UCB LeConte Hall MBCx

PreFunctional Test Procedures

Report generated on 9/1/2010 Report Filter For: , Units:Chilled Water System

Chilled Water System *(HVAC / Cooling)*	**OK?**	**Party**	**Initials**

Chilled Water System

RCx Thermal Flywheel | PreTest | 1/12/2010 12:00:00 AM | Pass | __________

TEST GOALS AND ASSUMPTIONS

ASSUMPTIONS

For the purposes of functional testing, the following assumptions will be made regarding the Le Conte chilled water system and facility.

1. Research activities are such that a loss of chilled water service will not adversely affect them should a problem occur during the test.

Julia and I met with Elanor who took us over to the lab. We met with the lab staff and verified that we would not disrupt research by running the test.
Chuck Frost and Mark Porter arrived and we reviewed the test procedure with everyone.

Remarks:
Noted that the labs fan coil units are in series with the reheat coils serving the zone, not stand-alone as we had thought.
The lab is controlling the fan coil units and the fan coil units have variable speed drives that are running at minimum speed.
The lab is seeing the same sort of zone temperature swing that we are seeing in the reheat coils, which they do not control.

RCx Thermal Flywheel | PreTest | 1/12/2010 12:00:00 AM | Pass | __________

TEST GOALS

1. To assess the thermal flywheel represented by the existing Le Conte chilled water system.
2. To verify the minimum chilled water temperature that can be delivered by the chiller in a repeatable, reliable, robust manner.
3. To determine the maximum chilled water temperature that can exist in the system before research activities will be impacted.
4. To quantify the thermal flywheel represented by the system in terms of ton-hours based on the flow rate from our pump test and the logged temperature rise that occurs over the course of the test.

Remarks:

RCx Thermal Flywheel | PreTest | 1/12/2010 12:00:00 AM | Pass | __________

ACCEPTANCE CRITERIA

1. This is an information gathering test and as such, there are no acceptance criteria.

Remarks:

RCx Thermal Flywheel | PreTest | 1/12/2010 12:19:27 PM | Pass | __________

GENERAL INSTRUCTIONS

1. Review the recommended test sequence to prior to testing.
2. Document all results as you proceed in the CACEA data base forms provided for the test.
3. Review all decisions to deviate from the procedure or recommended test sequence with other team members prior to making the change. Note any changes made for future reference.

4. If a test is suspended for any reason, go through the return to normal procedures to ensure that the system is left in a stable, known, satisfactory operating condition.

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

TEST EQUIPMENT

The following test equipment is recommended for this test:

1. Standard hand tool kit.

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

PREREQUISITES

The following prerequisites should be completed or in place prior to

1. The test needs to be conducted on a day when the only load on the system is the lab research loads or on a day when the building can tolerate having the chilled water valve for AHU2 forced to full bypass or can tolerate having AHU2 shut down for the duration of the test so that it imposes no load on the system if flow occurs through the cooling coil. If the cavitation issues with the AHU2 control valve has not been resolved, the latter requirement may become a driver. But, the requirement to open the throttling valve in the basement to allow some flow to occur through the piping to the basement to charge it may reduce the flow available to AHU2 to the point where cavitation is not a problem.

We verified that we could shut down AHU2. Chuck Frost verified that Ron had set up the system already with a trickle of flow through the basement bypass line.

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

2. The test needs to be conducted on a day when a loss of chilled water will not adversely impact research should problems occur during the test sequence.

Verified, see notes under test goals.

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

3. The building staff and management need to know we are going to do the test and be on board

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

4. Hartmut or his representative needs to be available so we can monitor their equipment to find out when we start to lose control from their perspective.

Remarks:

RCx Thermal Flywheel	PreTest	1/12/2010 12:19:27 PM	Pass	__________

5. Someone from Physical Plant should be available to help us get out of trouble if we get in trouble (trip the chiller off or something).

Chiller password is 9973

Remarks:
1-12-2010

We were not sure that we could easily adjust the set point for the chiller. It turned out that it was not a mapped point for the ALC system and there was not a manual adjusting pot.

