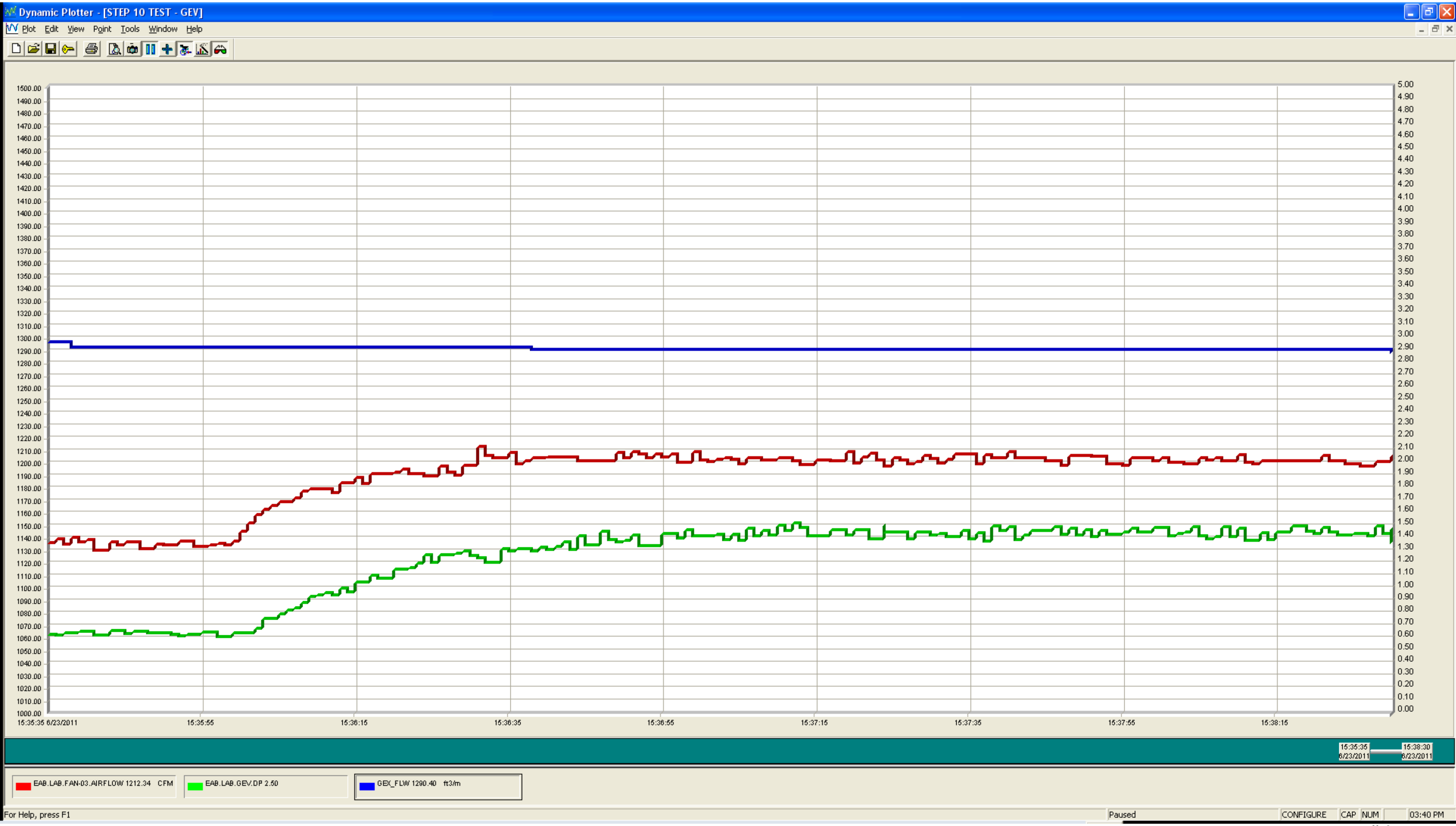
	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint	
2H	Supply	2.71	3.71	2.59	3.61	776	767	800	
	General Exhaust	3.42	4.42	2.50	3.55	759	755	800	
	Hood Exhaust	3.37	4.37	2.56	3.57	793	794	800	
2I	Supply	3.71	7.71	3.61	4.63	767	776	800	
	General Exhaust	*	*	*	*	*	*	800	
	Hood Exhaust	*	*	*	*	*	*	800	

The terminal control valves will be tested for pressure independence and the ability to maintain airflow setpoint across a range of operating static pressures. The valves must maintain the airflow setpoint within 1.5 seconds of the change in static pressure. The test will be conducted at 1300 CFM respectively at each system static pressure.

With the terminal control valves installed with three diameters of straight duct entering and leaving the valves, adjust each fan system static pressure to achieve the minimum operating valve differential pressure at a1300 CFM airflow setpoint for each valve.

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2J	Supply	0.00	0.85	0.00	0.61	0	1156	1300
	General Exhaust	0.00	2.58	0.00	0.65	0	1136	1300
	Hood Exhaust	0.00	2.60	0.00	0.70	0	1240	1300
2K	Supply	0.85	1.87	0.61	1.63	1156	1215	1300
	General Exhaust	2.58	3.58	0.65	1.37	1136	1204	1300
	Hood Exhaust	2.60	3.61	0.70	1.51	1240	1312	1300
	Hood Sash Change In Heating Mode Hood Sash Closed Test Failed							

Test 2J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	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2L	Supply	1.87	2.87	1.63	2.64	1215	1224	1300
	General Exhaust	3.58	4.60	1.37	2.49	1204	1210	1300
	Hood Exhaust	3.61	4.59	1.51	2.54	1312	1322	1300
2M	Supply	2.87	3.85	2.64	3.61	1224	1251	1300
	General Exhaust	*	*	*	*	*	*	1300
	Hood Exhaust	*	*	*	*	*	*	1300
2N	Supply	3.71	7.71	3.61	4.63	767	776	1300
	General Exhaust	*	*	*	*	*	*	1300
	Hood Exhaust	*	*	*	*	*	*	1300
The fan systems could only produce 5”WC. Therefore testing above 5” WC was not performed. * = Did Not Test								

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2O	Supply	*	*	*	*	*	*	1300
	General Exhaust	*	*	*	*	*	*	1300
	Hood Exhaust	*	*	*	*	*	*	1300
The fan systems could only produce 5"WC. Therefore testing above 5" WC was not performed. * = Did Not Test								
2P	Supply	3.85	2.85	3.61	2.61	1251	1221	1300
	General Exhaust	*	*	*	*	*	*	1300
	Hood Exhaust	*	*	*	*	*	*	1300
2Q	Supply	1.71	0.71	2.61	1.82	1221	1209	1300
	General Exhaust	4.00	3.58	2.49	1.47	1210	1196	1300
	Hood Exhaust	4.59	3.60	2.54	1.54	1322	1301	1300

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2R	Supply	1.85	0.86	1.62	0.62	1209	1151	1300
	General Exhaust	3.58	2.58	1.47	0.63	1196	1137	1300
	Hood Exhaust	3.60	2.60	1.54	0.72	1301	1235	1300

Command each terminal control valve to a zero CFM setpoint and command each fan system to maintain 4.75” WC duct static pressure to verify the airflow at the close position.

The valves tested were not full shut off valves. Therefore this test is not applicable. * = Did Not Test

	Terminal Valve	Initial Duct SP	Final Duct SP	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Final BAS Airflow	Airflow Setpoint
2S	Supply	*	*	*	*	*	*	*
	General Exhaust	*	*	*	*	*	*	*
	Hood Exhaust	*	*	*	*	*	*	*

3. Dynamic Testing – Thermal Demand Override to Heating

The purpose of the following test will be to evaluate the ability of the LCS to control the supply and exhaust valves to maintain room offset during a thermal demand situation whereby the zone is commanded from full cooling to full heating. Upon a change of system thermal load, the LCS must gain control within 1.5 seconds and control the airflow to 90% of setpoint.

With the hood sash closed (hood valve at minimum airflow setpoint of 100 FPM) and the zone thermal demand to full heating utilizing the room temperature input in the LCS. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

Through pretesting the system, the minimum and static pressure setpoint is to achieve maximum airflow at the minimum valve differential pressure were determined as listed in the tests. These remained the same throughout all the dynamic testing.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
3A	Supply	2.00	1.77	2.09	1310	1400	120	90
	General Exhaust	3.50	1.11	3.32	1279	1395	80	90
	Hood Exhaust	3.00	2.85	2.81	213	195	215	195
	Room Offset	----------	----------	----------	-182	-190	-175	-195

3A Thermal Demand Override To Heating

4. Dynamic Testing – Hood Sash Change In Heating Mode

The purpose of the following test will be to evaluate the ability of the LCS to control the supply and exhaust valves to maintain room offset during a change in the hood sash position with the zone thermal demand in full heating. Upon a change of system thermal load, the LCS must gain control within 1.5 seconds and control the airflow to 90% of setpoint.

With the hood sash in the minimum position at 100 FPM and the zone thermal demand in full heating, open the hood sash abruptly to the full open position. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
4A	Supply	2.00	1.95	1.92	120	90	630	667
	General Exhaust	3.50	3.31	3.30	80	90	78	89
	Hood Exhaust	3.00	2.85	2.20	215	195	774	780
	Room Offset	----------	----------	----------	-175	-195	-222	-202

4A Hood Sash Change In Heating Mode Hood Sash Opened

With the hood sash in the full open position at 100 FPM and the zone thermal demand in full heating, close the hood sash. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 40 CFM positive and .005"WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
4B	Supply	2.00	1.95	1.92	630	670	120	90
	General Exhaust	3.50	3.29	3.33	80	95	80	90
	Hood Exhaust	3.00	2.21	2.86	770	780	205	195
	Room Offset	----------	----------	----------	-220	-205	-165	-195

4B Hood Sash Change In Heating Mode Hood Sash Closed Test Failed

With the hood sash in the closed position at 100 FPM and the zone thermal demand in full heating, open the hood sash to the full open position for approximately 10 seconds and then close the hood sash. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 40 CFM positive and .005"WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
4C	Supply	2.00	1.95	1.95	120	90	120	90
	General Exhaust	3.50	3.30	3.32	85	90	80	95
	Hood Exhaust	3.00	2.85	2.84	205	195	205	195
	Room Offset	----------	----------	----------	-170	-195	-165	-200

4C Hood Sash Change In Heating Mode Hood Sash Opened & Closed After 10 Seconds Test Failed

5. Dynamic Testing – Thermal Demand Override to Cooling With Hood Full Open

The purpose of the following test will be to evaluate the ability of the LCS to control the supply and exhaust valves to maintain room offset during a thermal demand situation whereby the zone is commanded from full cooling to full heating with the hood sash fully open. Upon a change of system thermal load, the LCS must gain control within 1.5 seconds and control the airflow to 90% of setpoint.