Given this problem, we decided to abandon the test for the day and pick up on Wednesday or Thursday. Mark and Chuck were going to follow up with contacts they have to find the password for the JCI controller that operates the chiller.

1-13-2010

Mark Porter found out that the chiller password is 9973.

As a result, he and Mark Arney picked up and continued the test after re-verifying things to this point.

RCx Thermal Flywheel	PreTest	1/13/2010 12:00:00 AM	Not Done	__________

PRECAUTIONS AND PREPERATION

1. Verify that a pump test has been performed that documents the actual system flow rate and that the pump appears to be running at that point. This in formation is required for the thermal flywheel calculation.

Remarks:

RCx Thermal Flywheel	PreTest	1/13/2010 12:00:00 AM	Pass	__________

3. Observe standard safety precautions associated with working around live electrical equipment, pressurized piping, and rotating machinery.

Remarks:

RCx Thermal Flywheel	PreTest	1/13/2010 12:00:00 AM	Pass	__________

2. Verify that the control systems is logging the system temperature differential. This information will be used to calculate the system thermal flyweel capacity.

See the Excel spreadsheet titled 01-13-09 Flywheel Test.xlsx on the portal in the Trends folder, 01-14-10 subfolder for trend data from ALC for the test sequence and after.

Remarks:

RCx Thermal Flywheel	PreTest	1/13/2010 12:19:27 PM	Pass	__________

4. When forcing system variables to simulate a condition and verify a response, bear in mind that multiple processes may be dependent upon the variable you are about to manipulate. Prior to manipulating it, verify that your manipulation will not upset some other process and cause problems in the facility. For instance, forcing the outdoor air temperature to 75 degrees F in a cold day to verify the reset schedule on a condenser water system may also shut down the heating water system. If it is below freezing this could lead to a frozen coil.

Remarks:

RCx Thermal Flywheel	PreTest	1/13/2010 12:19:27 PM	Pass	__________

REFERENCES

All of these items have been loaded onto the project portal unless otherwise noted.

1. System diagram.

2. Mechanical drawings.

3. Control sequences (Barrington version and our outline sequences for Le Conte).

4. Control shop drawings (these are probably dated; I've asked for current copies but have not heard back from Craig or Robert).

5. O&M information and equipment submittal data

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

TEST PROCEDURE

1. Open the balance valve in the lines that serve AHU1 to set up about 5 gpm of flow in the lines. This will allow the lines to be charged as a part of the flywheel and will simulate flow in the range of what we would need if we added a flywheel tank in the basement.

See previous comment; Chuck Frost verified that Ron left the system with the valve cracked open.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

2. With the CHW pump running, put AHU2 in full bypass and assess the cavitation if it exists. If it is not objectionable, then we can run the test with AHU2 running. If it is not, then we will need to shut down AHU2 and put the valve in a position to divert some flow through the AHU2 coil so it doesn't cavitate.

AHU2 was shut down.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

3. Document the system flow rate via pump test or evaporator pressure drop or what ever other method you want to use that you are comfortable with given your experience with the system.

Pump appear to be running about where Ron had left it based on the gauges.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

4. Try to find out how cold the chiller can drive the system with out a safety trip of some kind. If you can't find that out, I'm guessing it's 39-40°F based on my observations of the system so I would try 39°F and if that gives you problem go up a degree at a time until you get out of trouble. For what we are trying to do, the colder the better.

Chuck frost had seen the system run at 37-38°F so that temperature was targeted. There was some difficulty in that the chiller tended to overshoot at low load and do a nuicance safety trip. We will need to address this if we auotmate this process and limit capacity somehow to avoid this type of problem.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

5. Operate the chiller to drive the system down to the lowest possible temperature. When the chiller shuts down, manually turn it off and document the time.

Changed CHW temp setpoint to 37F at 4:14 pm. Also shut off AHU-2. Test started at 4:21 pm.
Ran CHW setpoint up to max of 60F in order to keep CHW pump ON and compressors OFF.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

6. Monitor conditions in Hartmut's lab.

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

7. When Hartmut's instruments begin to detect a loss of the ability to maintain temperature control, document the time, chilled water temperature, and temperature in the lab. Based on data that Hartmut provided along with Barrington data, I think this will be when the chilled water gets into the low to mid 50's°F.

At 6:22 CHW temp reached 59.9F and compressors came ON. The lab was starting to see their temperatures shift from the tolearance they need at this point so we considered this the end of the test and adjusted CHW setpoint back to 37F.
The system pulled down in about 5 minutes; we did not document the time exactly. This is where we ran into problems with overshoot and nuisance low temperature safety trips with a low load (AHU 2 had not been restarted).

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 1:34:47 PM	Pass	__________

8. Note the time and then restart the chiller and run it long enough to pull the system back down to the start temperature. Document how long this takes.

See notes in previous step

Remarks:

RCx Thermal Flywheel	FPT	1/13/2010 2:13:59 PM	Pass	__________

9. Time permitting, repeat the test cycle once or twice.

Not enough time to retest, but there seems to be a significant flywheel in terms of the load in the lab, thus we consider the test successful and sufficient for the information we were trying to gather.

Remarks:

RCx Thermal Flywheel	PostTest	1/13/2010 12:34:55 PM	Pass	__________

RETURN TO NORMAL

1. Release all manual over-rides and external triggers, simulated conditions, etc. to totally return the system to normal operation and monitor the performance of the system long enough to verify and ensure that normal operation is in fact resumed.

Remarks:

RCx Thermal Flywheel	PostTest	1/13/2010 12:00:00 AM	Pass		__________

2. Pull trend data covering the test period. At a minimum chilled water supply and return temperature are required, but other pertinent chilled water data should be retrieved if its available.

See the Excel spreadsheet titled 01-13-09 Flywheel Test.xlsx on the portal in the Trends folder, 01-14-10 subfolder for trend data from ALC for the test sequence and after.

Remarks:

RCx Thermal Flywheel	PostTest	1/29/2010 1:34:47 PM	Pass		__________

3. Document all test results in CACEA and synchronize with the portal.

Remarks:

RCx Thermal Flywheel	PostTest	1/13/2010 1:34:47 PM	Pass		__________

4. Create action items directed to the contractors to address any contractual issues.

None required.

Remarks:

RCx Thermal Flywheel	PostTest	1/29/2010 1:34:47 PM	Not Done		__________

5. Create action items directed to UCB to address any non-contractual issues that have operational implications.

Remarks:

Chilled Water System Chilled Water Coil AHU2 -

Chw Sys Volume	Assess	6/23/2009 12:00:00 AM	Not Done	TAB	Engman, M.

DOCUMENT CHILLED WATER COIL DATA

Document the chilled water coil performance data and/or physical charcteristics. If you can not get the performance data from a shop drawing, then the physical data will allow us to model the coil performance using the USA Coil selection software or equivalent.

Performance Data

Note if data is for the total coil bank or for each coil in the bank. Not also that if the coils int eh bank are different physical sizes, the entering conditions and leaving conditions may be the same but the flow rates will be different.

• Waterside flow -
• Water side entering temperature -
Physical Data

• Water side leaving temperature -
• Airside flow -
• Air side entering wet bulb and dry bulb temperature -
• Air side leaving wet bulb and dry bulb temperature -

• Number of coils in bank - 2 (Typical)
• Coil finned length for each coil in the bank - 114 in.
• Coil finned height for each coil in the bank - 45 in.
• Coil tube diameter (usually 1/2" or 5/8" O.D.) - 5/8 in. O.D.
• Coil circuiting (see ASHRAE Handbook figure) -
ROWS: 3
TUBES PER ROW:30
CIRCUITS:22
PASSES:4
• Rows in coil - 3
• Fins per inch - 8
• Fin design (Flat plate, wave, etc.; take a picture if in doubt) - Flat Plate
• Fin material (aluminum, copper, etc.) -Aluminum
• Tube material (aluminum, copper, etc.) - Copper

• Corrosion coating (yes or no)? -Yes

Remarks:

Chilled Water System Chilled Water Control Valve AHU2 -

Chw Sys Volume	Assess	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

DOCUMENT VALVE AND ACTUATOR DATA

Document the control valve and actuator nameplate data in the CACEA nameplate data form.