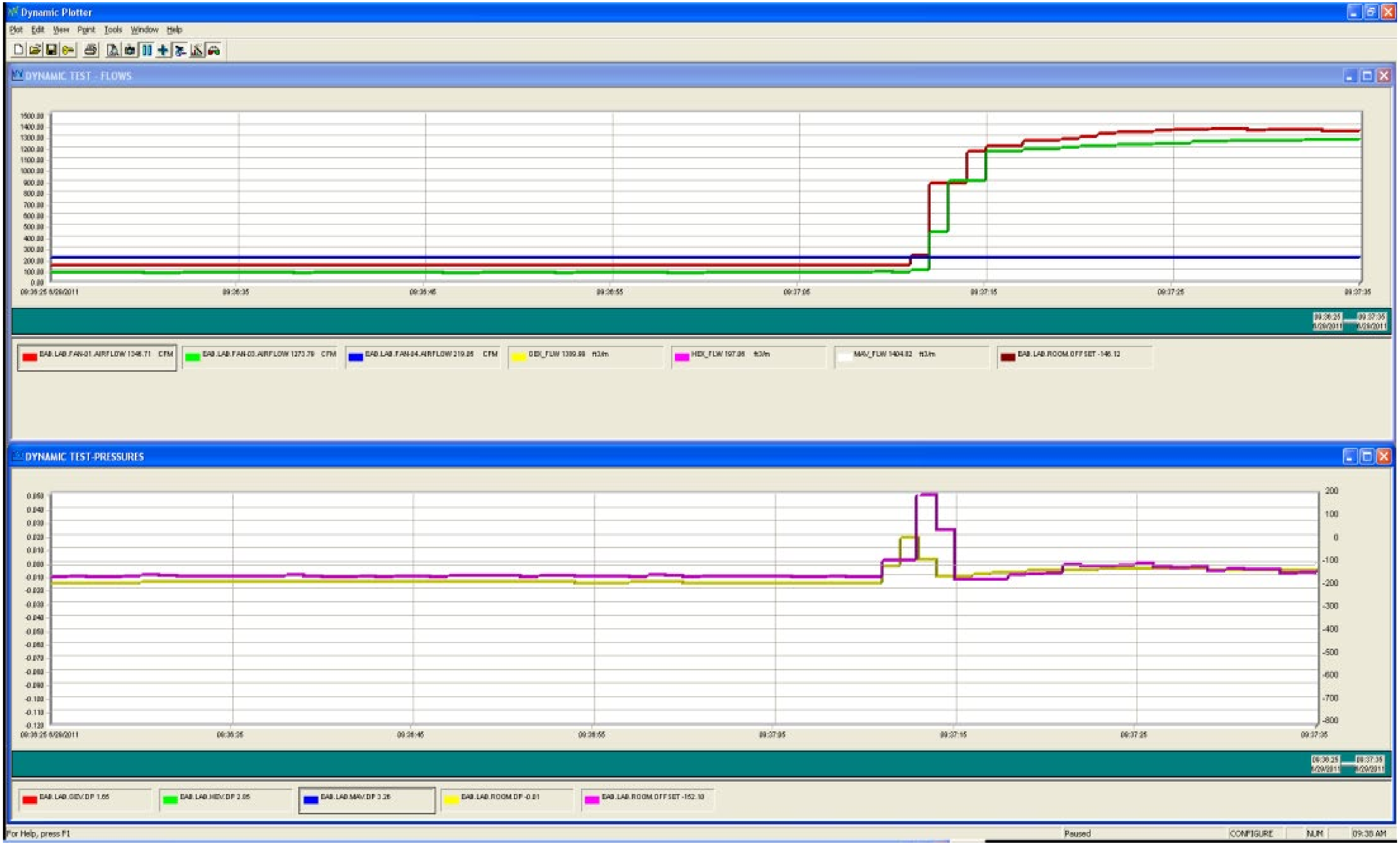
With the hood sash open at 100 FPM and the zone thermal demand to full cooling, command the zone thermal demand to full heating utilizing the room temperature input in the LCS. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

Through pretesting the system, the minimum and static pressure setpoint is to achieve maximum airflow at the minimum valve differential pressure were determined as listed in the tests. These remained the same throughout all the dynamic testing.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
5A	Supply	3.50	3.42	3.22	152	93	1332	1402
	General Exhaust	4.00	3.72	1.71	87	95	1270	1390
	Hood Exhaust	3.00	2.85	2.85	217	197	217	199
	Room Offset	----------	----------	----------	-152	-199	-155	-187

The lab airflow offset and differential pressure briefly went positive as the supply and exhaust valves tracked to the increased airflows.

5A Thermal Demand Override To Cooling Test Failed



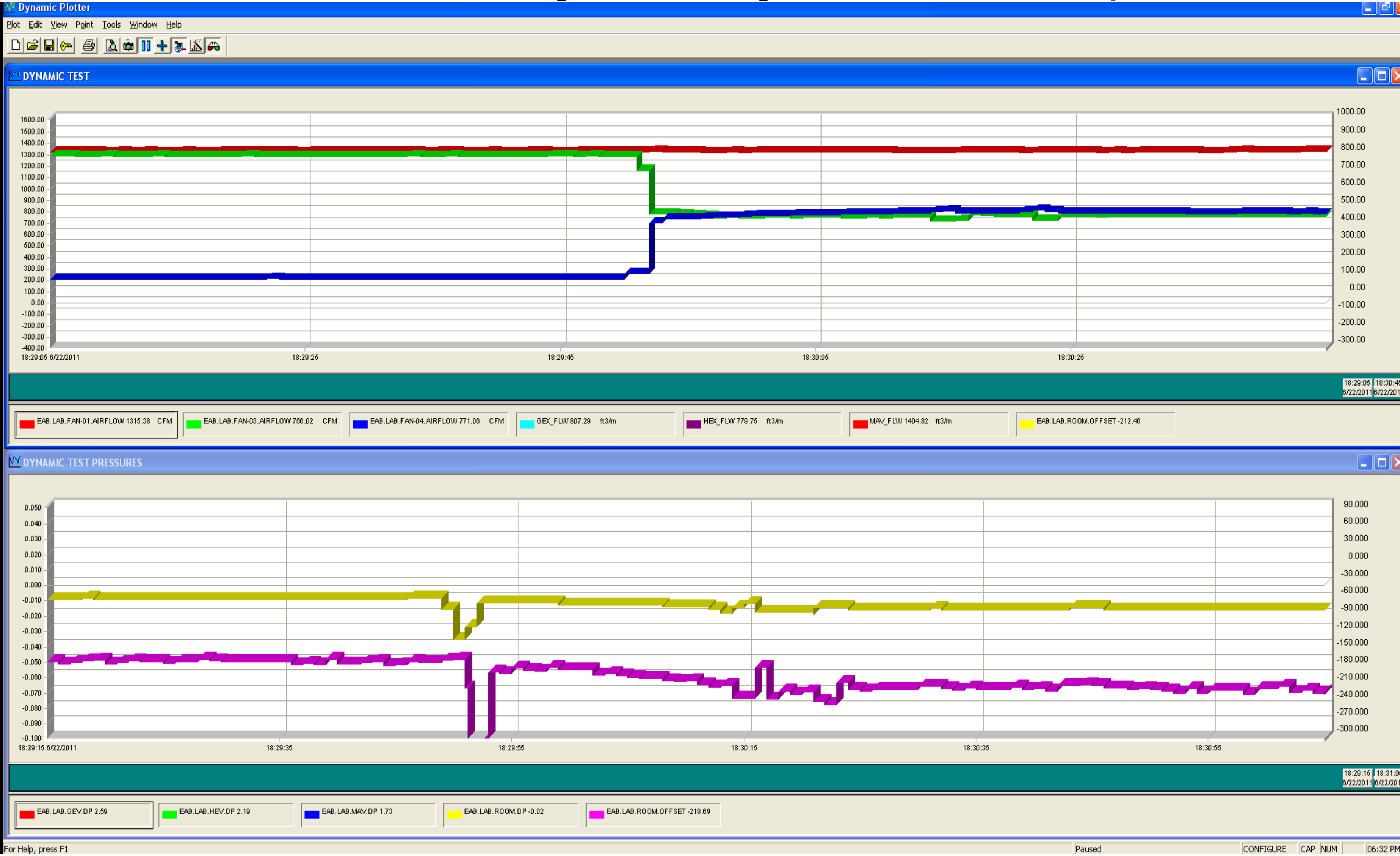
6. Dynamic Testing – Hood Sash Change In Cooling Mode

The purpose of the following test will be to evaluate the ability of the LCS to control the supply and exhaust valves to maintain room offset during a change in the hood sash position with the zone thermal demand in full cooling. Upon a change of system thermal load, the LCS must gain control within 1.5 seconds and control the airflow to 90% of setpoint.

With the hood sash in the minimum position at 100 FPM and the zone thermal demand in full cooling, open the hood sash abruptly to the full open position. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
6A	Supply	2.00	1.75	1.78	1315	1465	13	1405
	General Exhaust	3.50	1.12	2.59	1275	1395	785	805
	Hood Exhaust	3.00	2.83	2.21	205	197	775	780
	Room Offset	----------	----------	----------	-165	-187	-220	-180

6A Hood Sash Change In Cooling Mode Hood Sash Opened

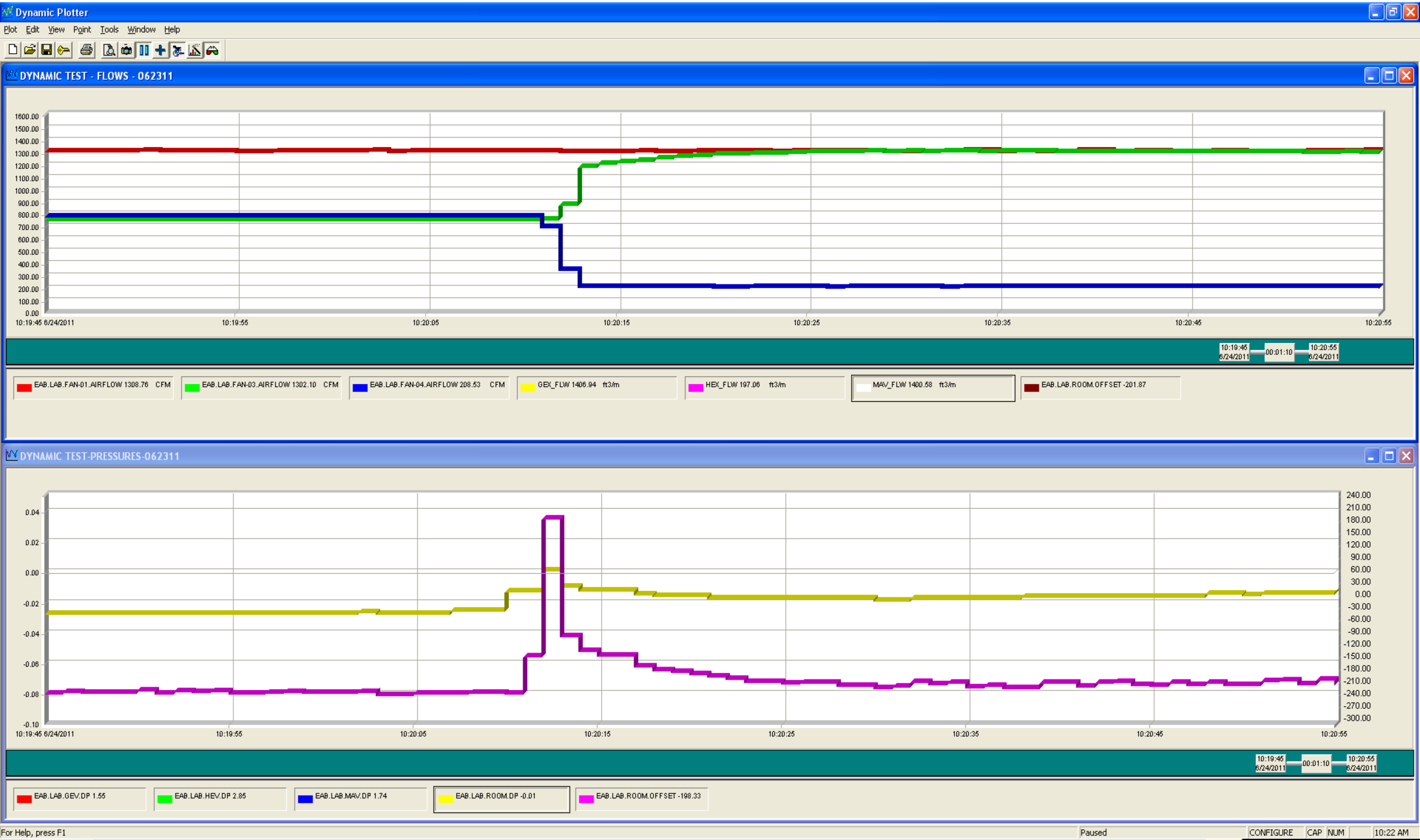


With the hood sash in the full open position at 100 FPM and the zone thermal demand in full cooling, close the hood sash. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 200 CFM positive and .005"WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
6B	Supply	2.00	1.77	1.77	1315	1401	1314	1401
	General Exhaust	3.50	3.09	1.53	751	803	1309	1407
	Hood Exhaust	3.00	2.14	2.85	781	790	211	197
	Room Offset	----------	----------	----------	-217	-192	-206	-203

6B Hood Sash Change In Cooling Mode Hood Sash Closed Test Failed



With the hood sash in the closed position at 100 FPM and the zone thermal demand in full heating, open the hood sash to the full open position for approximately 10 seconds and then close the hood sash. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.
This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and .005"WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
6C	Supply	2.00	1.71	1.78	1318	1405	1313	1405
	General Exhaust	3.50	1.13	1.13	1275	1396	1270	1390
	Hood Exhaust	3.00	2.83	2.84	205	200	205	200
	Room Offset	----------	----------	----------	-162	-191	-162	-185

6C Hood Sash Change In Cooling Mode Hood Sash Opened & Closed After 10 Seconds Test Failed

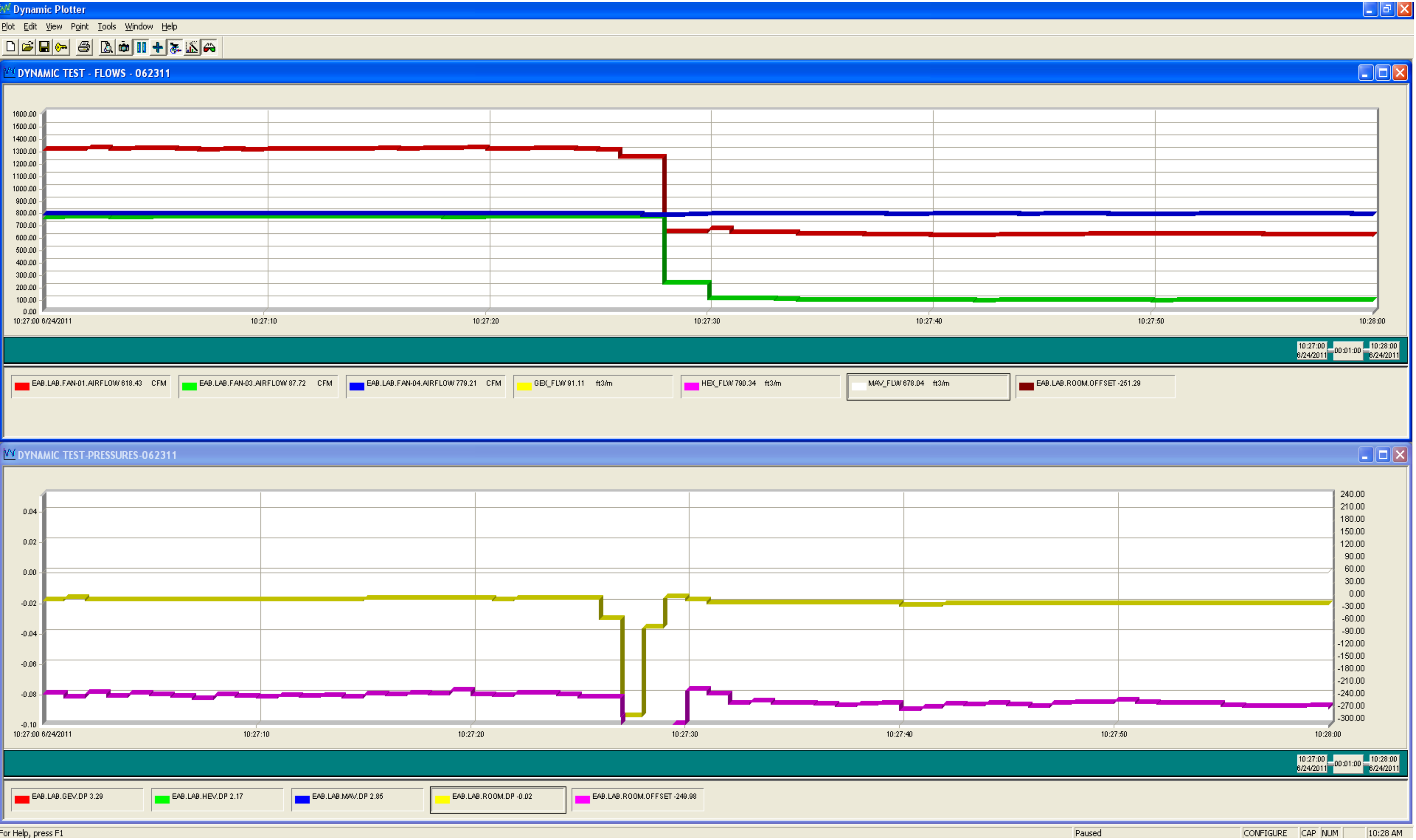
7. Dynamic Testing- Thermal Demand Override to Heating With Hood Full Open

The purpose of the following test will be to evaluate the ability of the LCS to control the supply and exhaust valves to maintain room offset during a thermal demand situation whereby the zone is commanded from full cooling to full heating with the hood sash in the fully open position. Upon a change of system thermal load, the LCS must gain control within 1.5 seconds and control the airflow to 90% of setpoint.

With the hood sash fully open at 100 FPM and the zone thermal demand in full cooling, command the zone thermal demand to full heating utilizing the room temperature input in the LCS. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at the minimum operating differential pressure and the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
7A	Supply	2.00	1.79	2.51	1312	1401	622	678
	General Exhaust	3.50	2.58	3.32	754	805	87	91
	Hood Exhaust	3.00	2.19	2.18	787	790	782	790
	Room Offset	----------	----------	----------	-229	-194	-247	-203

7A Thermal Demand Override To Heating With Hood Full Open



8. Dynamic Testing- Exhaust System Failure With Setpoint Control

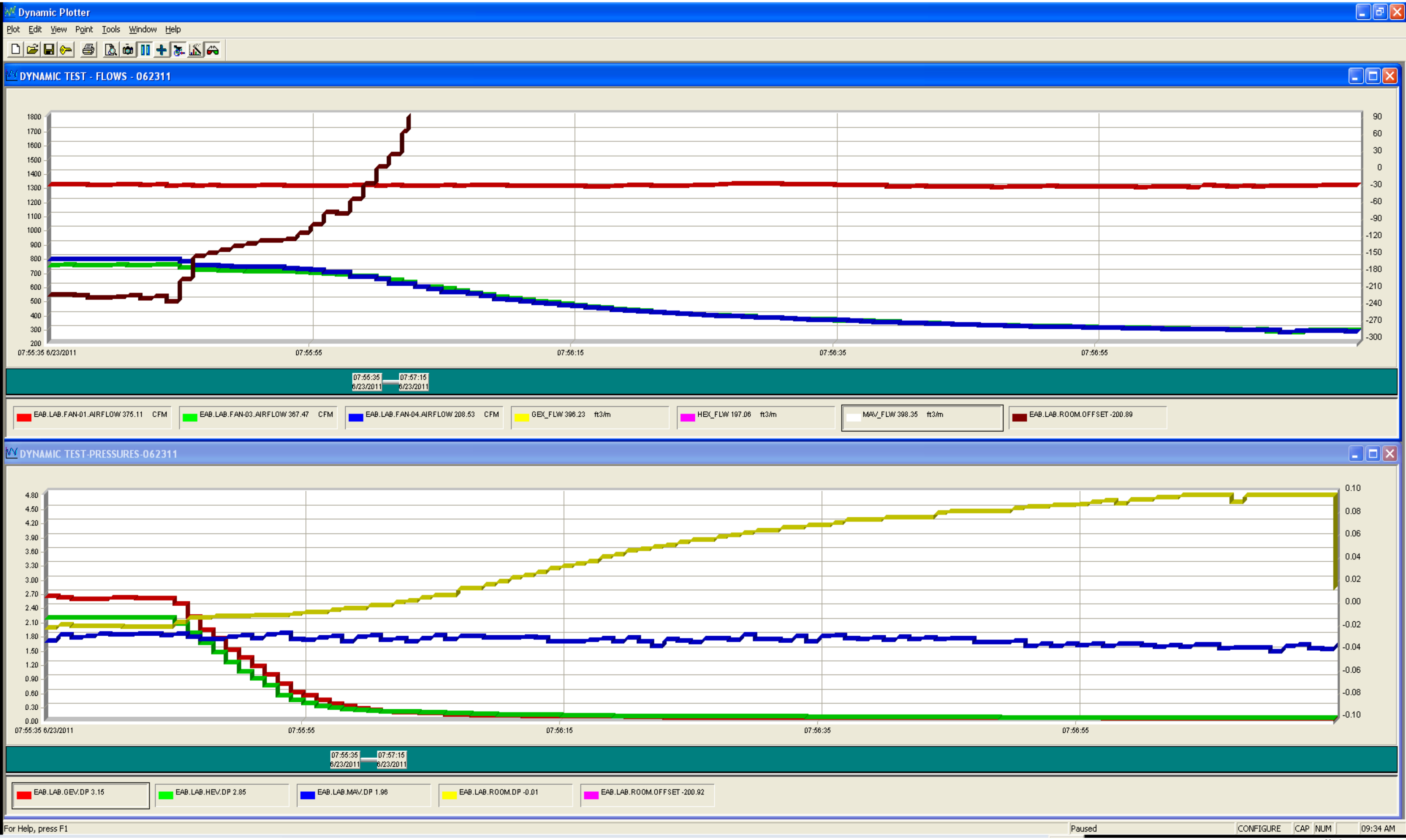
The following test will simulate loss of exhaust airflow and evaluate the ability of the LCS to track airflow offset based upon setpoint control. Based upon the setpoint, the terminal control valves will maintain airflow position and airflow setpoint.

Place the LCS and temperature override in full cooling with hood sash fully open and de-energize both exhaust fans systems. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

This system does not actively control airflow and therefore is always in setpoint control. The valve differential pressure is monitored and alarms when the DP is below the minimum setpoint of 0.6" WC. When this alarm is active, the airflow feedback from the LCS is failed.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
8A	Supply	2.00	1.81	1.53	1309	1496	1301	1398
	General Exhaust	3.50	2.59	0.01	752	803	238	Unreliable
	Hood Exhaust	3.00	2.17	0.02	787	795	241	Unreliable
	Room Offset	----------	----------	----------	-230	-202	822	

8A Dynamic Testing- Exhaust System Failure With Setpoint Control Test Failed



9. Dynamic Testing- Exhaust System Failure With Offset Control

The following test will simulate loss of exhaust airflow and evaluate the ability of the LCS to track airflow offset based upon flow tracking control. Based upon tracking control, the terminal control valves will modulate to attempt to maintain offset when the exhaust flow is reduced.

Place the LCS and temperature override in full cooling with hood sash fully open and de-energize both exhaust fans systems. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

This LCS does not actively control airflow and therefore is always in setpoint control. This portion of the test was not conducted.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
9A	Supply		*	*	*	*	*	*
	General Exhaust		*	*	*	*	*	*
	Hood Exhaust		*	*	*	*	*	*
	Room Offset	----------	----------	----------	*	*	*	*

* = Did Not Test

10. Dynamic Testing- Supply System Failure With Setpoint Control

The following test will simulate loss of supply airflow and evaluate the ability of the LCS to track airflow offset based upon setpoint control. Based upon the setpoint, the terminal control valves will maintain airflow position and airflow setpoint.

Place the LCS and temperature override in full cooling with hood sash fully open and de-energize the supply fan system. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

This system does not actively control airflow and therefore is always in setpoint control. The valve differential pressure is monitored and alarms when the DP is below the minimum setpoint of 0.6" WC. When this alarm is active, the airflow feedback from the LCS is failed.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
10A	Supply	2.00	1.78	0.04	1300	1394	362	Unreliable
	General Exhaust	3.50	2.60	2.27	750	801	750	801
	Hood Exhaust	3.00	2.21	1.88	769	790	767	790
	Room Offset	----------	----------	----------	-219	197	1155	

10A Dynamic Testing- Supply System Failure With Setpoint Control Test Failed

11. Dynamic Testing- Supply System Failure With Offset Control

The following test will simulate loss of supply airflow and evaluate the ability of the LCS to track airflow offset based upon flow tracking control. Based upon tracking control, the terminal control valves will modulate to attempt to maintain offset when the exhaust flow is reduced.