AHU-2 3-WAY valve actuator:
Belimo
NM 24-SR US
(NM3010)

Remarks:

Chilled Water System Chilled Water Piping System - -

Verify	Assess	6/23/2009 12:00:00 AM	Pass	CA	__________

SYSTEM DIAGRAM

Develop a system diagram for this system.

Remarks:

	Assess	6/23/2009 7:10:17 AM	Not Done		__________

Field verify the system diagram.

Remarks:

Chilled Water System Chilled Water Pump -

Chw Sys Volume	RCxEBCx	8/4/2009 12:00:00 AM	Pass	TAB	Engman, M.

Document the make, model, and setting of the AHU-2 main balancing valve and the individual coil balancing valves.

AHU-2 main balancing valve make - Armstrong
AHU-2 main balancing valve model - 3GA / 3"
AHU-2 main balancing valve position - full open / 6.5

AHU-2 upper coil balancing valve make - Armstrong
AHU-2 upper coil balancing valve model - CBV-VT (or CBV-VS) / 2"
AHU-2 upper coil balancing valve position - full open

AHU-2 lower coil balancing valve make - Armstrong
AHU-2 lower coil balancing valve model - CBV-VT (or CBV-VS) / 2"
AHU-2 lower coil balancing valve position -full open

by pass balancing valve is same make, model, and position as upper and lower.

Remarks:

Chw Sys Volume	RCxEBCx	11/24/2009 12:00:00 AM	Pass	CA	Simens, R

Document the pressure drop through the AHU-2 balancing valves (AHU-2 Full Cooling)

TEST WITH BY CHW BPASS (Basement) 100% OPEN
AHU-2 main balancing valve pressure drop - 1.9 Feet, 90.7 GPM

Remarks:

Result of 11/24/2009 *Pass* *Simens, R*

TEST WITH BY PASS 100% OPEN
AHU-2 main balancing valve pressure drop - 1.9 Feet

Remarks:

Result of 8/4/2009 *Pass* *Engman, M.*

TEST WITH BY PASS 100% CLOSED
AHU-2 main balancing valve pressure drop - 1.5 FT.
AHU-2 upper coil balancing valve pressure drop - 3.6 FT.
AHU-2 lower coil balancing valve pressure drop - 3.5 FT.

TEST WITH BY PASS AT ITS MIN SETTING OF 60% OPEN
AHU-2 main balancing valve pressure drop - 0.8 FT.
AHU-2 upper coil balancing valve pressure drop - 2.2 FT.
AHU-2 lower coil balancing valve pressure drop - 2.0 FT.
by pass valve pressure drop- 0.6 FT.

Remarks:

The AHU-2 by-pass valve has a min 60% setting to allow the chiller's flow switch enough flow.

Chw Sys Volume	RCxEBCx	8/4/2009 12:00:00 AM	Pass	TAB	Engman, M.

Document the make, model, and setting of the balancing valve that shorts the mains together in the basement near AHU1.

Balancing valve make - Armstrong
Balancing valve model - 3GA / 3"
Balancing valve position - 1.5

Remarks:

Chw Sys Volume	RCxEBCx	8/4/2009 12:00:00 AM	Pass	CA	Simens, R

Document the pressure drop through the balancing valve that shorts the mains together in the basement near AHU1

Balancing valve pressure drop (Circuit Setter @ adjustment 5) - 4.5 ft, 139.6 GPM
TESTED WITH AHU-2 AT 100% FLOW THROUGH COIL.

Balancing valve pressure drop (Circuit Setter @ adjustment 5) - 5.7 ft, 157.1 GPM
TESTED WITH AHU-2 AT 0% FLOW THROUGH COIL.