Place the LCS and temperature override in full cooling with hood sash fully open and de-energize the supply fan system. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

This LCS does not actively control airflow and therefore is always in setpoint control. This portion of the test was not conducted.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
11A	Supply		*	*	*	*	*	*
	General Exhaust		*	*	*	*	*	*
	Hood Exhaust		*	*	*	*	*	*
	Room Offset	----------	----------	----------	*	*	*	*

* = Did Not Test

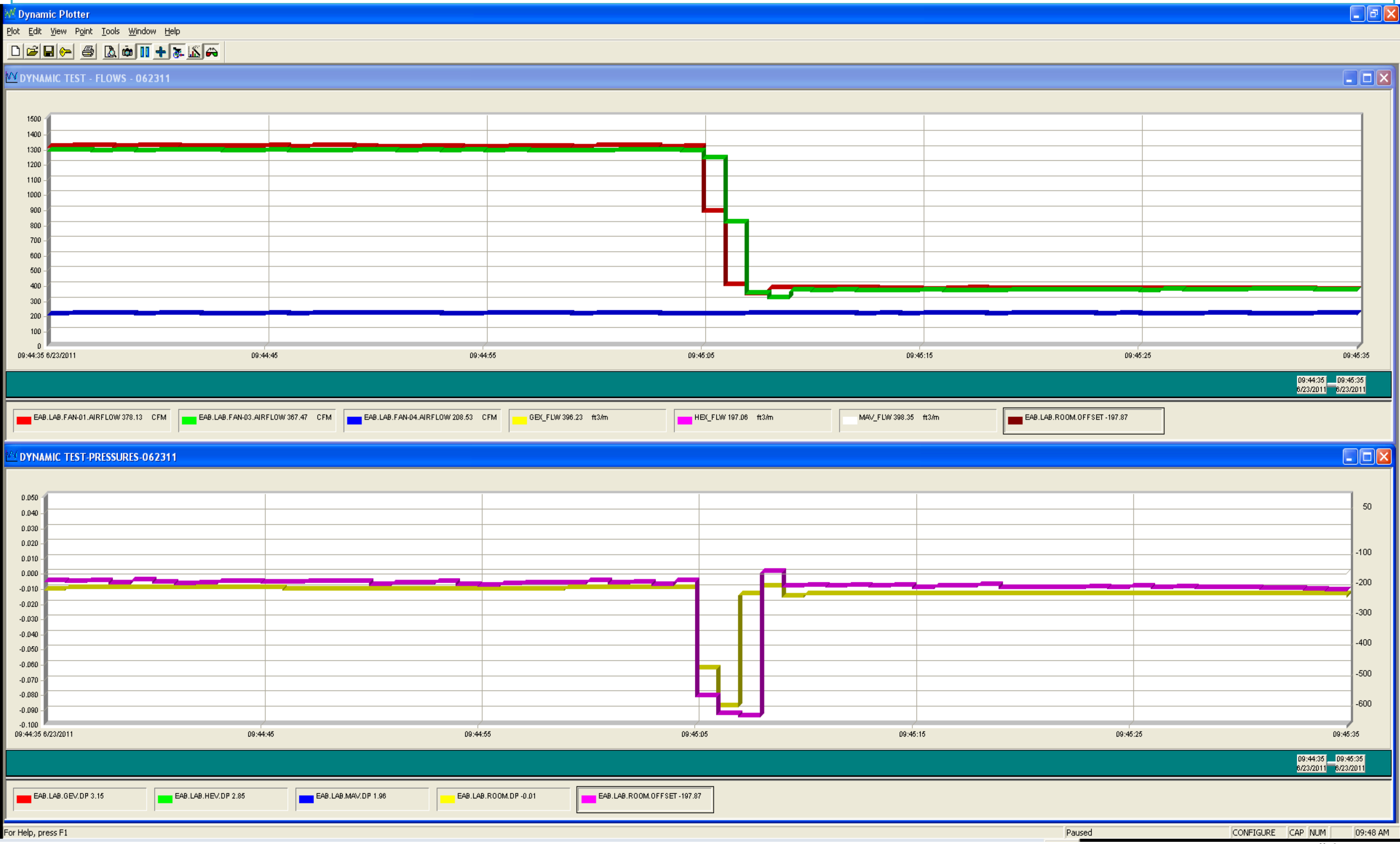
12. Unoccupied Mode and Occupancy Override

The LCS will be tested for unoccupied operation and the ability to accept an occupancy sensor input to reduce the laboratory airflows. Upon a change in occupancy status, the LCS must react and reach the required airflow setpoints within 1.5 seconds and 90% of the required airflow.

With the LCS in occupied mode, the hood fully closed, and the thermal demand in full cooling, simulate a change of occupancy by flipping the occupancy switch to the unoccupied mode. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
12A	Supply	2.00	1.75	1.96	1318	1409	378	398
	General Exhaust	3.50	1.07	3.14	1285	1396	370	396
	Hood Exhaust	3.00	2.84	2.87	208	197	211	197
	Room Offset	----------	----------	----------	-175	-184	-203	-195

12. Occupied Mode to Unoccupied Mode

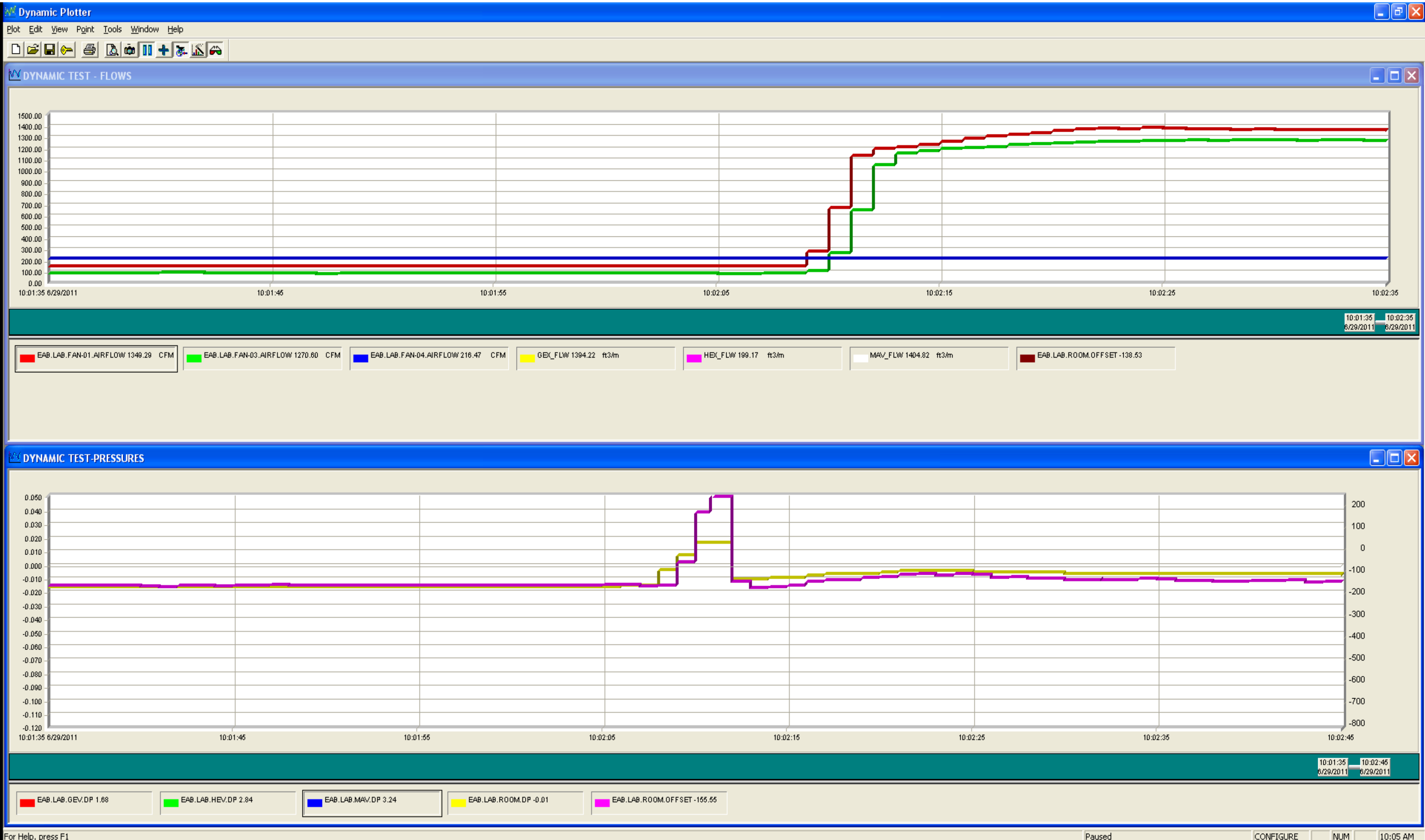


With the LCS in unoccupied mode, the hood fully closed, and the thermal demand in full cooling, simulate a change of occupancy by flipping the occupancy switch to occupied mode. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

The tests failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure when the change in occupancy mode went from unoccupied to occupied while the system was in full cooling. The dynamic test reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 300 CFM positive and 0.015” WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
12B	Supply	3.50	3.47	3.25	152	91	1345	1465
	General Exhaust	4.00	3.82	1.65	93	93	1269	1392
	Hood Exhaust	3.00	2.86	2.85	216	199	216	199
	Room Offset	----------	----------	----------	-157	-201	-140	-186

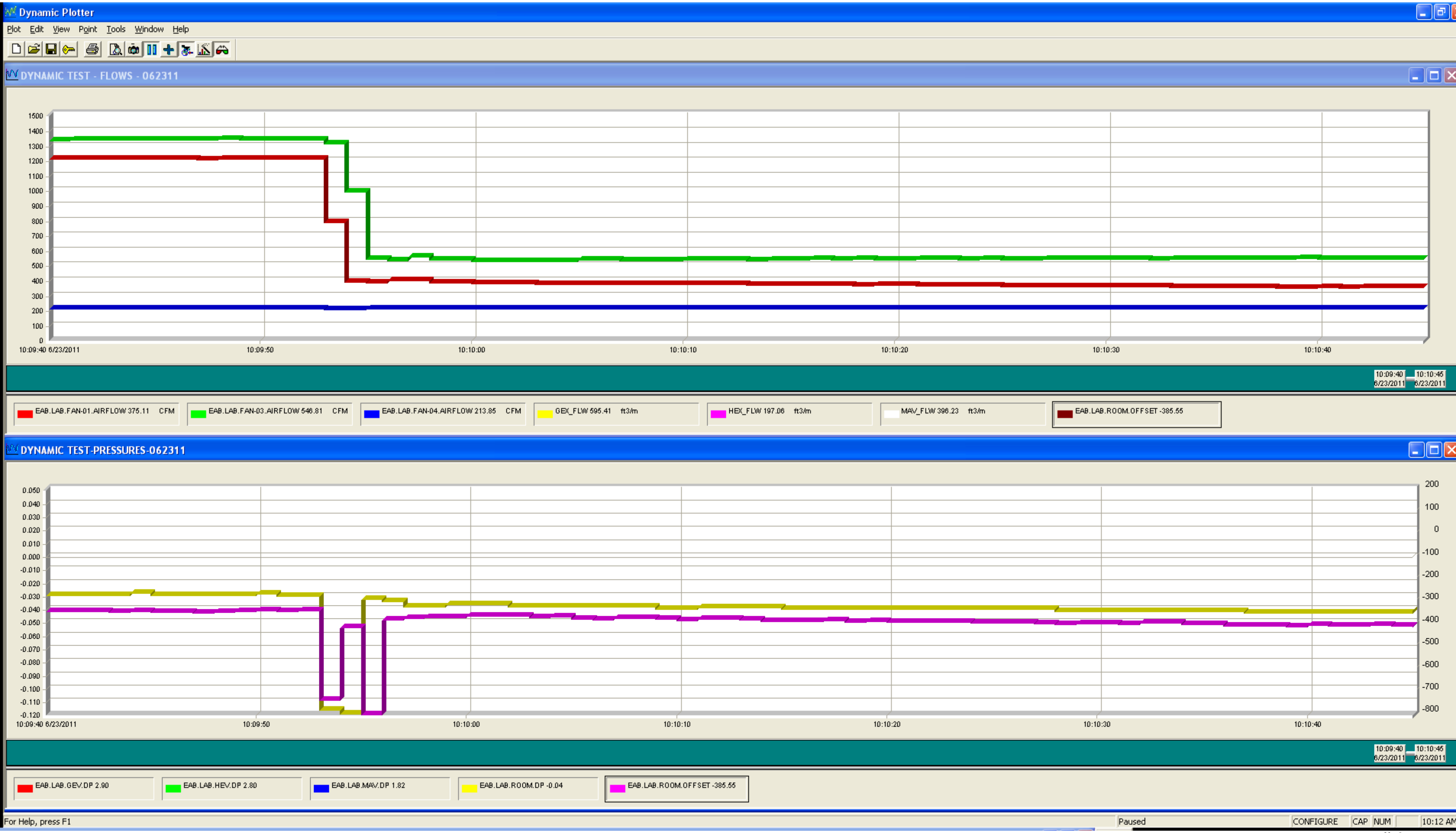
12B Unoccupied Mode to Occupied Mode Test Failed



Change room offset setpoint to -400 CFM. With the LCS in occupied mode, the hood fully closed, and the thermal demand in full cooling, simulate a change of occupancy by flipping the occupancy switch to unoccupied mode. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
12C	Supply	2.00	1.78	1.99	1216	1293	375	396
	General Exhaust	3.50	0.85	2.90	1336	1490	545	594
	Hood Exhaust	3.00	2.81	2.81	211	197	211	197
	Room Offset	----------	----------	----------	-331	-394	-381	-395

12C With -400 CFM Offset Change from Occupied Mode to Unoccupied Mode

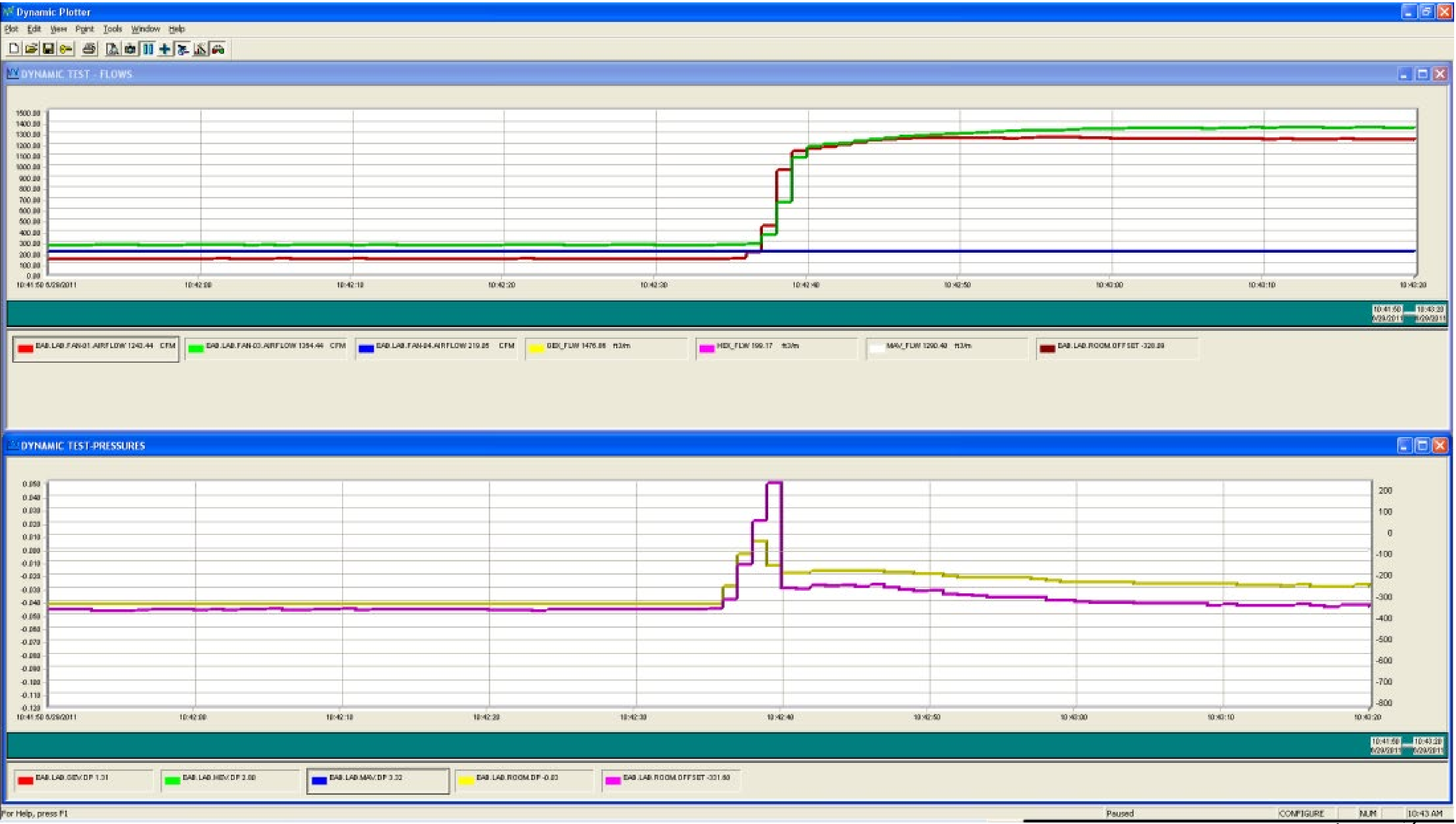


With the LCS in unoccupied mode, the room offset setpoint at -400 CFM. the hood fully closed, and the thermal demand in full cooling, simulate a change of occupancy by flipping the occupancy switch the occupied mode. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

The tests failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure when the change in occupancy mode went from unoccupied to occupied while the system was in full cooling. The dynamic test reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 300 CFM positive and 0.005” WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
12D	Supply	3.50	3.44	3.35	152	89	1225	1289
	General Exhaust	4.00	3.65	1.27	271	297	1358	1477
	Hood Exhaust	3.00	2.82	2.83	216	199	216	199
	Room Offset	----------	----------	----------	-335	-470	-348	-387

12D With -400 CFM Offset Change from Occupied Mode to Unoccupied Mode Test Failed



13. Dynamic Testing – Change Hood Velocity Setpoint

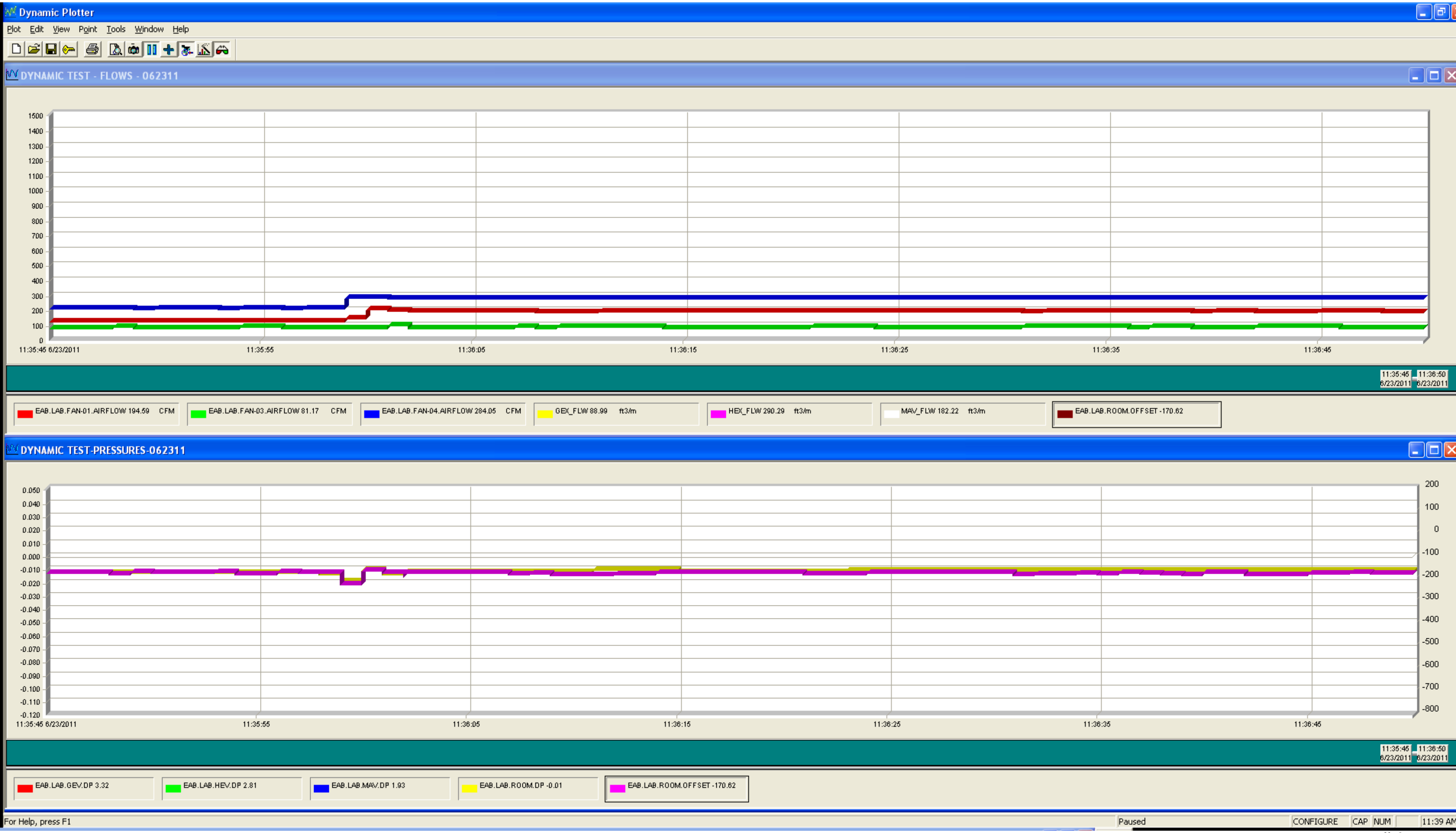
The purpose of these tests is to show that the system can be changed to maintain a higher hood face velocity setpoint and continue to track across the operating range of the system. The system must achieve control within 1.5 seconds and maintain 90% of the airflow setpoint.

Utilizing the LCS controls, modified the hood controller to maintain 150 FPM face velocity with the hood sash closed and the system in full heating demand. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

The LCS system cannot change hood face velocity with one set point change in the controller. The hood controller must be reconfigured for the face velocity setpoint change as well.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
13A	Supply	2.00	1.93	1.97	124	93	1332	1402
	General Exhaust	3.50	3.31	3.32	81	95	1270	1390
	Hood Exhaust	3.00	2.85	2.81	213	197	217	199
	Room Offset	----------	----------	----------	-175	-197	-247	-205

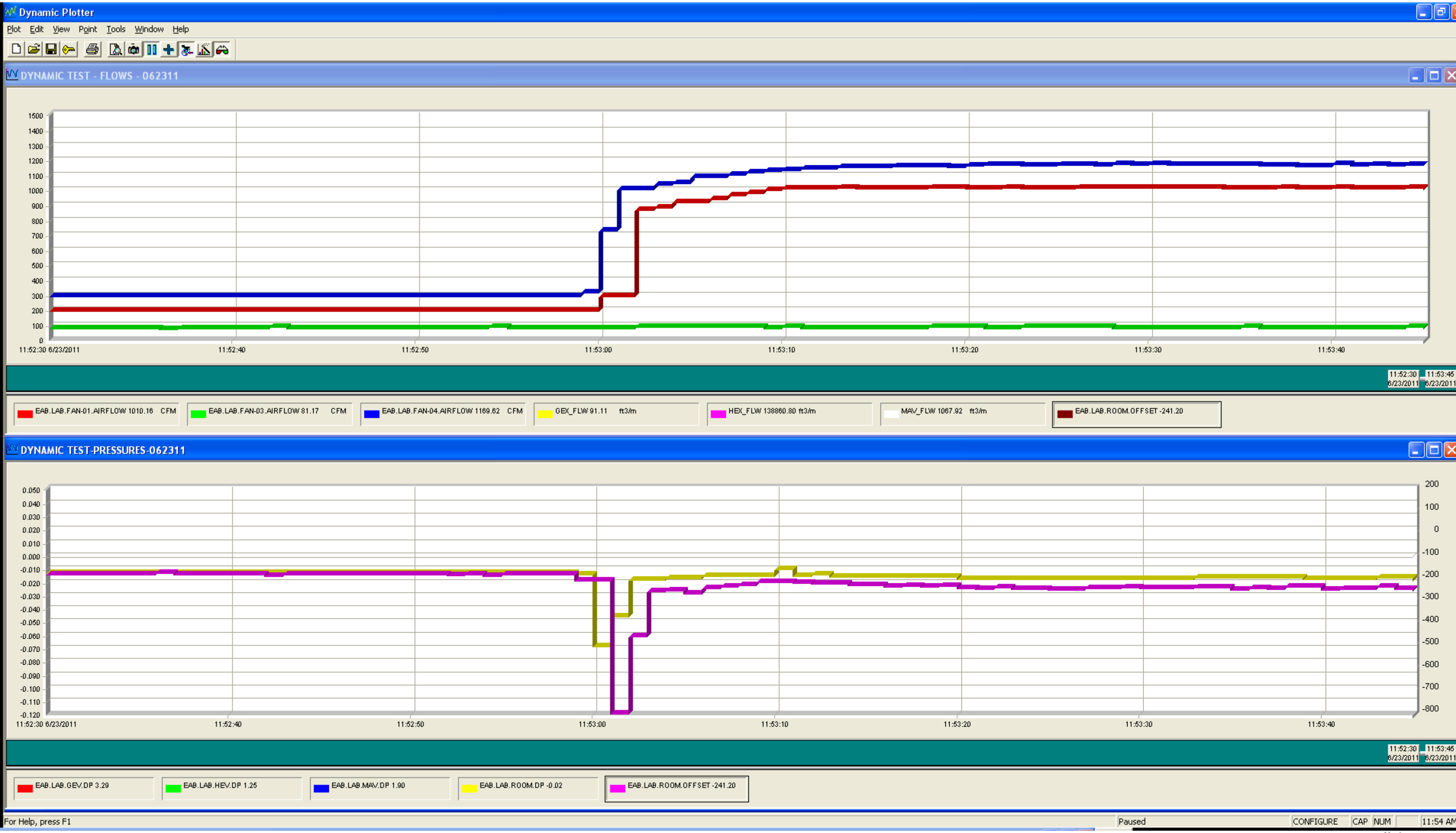
13A Modify The Hood Sash Controller to Maintain 150 FPM With Sash Closed in Full Heating Demand



With the LCS in full heating demand, raise the hood sash to full height at 150 FPM. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
13B	Supply	2.00	1.94	1.87	197	182	1010	1088
	General Exhaust	3.50	3.33	3.32	81	89	87	91
	Hood Exhaust	3.00	2.80	1.30	291	290	1170	1182
	Room Offset	----------	----------	----------	-175	-197	-247	-205

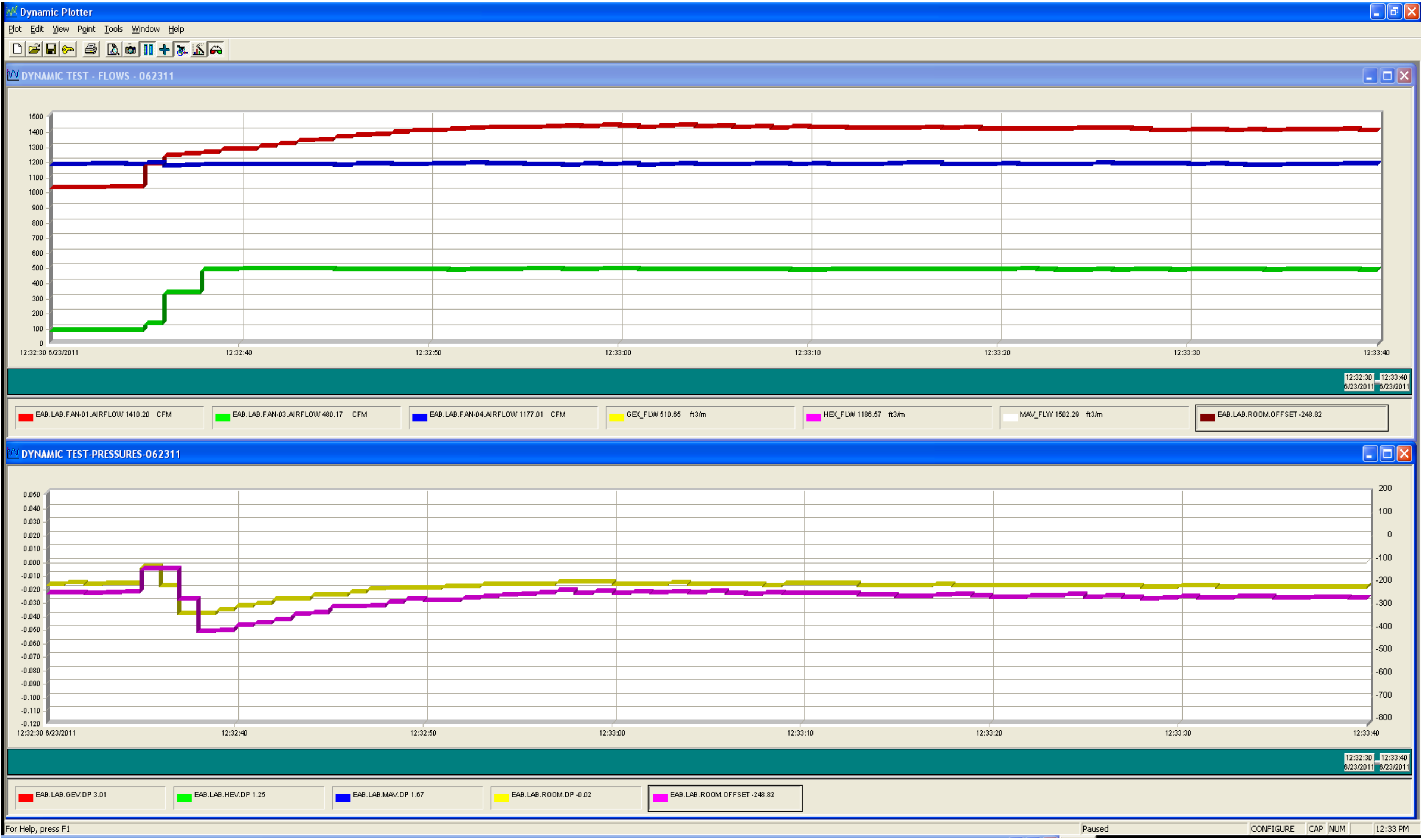
13B With the LCS in Full Heating Demand and Face Velocity at 150 FPM Raise the Sash to Full Height



With the hood sash at full height at 150 FPM, command the LCS to full cooling demand. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
13C	Supply	2.00	1.82	1.70	1028	1081	1404	1502
	General Exhaust	3.50	3.32	3.04	81	89	478	511
	Hood Exhaust	3.00	1.20	1.29	1177	1187	1181	1187
	Room Offset	----------	----------	----------	-236	-195	-255	-196

13C With the Hood Sash Fully Open Command the LCS to Full Cooling

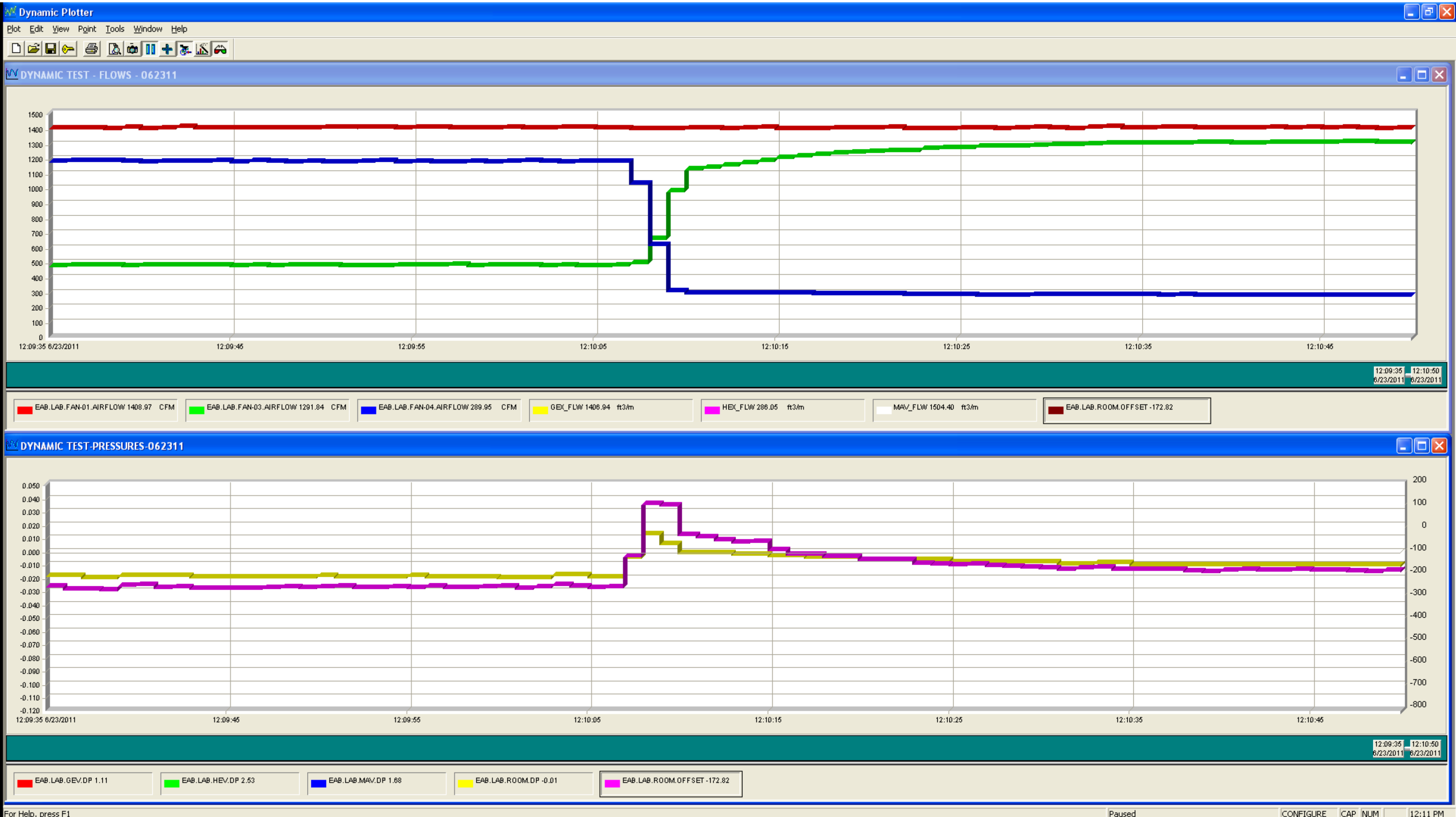


With the LCS set to full cooling demand and the hood sash at full height at 150 FPM, close the hood sash to the minimum position.. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

The test failed due to the system's inability to maintain a negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and 0.010" WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
13D	Supply	2.00	1.75	1.69	1406	1504	1409	1504
	General Exhaust	3.50	2.99	1.09	482	513	1290	1407
	Hood Exhaust	3.00	1.23	2.80	1185	1192	289	286
	Room Offset	----------	----------	----------	-261	-201	-170	-189

13D With the LCS Set For Full Cooling Modulate Fume Hood Sash From Full Open to Full Closed at 150 FPM Test Failed



14. Dynamic Testing – Terminal Valve Power Failure

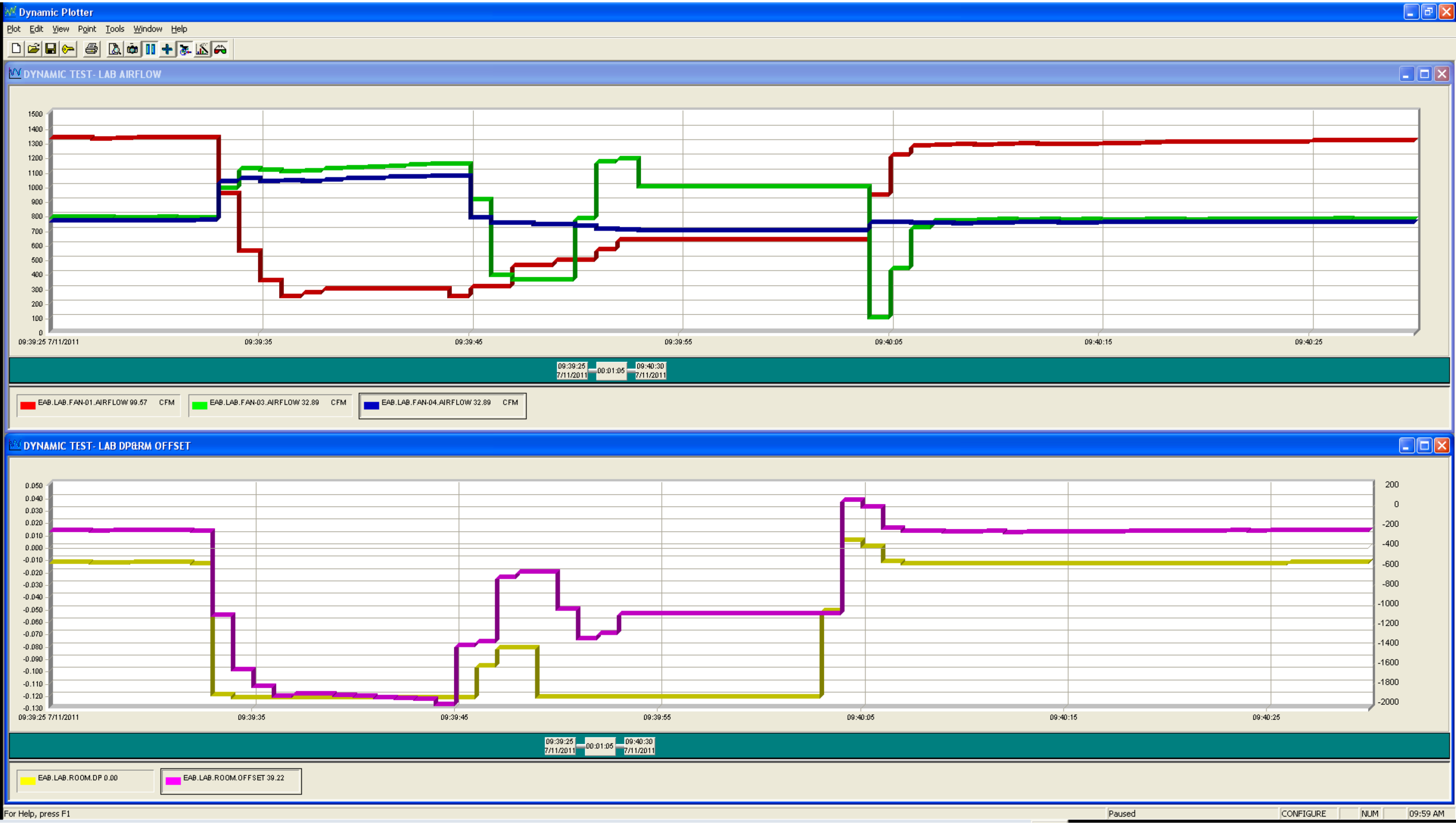
The following test will simulate the loss of power to the terminal control valves and evaluate the ability of the LCS to track airflow offset based upon setpoint tracking control. Based upon the setpoint, the terminal control valves will maintain airflow position and airflow offset.

Place the LCS in temperature override in full cooling with the hood sash fully open and deenergize the terminal valves for approximately 10 seconds then restore the power to the terminal valves. The BAS will be configured to maintain a duct static pressure in each system at the minimum setpoint to maintain each valve at a minimum operating differential pressure at the maximum airflow setpoint.

The test failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure after the power was restored in the terminal valves. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and 0.005” WC respectively.

	Terminal Valve	Duct SP Setpoint	Initial Valve ΔP	Final Valve ΔP	Initial BAS Airflow	Initial LCS Airflow	Final BAS Airflow	Final LCS Airflow
14A	Supply	3.50	3.24	3.15	1330	1400	1336	1400
	General Exhaust	3.50	2.53	2.55	785	809	769	817
	Hood Exhaust	3.00	2.24	2.25	762	790	757	773
	Room Offset	----------	----------	----------	-217	-199	-190	-190

14A Dynamic Testing- Terminal Valve Power Failure Test Failed



Issues With Venturi- Valve 1 – Mechanical Airflow Control

Issue
2J General and Hood Exhaust Valves Required a DP > 0.60" WC, Test Failed The general and hood exhaust valves each required a valve DP greater than 0.6" WC for the BAS flow alarm to achieve a non-alarm state. This test failed due to the supply, general exhaust, and hood valves exhibiting and airflow change greater than 5% whenever the duct static pressure required a minimum valve differential pressure of 0.6" WC was increase by 1 WC". Thereafter, all valves maintained airflow changes within the 5% testing criteria of the steady-state airflow for the remaining variable static pressure test.
4B Hood Sash Change In Heating Mode Hood Sash Open to Closed, Test Failed This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 40 CFM positive and .005"WC respectively.

Issues With Venturi - Valve1 – Mechanical Airflow Control

Issue
4C Hood Sash Change In Heating Mode Hood Sash Opened & Closed After 10 Seconds ,Test Failed This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 40 CFM positive and .005"WC respectively.
5A Thermal Demand Override To Cooling Test Failed The lab airflow offset and differential pressure briefly went positive as the supply and exhaust valves tracked to the increased airflows.
6B Hood Sash Change In Cooling Mode Hood Sash Closed Test Failed This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 200 CFM positive and .005"WC respectively.

CONTINU AIA

Issues With Venturi - Valve1 – Mechanical Airflow Control

Issue
6C Hood Sash Change In Cooling Mode Hood Sash Opened & Closed After 10 Seconds Test Failed This test failed due to the system's inability to maintain negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and .005"WC respectively.
8A Dynamic Testing- Exhaust System Failure With Setpoint Control Test Failed This system does not actively control airflow and therefore is always in setpoint control. The valve differential pressure is monitored and alarms when the DP is below the minimum setpoint of 0.6" WC. When this alarm is active, the airflow feedback from the LCS is failed.
9A Dynamic Testing- Exhaust System Failure With Offset Control Not Tested This LCS does not actively control airflow and therefore is always in setpoint control. This portion of the test was not conducted.
11A Dynamic Testing- Supply System Failure With Offset Control This LCS does not actively control airflow and therefore is always in setpoint control. This portion of the test was not conducted.

Issues With Venturi - Valve1 – Mechanical Airflow Control

Issue
12B Unoccupied Mode to Occupied Mode Test Failed The tests failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure when the change in occupancy mode went from unoccupied to occupied while the system was in full cooling. The dynamic test reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 300 CFM positive and 0.015” WC respectively.
12D With -400 CFM Offset Change from Occupied Mode to Unoccupied Mode Test Failed The tests failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure when the change in occupancy mode went from unoccupied to occupied while the system was in full cooling. The dynamic test reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 300 CFM positive and 0.005” WC respectively.

Issues With Venturi - Valve1 – Mechanical Airflow Control

Issue
13D With the LCS Set For Full Cooling Modulate Fume Hood Sash From Full Open to Full Closed at 150 FPM Test Failed The test failed due to the system's inability to maintain a negative airflow offset and laboratory negative pressure when the fume hood sash was modulated from the full open to the full close positions. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and 0.010" WC respectively.
14A Dynamic Testing- Terminal Valve Power Failure Test Failed The test failed due to the systems inability to maintain a negative airflow offset and laboratory negative pressure after the power was restored in the terminal valves. The dynamic test data reveals that the loss of offset and subsequent pressure was less than two seconds with a maximum airflow offset and room pressure of 100 CFM positive and 0.005" WC respectively.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
8C.4 At an airflow setpoint of 90 CFM, the supply valve exhibited an airflow change greater than five percent of the steady state value when the measured airflow at a valve differential static pressure of 2.0“ WC was compared to the measured airflow at a valve differential static pressure of 0.60” WC.
8C.8 & 8C.9 At an airflow setpoint of 90 CFM, the general exhaust valve exhibited an airflow change greater than five percent of the steady state value when measured airflows at a valve differential static pressure of 2.0” WC and 3.0” WC were compared to the measured airflow at a differential static pressure of 0.6” WC.
1E At an airflow setpoint of 800 CFM, the supply valve exhibited an airflow change greater than five percent of the steady state value with three diameters of straight duct entering and leaving the valve whenever the valve was connected ninety degrees directly into a plenum tap and the discharge connected ninety degrees directly into a plenum tap.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
2A, 2B, 2C At an airflow setpoint of 800 CFM, the supply valve exhibited an airflow change greater than five percent of the steady state value when the measured airflows at a valve differential static pressure of 2.6, 1.6 and 0.6 IWC with decreasing static pressure were compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.
2C At an airflow setpoint of 800 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflow at a valve differential static pressure of 2.7 IWC with increasing static pressure was compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.
2G, 2H, 2I At an airflow setpoint of 800 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflows at a valve differential static pressure of 2.8, 1.65 and 0.7 IWC with decreasing static pressure were compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
2K & 2L At an airflow setpoint of 1300 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflows at a valve differential static pressure of 1.45 and 2.45 IWC with increasing static pressure were compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.
2Q At an airflow setpoint of 1300 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflow at a valve differential static pressure of 1.4 IWC with decreasing static pressure was compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
2K & 2L At an airflow setpoint of 1300 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflows at a valve differential static pressure of 1.45 and 2.45 IWC with increasing static pressure were compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.
2Q At an airflow setpoint of 1300 CFM, the hood exhaust valve exhibited an airflow change greater than five percent of the steady state value when the measured airflow at a valve differential static pressure of 1.4 IWC with decreasing static pressure was compared to the measured airflow at a valve differential static pressure of 0.60 IWC with increasing static pressure.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
4B Hood Sash Change in Heating Mode – Full Open to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully closed to the fully open position for approximately 10 seconds then fully closed while in heating mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 100 CFM positive and laboratory pressure was +0.01" WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.
4C Hood Sash Change in Heating Mode – Full Open, 10Second Delay to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully closed to the fully open position for approximately 10 seconds then fully closed while in heating mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 100 CFM positive and laboratory pressure was +0.01" WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
6A Hood Sash Change in Cooling Mode – Full Closed to Fully Open – Test Failed Whenever the fume hood sash was modulated from fully closed to the fully open position while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 60 CFM positive and laboratory pressure was +0.01” WC for less than 1 second. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.
6B Hood Sash Change in Cooling Mode– Full Open to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully open to the fully closed position while in full cooling mode, there was a brief loss of negative airflow offset within the lab and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 100 CFM positive for less than 1 second. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
6C Hood Sash Change in Cooling Mode – Full Closed, Wait 10 Seconds to Fully Open Test Failed Whenever the fume hood sash was modulated from fully closed to the fully open position while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 60 CFM positive and laboratory pressure was +0.01” WC for less than 1 second. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.
9A Exhaust System Failure With Offset Control Test Failed Whenever an exhaust system failure was initiated, the lab went extremely positive. The supply valve did not track down to maintain a negative environment once the exhaust valves exhibited a differential pressure alarm.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
11A Supply Fan System Failure With Offset Control Test Failed Whenever a supply system failure was initiated, the lab temporarily went positive. The general exhaust valve closed once the supply valve exhibited a valve static pressure alarm thus causing the space to go positive as the supply fan was de-energized and decreasing in speed. However, TRIATEK stated that they are in the process of modifying the programming to allow the system to maintain the programmed offset environment.
12A Unoccupied Mode and Occupancy Override – BAS Commanded to Unoccupied Mode - Test Failed Whenever a state change from occupied to unoccupied mode was initiated with the hood sash fully closed, there was a brief loss of negative airflow offset within the lab and loss of laboratory negative pressure. The test data revealed that the maximum loss of negative airflow was 50 CFM positive and laboratory pressure was +0.01” WC for less than 1 second.

Issues With Venturi – Valve - 2 – Mechanical Airflow Control

Issue
13C Unoccupied Mode and Occupancy Override – BAS Command to Unoccupied Mode With -400CFM Offset Test Failed Whenever a state change from full heating to full cooling mode was initiated with the hood sash fully open at 125 FPM, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.
13D Unoccupied Mode and Occupancy Override – BAS Command to Occupied Mode With -400 CFM Offset Test Failed Whenever the fume hood sash was modulated from fully open to the fully closed position at 125 FPM while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 165 CFM positive and laboratory pressure was +0.02” WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.

Issues With Venturi – Valve 3 – Mechanical / Digital Airflow Control

Issue
4A Hood Sash Change in Heating Mode From Full Close to Full Open – Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.
4C Hood Sash Change in Heating Mode – Fully Open, 10 Second Delay, Fully Closed Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position for approximately 10 seconds then fully closed while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.

Issues With Venturi – Valve 3 – Mechanical / Digital Airflow Control

Issue
6A Hood Sash Change in Cooling Mode From Full Close to Full Open – Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position while in cooling mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.
6C Hood Sash Change in Cooling Mode – Fully Closed, 10 Second Delay, Fully Open Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position for approximately 10 seconds then fully closed while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.

Issues With Venturi – Valve 3 – Mechanical / Digital Airflow Control

Issue
10A Supply System Failure With Offset Control – Test Failed Whenever the occupancy was commanded from unoccupied to occupied mode while in cooling mode with a negative 400 CFM offset, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 4 seconds.
11D Unoccupied Mode and Occupancy Override – BAS Command Mode With -400 CFM Offset - Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position while in cooling mode and the face velocity at 125 FPM, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds.

Issues With Venturi – Valve 3 – Mechanical / Digital Airflow Control

Issue
13A Terminal Valve Power Failure - Test Failed Whenever a terminal valve power failure was initiated, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum delay in airflow control to 90% of setpoint was approximately 25 seconds.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
2 Airflow Accuracy With Variable Static Pressure – Test Failed With an airflow set point of 800 CFM the supply and exhaust valves exhibited a maximum airflow change of 13% and 9% respectively whenever the duct static pressure was increased then decreased above the minimum static pressure required. With an airflow set point of 1300 CFM the supply and exhaust valves exhibited a maximum airflow change of 25% and 16% respectively whenever the duct static pressure was increased then decreased above the minimum static pressure required.
3A Thermal Demand Override to Heating – Test Failed Whenever a state change from full cooling to full heating mode was initiated with the hood sash fully closed, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 13 minutes.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
4A Hood Sash Change in Heating Mode – Full Closed to Fully Open – Test Failed Whenever the fume hood sash was modulated from fully closed to fully open while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 15 seconds.
4B Hood Sash Change in Heating Mode – Full Open to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully open to fully closed while in heating mode, there was a brief loss of the negative airflow offset within the lab, loss of laboratory negative pressure and LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The test data revealed that the maximum loss of negative airflow was 95 CFM positive and laboratory pressure was +0.01" WC for less than 4 seconds. The maximum delay in airflow control to 90% of set point was approximately 8 seconds.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
4C Hood Sash Change in Heating Mode – Full Open, 10-Second Delay to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully closed to fully open for 10 seconds then fully closed while in heating mode, there was a brief loss of the negative airflow offset within the lab, loss of laboratory negative pressure and LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The test data revealed the maximum loss of negative airflow was 65 CFM positive and laboratory pressure was +0.01” WC for approximately 3 seconds. The maximum delay in airflow control to 90% of set point was approximately 8 seconds.
5A Demand Override To Cooling - Test Failed Whenever the thermal demand was switched from full heating to full cooling, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 14 minutes.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
6A– Hood Sash Change in Cooling Mode – Full Closed to Fully Open – Test Failed Whenever the fume hood sash was modulated from fully closed to fully open while in full cooling mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 6 seconds.
6B - Hood Sash Change in Cooling Mode – Full Open to Fully Closed– Test Failed Whenever the fume hood sash was modulated from fully open to fully closed while in full cooling mode the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 6 seconds.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
6C– Hood Sash Change in Cooling Mode – Fully Closed, 10 Second Delay, Fully Open -Test Failed Whenever the fume hood sash was modulated from fully closed to fully open for 10 seconds then fully closed while in full cooling mode the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 6 seconds.
7A – Thermal Demand Override From Full Cooling to Full Heating– Test Failed Whenever the thermal demand was switched from full cooling to full heating with hood sash fully open, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 8 minutes.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
10A– Supply System Failure With Setpoint Control-Test Failed Whenever the supply system was de-energized with the system in full heating, there was a brief loss of the negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. Once a differential static pressure alarm of the supply valve was activated, the general exhaust valve closed causing the lab to go positive for approximately 25 seconds as the supply airflow decreased. The hood exhaust valve maintained airflow to set point as the supply airflow decreased causing the space to become negative after 25 seconds.
12A – Occupancy Mode Switched from Occupied to Unoccupied– Test Failed Whenever the occupancy mode was switched from occupied to unoccupied while in full cooling mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 14 seconds.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
12B– Occupancy Mode Switched from Unoccupied to Occupied– Test Failed Whenever the occupancy mode was switched from unoccupied to occupied while in full cooling mode, there was a brief loss of the negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The test data revealed that the maximum loss of negative airflow was 315 CFM positive and laboratory pressure was +0.04" WC for less than 1 second. The maximum delay in airflow control to 90% of set point was approximately 9 seconds. The LCS mode went to full heating airflows once in occupied mode then modulated to full cooling airflows similar to the full heating to full cooling tests
12C– Occupancy Mode Switched from Occupied to Unoccupied With an Offset set for -400 CFM– Test Failed Whenever the occupancy mode was switched from occupied to unoccupied mode while in full cooling mode with airflow offset at -400 CFM the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The maximum delay in airflow control to 90% of set point was approximately 18 seconds.

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
12D– Occupancy Mode Switched from Unoccupied to Occupied With an Offset set for -400 CFM– Test Failed Whenever the occupancy mode was switched from unoccupied to occupied mode while in full cooling mode with airflow offset of -400 CFM, there was a brief loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of set point. The test data revealed that the maximum loss of laboratory pressure was +0.02" WC for less than 1 second. The maximum delay in airflow control to 90% of set point was approximately 8 seconds. Upon starting, the LCS went to full heating airflows once in occupied mode then modulated to full cooling airflows similar to the full heating to full cooling tests.
14A–Terminal Valve Power Failure Test Failed Whenever the power to the terminal valves was terminated then restored after 10 seconds, the room pressure and airflow in the lab went positive for about 3 seconds after the power was restored and the control valves were initializing. .

Issues With Venturi – Valve 4 – Mechanical Airflow Control

Issue
Extra Test- Separate Power Source to Control Panel Terminated for 10 Seconds Whenever the power to the control panel, which has a separate power source than the terminal valves, was terminated then restored after 10 seconds the supply, general exhaust and hood valves closed immediately once de-energized. Once the power was restored the room pressure and airflow in the lab went positive for approximately 4 seconds after the power was restored and the control valves were initializing.
Extra Test- Differential Static Pressure Alarm Activated Whenever a differential static pressure alarm of the supply terminal valve was activated, the general exhaust valve would immediately close. .

Issues With Blade Damper – Valve 5 – Butterfly Damper- Digital Airflow Control

Issue
6C – Hood Sash Change in Cooling Mode – Fully Closed, 10 Second Delay, Fully Open -Test Failed Whenever the fume hood sash was modulated from the fully closed position to the fully open position for approximately 10 seconds then fully closed while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.
7A Thermal Override From Cooling to Heating With The Hood Sash Fully Open – Test Failed Whenever a state change from full cooling to full heating mode was initiated with the hood sash fully closed, there was a brief loss of negative airflow offset within the lab. The test data revealed that the maximum loss of negative airflow was 60 CFM positive for less than 1 second

Issues With Blade Damper – Valve 5 – Butterfly Damper- Digital Airflow Control

Issue
11A – Supply System Failure with Offset Control-Test Failed Whenever a supply system failure was initiated, the lab went extremely negative. Since the space was setup as a negative environment, the supply valve was programmed to track the general exhaust valve to maintain airflow offset to setpoint.
12A - Occupancy Mode Switched from Occupied to Unoccupied– Test Failed Whenever a state change from occupied to unoccupied mode was initiated with the hood sash fully closed, there was a brief loss of negative airflow offset within the lab and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum loss of negative airflow was 50 CFM positive for less than 1 second and the maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.

Issues With Blade Damper – Valve 5 – Butterfly Damper- Digital Airflow Control

Issue
12B– Occupancy Mode Switched from Unoccupied to Occupied– Test Failed Whenever a state change from unoccupied to occupied mode was initiated with the hood sash fully closed, there was a brief loss of negative airflow offset within the lab and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that maximum delay in airflow control to 90% of setpoint was approximately 3 seconds.
14A – Terminal Valve Power Failure– Test Failed Whenever a terminal valve power failure was initiated, there was a temporary loss of laboratory negative pressure within the lab and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the loss of negative pressure was for about 50 seconds and the maximum delay in airflow control to 90% of setpoint was approximately 60 seconds.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
8C.3 & 8C.4 Minimum Airflow vs ΔP At an airflow setpoint of 200 CFM, the supply valve exhibited an airflow change greater than five percent of the steady state value whenever the duct static pressure required at the minimum valve differential pressure (DP) of 0.2” WC was increased by 1” WC.
8C.7, 8C.8, 8C.9 Minimum Airflow vs ΔP At an airflow setpoint of 200 CFM, the general exhaust valve exhibited an airflow change greater than five percent of the steady state value whenever the duct static pressure required at the minimum valve differential pressure (DP) of 0.2” WC was increased by 1” WC.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
2K.4 Airflow Accuracy With Variable Static Pressure At an airflow setpoint of 1300 CFM, the hood valve exhibited an airflow change greater than five percent of the steady state value whenever the duct static pressure required at the minimum valve differential pressure (DP) of 0.46” WC was increased by 1” WC.
3A Thermal Demand Override to Heating – Test Failed Whenever a state change from full cooling to full heating mode was initiated with the hood sash fully closed, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 550 CFM positive and laboratory pressure was +0.06” WC for less than 3 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 5 seconds.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
4A Hood Sash Change in Heating Mode – Full Closed to Fully Open – Test Failed Whenever the fume hood sash was modulated from fully closed to fully open while in heating mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the airflow control delay was less than 7 seconds. The lab hood fan speed was increasing to compensate for the sudden change in airflow requirements. Throughout this test, the hood valve command did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
4B Hood Sash Change in Heating Mode – Full Open to Fully Closed – Test Failed Whenever the fume hood sash was modulated from fully open to fully closed while in heating mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 550 CFM positive and laboratory pressure was +0.04" WC for less than 3 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 6 seconds. The lab exhaust fan speed was increasing to compensate for the sudden change in airflow requirements. Throughout this test, the exhaust valve command did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
5A Demand Override To Cooling - Test Failed Whenever the thermal demand was switched from full heating to full cooling, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The maximum delay in airflow control to 90% of setpoint was approximately 2 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.
6A– Hood Sash Change in Cooling Mode – Full Closed to Fully Open – Test Failed Whenever the fume hood sash was modulated from fully closed to fully open while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 50 CFM positive and laboratory pressure was +0.004" WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 6 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
6B - Hood Sash Change in Cooling Mode – Full Open to Fully Closed– Test Failed Whenever the fume hood sash was modulated from fully open to fully closed while in the full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 350 CFM positive and laboratory pressure was +0.025" WC for less than 3 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 5 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
6C– Hood Sash Change in Cooling Mode – Fully Closed, 10 Second Delay, Fully Open -Test Failed Whenever the fume hood sash was modulated from fully closed to fully open for 10 seconds then fully closed while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 350 CFM positive and the laboratory pressure was +0.03" WC for less than 3 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 4 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
7A Thermal Override From Cooling to Heating With The Hood Sash Fully Open – Test Failed Whenever the thermal demand was switched from full cooling to full heating with the hood sash fully open, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 500 CFM positive and the laboratory pressure was +0.04" WC for less than 3 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 4 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
12A - Occupancy Mode Switched from Occupied to Unoccupied– Test Failed Whenever the occupancy mode was switched from occupied to unoccupied while in full cooling mode, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 380 CFM positive and the laboratory pressure was +0.025" WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 7 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
12B– Occupancy Mode Switched from Unoccupied to Occupied– Test Failed Whenever the occupancy mode was switched from occupied to unoccupied while in Whenever the occupancy mode was switched from unoccupied to occupied while in full cooling mode, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed the maximum delay in airflow control to 90% of setpoint was approximately 4 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
12C– Occupancy Mode Switched from Occupied to Unoccupied With an Offset set for -400 CFM– Test Failed Whenever the occupancy mode was switched from occupied to unoccupied while in full cooling mode with the airflow offset at -400 CFM, there was a brief loss of negative airflow offset within the lab, loss of laboratory negative pressure and the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed that the maximum deviation of airflow offset was 100 CFM positive and the laboratory pressure was +0.01” WC for less than 2 seconds. The maximum delay in airflow control to 90% of setpoint was approximately 3 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.

Issues With Blade Damper – Valve 6 – Airfoil Split Damper- Digital Airflow Control

Issue
12D– Occupancy Mode Switched from Unoccupied to Occupied With an Offset set for -400 CFM– Test Failed Whenever the occupancy mode was switched from unoccupied to occupied mode while in full cooling mode with airflow offset of -400 CFM, the LCS took longer than 1.5 seconds to control the airflow to 90% of setpoint. The test data revealed the maximum delay in airflow control to 90% of setpoint was approximately 4 seconds. The lab fan speeds were increasing to compensate for the sudden change in airflow requirements. Throughout this test, the valve commands did not go past 90% open.
14A – Terminal Valve Power Failure– Test Failed Whenever the power to the terminal valves and LCS controllers was terminated then restored after 10 seconds, the room pressure and airflow in the lab went positive for about 3 seconds after the power was restored. The parameters such as airflow offset and room temperature setpoint reverted to default values, thus the LCS controlled at different airflow and temperature setpoints once the power was restored. A capacitive reserve or UPS solution on any critical control applications should be considered.

Conclusion

1. Generally speaking, venturi systems are faster, but cannot counteract supply and exhaust system failures.
2. Systems with direct airflow measurement are slower, but typically control offset more consistently.
3. Systems with airflow measurement can better counteract supply and exhaust system failures.
4. Long term reliability and maintenance of airflow sensors should be carefully evaluated.
5. Control Sequences that have isolation valves should be considered in offset control labs with critical environments.
6. Labs requiring a pressure differential and using an offset control that we have discussed may need a pressure sensor to reset the offset.

Questions

This concludes The American Institute of Architects Continuing Education Systems Course

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