Remarks:

Result of 11/24/2009 *Pass* *Simens, R*

Balancing valve pressure drop (Circuit Setter @ adjustment 5) - 4.5 ft, 139.6 GPM
TESTED WITH AHU-2 AT 100% FLOW THROUGH COIL.

Balancing valve pressure drop (Circuit Setter @ adjustment 5) - 5.7 ft, 157.1 GPM
TESTED WITH AHU-2 AT 0% FLOW THROUGH COIL.

Remarks:

Result of 8/4/2009 *Pass* *Engman, M.*

Balancing valve pressure drop - 46.2 FT.
TESTED WITH AHU-2 AT 100% FLOW THROUGH COIL.

Remarks:

Chilled Water System Chilled Water Pump - -

	RCxEBCx	1/29/2010 3:08:19 PM	Not Done	__________

Remarks:

	RCxEBCx	1/29/2010 3:17:49 PM	Not Done	__________

Remarks:

Capacity - Pump	Assume	6/22/2009 5:46:26 PM	Not Done	__________

PUMP TEST

Revised 06-24-09 to tailor generic test to the LeConte project.

TEST GOALS AND ASSUMPTIONS

ASSUMPTIONS

This test assumes that a valid pump curve can be obtained for the pump under test and that the impeller diameter can be verified by a pump shut-off test

Remarks:

Capacity - Pump	Goals	6/22/2009 5:38:20 PM	Not Done	__________

TEST GOALS

The purpose of this test is to identify the current operating point for the pump system under test as well as the wide open operating point. This data will then be used to assess what pump optimization alternatives are viable, if any

Remarks:

Capacity - Pump	Accept	6/22/2009 5:46:26 PM	Not Done	__________

ACCEPTANCE CRITERIA

This is an information gathering test and there are no specific acceptance criteria

Remarks:

Capacity - Pump	Instruct	6/22/2009 5:46:26 PM	Not Done	__________

GENERAL INSTRUCTIONS

1. The test as loaded initially into CACEA is generic and should be edited to match the specific requirements of the system under test.
2. Review the recommended test sequence to prior to testing.
3. Document all results as you proceed in the CACEA data base

forms provided for the test.
4. Review all decisions to deviate from the procedure or recommended test sequence with other team members prior to making the change. Note any changes made for future reference.
5. If a test is suspended for any reason, go through the return to normal procedures to ensure that the system is left in a stable, known, satisfactory operating condition

Remarks:

Capacity - Pump	Equip	6/22/2009 5:46:26 PM	Not Done	__________

TEST EQUIPMENT

The following test equipment is recommended for this test:

1. Standard hand tool kit.
2. Multimeter with amp measuring capability at a minimum; kW capability preferred.
3. Pressure gauges, ar pressure transducer capable of interfacing with a Fluke meter, or a hydromanometer (preferred).
4. Tachometer

Remarks:

Capacity - Pump	Caution	6/22/2009 5:46:26 PM	Not Done	__________

PRECAUTIONS AND PREPERATION

1. Observe standard safety precautions associated with working around live electrical equipment, pressurized piping, and rotating machinery.
2. Performing a shut-off test has the potential to create a condition where there is no flow in the system. In turn, this can cause issues with some of the equipment served by the pump, including shutdown on loss of flow safeties. Prior to testing, steps should be taken to ensure that problems of this type are not created by the test procedure, either by temporarily shutting down the equipment with a flow interlock or by operating a different pump to serve that equipment while the pump in question is under test.
3. Avoid sudden flow changes to minimize the potential for water hammer.
4. During the shut-off test, make sure you have a firm grip on the shut-off valve when you throttle the pump as significant forces can be generated, especially for a large pump with large piping. Alternatively, shut down the pump, close the discharge valve, and then restart the pump to operate against the closed valve.

Remarks:

Capacity - Pump	Required	6/22/2009 5:46:26 PM	Not Done	__________

PREREQUISITES

The following prerequisites should be completed or in place prior to testing the pump.

1. The manufacturer's pump curve for the specific pump under test should be available.
2. Verify that a shut off test with the largest available impeller is not capable of generating a pressure that exceeds the rating of any component between the discharge valve used for the shut off test (including the valve itself) and the pump casing (including the casing itself). The peak pressure will be equal to the head generated at the peak of the pump curve with the largest possible impeller installed plus the static pressure at the pump suction

added together. Be sure to add consistent units; i.e. convert feet to psi or psi to feet if the pump curve is in ft.w.c. and the static pressure information is in psi. Also be sure to use the curve for the nominal speed of the motor that is installed on the pump.
3. Verify that the test can be accomplished with out significant or unacceptable disruption to the activities or processes served by the system under test. For instance, creating a wide open condition on a variable flow system will involve forcing two way valves on loads wide open. This could cause the areas served to overheat or over-cool if some other mitigating action is not taken

Remarks:

Capacity - Pump	Refer	6/22/2009 5:46:26 PM	Not Done		__________

REFERENCES

The following references will be required or may be useful while performing this procedure.

1. Pump curves for the pumps to be tested (required).
2. Motor curves for the pump motor (desirable).
3. A system diagram for the system under test (desirable).
4. The Bell and Gossett Hydronic Engineering manual.
5. The following design briefs, available for download from the Energy Design Resources web site (www.energydesignresources.com)

• “Pumping System Troubleshooting”, which includes a generic pump test procedure in the opening section.
• “Centrifugal Pump Application and Optimization

Remarks:

Capacity - Pump	RCxEBCx	9/22/2009 12:00:00 AM	Pass	TAB	Engman, M.

PROCEDURE

DOCUMENTATION OF EXISTING CONDITIONS

Document the as found status of the system including the status of all pumps and loads, current pressures and temperatures, the position of throttling valves, the position of speed dials and Hand-Off-Auto selector switches, etc.

This single CHW pump is located inside the rooftop chiller unit tagged CH-1.
Both the suction butterfly and discharge triple duty valves are 100% open.
Pump running press: 48.4/ 19.8 PSI
EWT 58 Deg F/ LWT 51 Deg F
No Hand-Off-Auto selector/ controlled by Chiller

Remarks:

Capacity - Pump	RCxEBCx	9/22/2009 12:00:00 AM	Pass	TAB	Engman, M.

Pump/Motor data

Pump: B&G 1510-BF
2 BC/ imp: 8.25 BF
Motor:Baldor HP-7.5 PH-3
460 V/10 A
1750 RPM
FR 213T SF 1.15

Remarks:

Capacity - Pump	RCxEBCx	6/22/2009 12:00:00 AM	Pass	TAB	Engman, M.

DOCUMENTATION OF STRAINER CONDITION

With one pump running (normal operating mode) document the following. Note the engineering units associated with the reading; i.e. psi or ft.w.c.

• Pump that is under test - only one pump
• Pressure ahead of the strainer – 21.0 PSI
• Pump suction pressure - 19.8 PSI
• Strainer pressure drop (the difference between the two reading just taken) - 1.2 PSI

Remarks:

Capacity - Pump	RCxEBCx	6/22/2009 12:00:00 AM	Pass	TAB	Engman, M.

If the pressure drop through the strainer exceeds 3 psi/7 ft.w.c. suspend the test and inspect and clean the strainer. After the strainer is clean, document the clean strainer pressure drop and proceed with the test.

The initial low strainer press drop indicates that the strainer is not loaded or dirty.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

DOCUMENTATION OF “AS FOUND” OPERATING POINT

Document the following to establish the “as found” operating point:

Note that a direct reading of differential pressure can be taken in place of individual suction and discharge pressure readings if the appropriate instrument is available. The goal is to obtain a differential pressure reading.

- Pump VFD speed setting (if so equipped) - No VFD
- Pump discharge pressure - 48.4 PSI
- Pump suction pressure - 19.8 PSI
- Pump differential pressure (read directly or subtract the two previous readings) - 28.6 PSI (66 FT. HD.)
- Pump amps (all phases) - 6.2/ 6.3/ 7.4
- Pump volts (all phases) - 478/ 479/ 474
- Pump kW (if kW meter is available) - N/A
- Pump speed - (NO VFD) 60 HZ

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

DOCUMENTATION OF “WIDE OPEN” OPERATING POINT

Verify that the changes about to be made for this portion of the test will not disrupt operations.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Document the position of the discharge throttling valve –

The 4" Armstrong Trip Duty Vlve is 100% open.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Fully open the discharge throttling valve.

Already found full open.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Fully open the AHU-2 chilled water coil main balancing valve.

Already found full open.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Fully open the AHU-2 chilled water coil bank balancing valves. | Already found full open.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Force the AHU-2 chilled water valve to full flow to the coil.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Document the following to establish the wide open operating point with full flow to the AHU-2 coil:

Note that a direct reading of differential pressure can be taken in place of individual suction and discharge pressure readings if the appropriate instrument is available. The goal is to obtain a differential pressure reading.

Pump parameters

- Pump discharge pressure -48.3 PSI
- Pump suction pressure - 19.8 PSI
- Pump differential pressure (read directly or subtract the two previous readings) - 28.5 PSI (66 FT HD)
- Pump amps (all phases) - 6.2/ 6.3/ 7.4
- Pump kW (if kW meter is available) - N/A
- Pump speed - No VFD (60 HZ)

AHU-2 parameters

- Main balancing valve pressure drop - 1.5 FT
- Upper coil balancing valve pressure drop - 3.6 FT
- Lower coil balancing valve pressure drop - 3.5 FT

Balancing valve shorting the mains near AHU-1 parameters

- Balancing valve pressure drop - 46.6 FT

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Force the AHU-2 chilled water valve to full bypass.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Document the following to establish the wide open operating point with full bypass flow at the AHU-2 coil:

Note that a direct reading of differential pressure can be taken in place of individual suction and discharge pressure readings if the appropriate instrument is available. The goal is to obtain a differential pressure reading.

Pump parameters

- Pump discharge pressure - 49.8 PSI
- Pump suction pressure - 19.1 PSI
- Pump differential pressure (read directly or subtract the two previous readings) - 30.7 PSI (71 FT HD)
- Pump amps (all phases) - 6.6/ 6.5/ 7.4
- Pump kW (if kW meter is available) - N/A
- Pump speed - No VFD (60 HZ)

AHU-2 parameters

- Main balancing valve pressure drop - 0.9 FT
- Upper coil balancing valve pressure drop - 2.2 FT
- Lower coil balancing valve pressure drop - 2.1 FT

Balancing valve shorting the mains near AHU-1 parameters

- Balancing valve pressure drop -

Remarks:
Full bypass is not available as this configuration will shut the chiller off on low flow. The 3-way valve at AHU-2 is set to close to a minimum of 60% so that the flow switch does not trip the chiller. Therefore, this test was done st this 60% position.

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Unable	TAB	Engman, M.

Briefly close the discharge throttling valve.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Unable	TAB	Engman, M.

Document the following to establish the shut-off head:

Note that a direct reading of differential pressure can be taken in place of individual suction and discharge pressure readings if the appropriate instrument is available. The goal is to obtain a differential pressure reading.

- Pump VFD speed setting (if so equipped; should be 100% for this portion of the test) -
- Pump discharge pressure -
- Pump suction pressure -
- Pump differential pressure (read directly or subtract the two previous readings) -
- Pump amps (all phases) -
- Pump kW (if kW meter is available) -
- Pump speed -

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Unable	TAB	Engman, M.

Return the discharge throttling valve to the "as found" state.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

RETURN TO NORMAL

Return all balance valves to the "as found" condition.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Return the system to the state it was operating in at the start of the test or as requested by the operating staff.

Remarks:

Capacity - Pump	RCxEBCx	9/23/2009 12:00:00 AM	Pass	TAB	Engman, M.

Remove all test equipment.

Remarks: