NEUDORFER ENGINEERS INC.

TEST, ADJUST & BALANCE
BALANCE REPORT

Neudorfer Engineers
2501 SE Columbia Way
Vancouver, Washington 98661
2013-000

Project Completion Date: 05/07/13

Revision Date: **Revision Number:**

SEATTLE

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Seattle, WA 98108
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Neudorfer Engineers
2501 SE Columbia Way
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Neudorfer Engineers. Inc.
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Report Title

CERTIFIED TEST: BALANCE REPORT

Project: Neudorfer Engineers
2501 SE Columbia Way
Vancouver, Washington 98661

NEI Job#: 2013-000

Mechanical Engineer: NEI

Architect:

HVAC Contractor: NEI

TAB Firm: Neudorfer Engineers Inc
Test Engineer: Dennis Hucke

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CERTIFICATION

Neudorfer Engineers

The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. Any variances from design quantities, which exceed NEBB tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

Significant / Noteworthy Remarks are noted on the General Remarks and General Field Notes pages. Other remarks are noted on individual test sheets.

Noted deficiencies are not the TAB firms responsibility to repair. Prior to issuance of this report, Deficiency Reports are forwarded to our contracted agent.

Warranty is limited to one year from date of this report. Within that time, any discrepancies, ambiguities, or omissions found in this report will be retested, adjusted, or balanced as needed. A written notification will be required.

Submitted and Certified by:

NEBB TAB Firm:	**Neudorfer Engineers Inc**
Certification No:	**2465 / 3414**
Expiration Date:	**March 31, 2013**
Certification Date: *(Date completed)*	**March 31, 2011**

Signed and Sealed by:

NEBB Supervisor:	**Mike Vawter P.E.**
NEBB Supervisor:	**Eric Stotts**

Terms and Abbreviations

Project: **Neudorfer Engineers**
2501 SE Columbia Way

AC or ACU Air Conditioner or Air Conditioning Unit
AH or AHU Air Handler or Air Handling Unit
AVG Average
BHP Brake Horsepower
CAV Constant Air Volume
CBV Calbirated Balancing Valve (Circuit Setter)
CC Cooling Coil
CD Ceiling Diffuser
CFM Cubic Feet per Minute
CH Chiller
CHWS Chilled Water Supply
CHWR Chilled Water Return
CP Circulating Pump
CR Ceiling Register
CRAC Computer Room Air Conditioner
CRU Computer Room Unit
CT Cooling Tower
CU Condenser Unit
CUH Cabinet Unit Heater
CWS Condenser Water Supply
CWR Condenser Water Return
DAT Discharge Air Temperature
DB Dyr Bulb
DD Direct Drive
DDC Direct Digital Controls: EMS Control System for the HVAC
Des. Design
Dia. Diameter
Disch. Discharge
EA Exhaust Air
EAT Entering Air Temperature
Economizer Controls and components that allow an air handler to logically utilize outdoor air for cooling as opposed to the use of mechanical cooling.
EF Exhaust Fan
EG Exhaust Grille
EMCS Energy Management Control System
ERU Energy Recovery Unit
E.S.P. External Static Pressure
HRC Heat Recovery Coil
EWT Entering Water Temperature
FCU Fan Coil Unit
FD Fire Damper
FLA Full Load Amperage: Maximum amperage a motor can draw.
Flow Hood Instrument that captures air and converts the reading to CFM.
FHT Fume Hood Test
FPB Fan Powered Box
FPM Feet per Minute
FR Field Report
FT Foot, Feet
FTU Fan Terminal Unit
GPM Gallons per Minute
HC Heating Coil
TDH Pressure Difference across the entering and leaving side of a pump.
HEPA High Efficiency Particulate Arrestance
HP Horsepower
HVAC Heating Ventilation and Air Conditioning
HWS Heating Water Supply
HWR Heating Water Return
HX Heat Exchanger
HZ Hertz, cycle per second
in. inches
in.w.g. inches of water gauge
Kfactor Correction factor to the free area need to calculate CFM.
KW Kilowatts
LAT Leaving Air Temperature
LWG Low Wall Grille
LWR Low Wall Register
LWT Leaving Water Temperature
MAU Make-up Air Hangling Unit
MBH 1,000 BTUH
N/A Not Applicable
OSA Outside Air
OBD Opposed Blade Damper
ΔP Pressure Drop.
PH Phase
PSI Pounds per Square Inch
RA Return Air
RAT Return Air Temperature
RF Return Fan
RH Relative Humidity
RHC Reheat Coil
RPM Revolutions per Minute
RTU Roof Top Unit
SA Supply Air
SAT Supply Air Temerature
S.F. Service Factor
SF Supply Fan
SFD Smoke/Fire Damper
SP Static Pressure
sq.ft. square feet
Suct. Suction
SWG Sidewall Grille
SWR Sidewall Register
TAB Test; Adjust; and Balance
TSP Total Static Pressure: Difference between the entering and leaving static pressure of a fan.
UH Unit Heater
VAV Variable Air Volume; box that contains a motorized damper that modulates airflow.
VD Volume Damper
VFD Variable Frequency Drive
Velgrid Instrument that reads used to read velocity in feet per minute.
VVT Variable Volume Terminal
WC Water Column
W.G. Water Gauge
WB Wet Bulb

Neudorfer Engineers

2501 SE Columbia Way

Instrument Calibrations

Instrument Type	Air Data Meter with Flowhood	Instrument Serial #	**M08839**
Instrument Manufacturer	**Shortridge**	Calibration Date	**11/16/2012**
Instrument Model Number	**ADM 860C**		
Instrument Type	Differential Pressure Water Meter	Instrument Serial #	**W06016**
Instrument Manufacturer	**Shortridge**	Calibration Date	**12/13/2012**
Instrument Model Number	**HDM-250**		
Instrument Type	Psychrometer	Instrument Serial #	**8084305**
Instrument Manufacturer	**Extech**	Calibration Date	**11/20/2012**
Instrument Model Number	**RH390**		
Instrument Type	Tachometer	Instrument Serial #	**166489**
Instrument Manufacturer	**Hasler Bern**	Calibration Date	**11/16/2012**
Instrument Model Number	**Type B**		
Instrument Type	Amp Probe	Instrument Serial #	**78212531**
Instrument Manufacturer	**Fluke**	Calibration Date	**11/16/2012**
Instrument Model Number	**36 Clamp Meter**		
Instrument Type	Digital Thermometer	Instrument Serial #	**M08839**
Instrument Manufacturer	**Shortridge**	Calibration Date	**11/16/2012**
Instrument Model Number	**ADM 860C**		
Instrument Type	Manometer	Instrument Serial #	**M08839**
Instrument Manufacturer	**Shortridge**	Calibration Date	**11/16/2012**
Instrument Model Number	**ADM 860C**		

Instrument Type	Thermal Anemometer	Instrument Serial #	**AVM440742003**
Instrument Manufacturer	**Alnor Instruments**	Calibration Date	**11/21/2012**
Instrument Model Number	**AVM 440**		

TEST & BALANCE REPORT SUMMARY

This project has been balanced per plans and specifications using the National Environmental Balancing Bureau (NEBB) standards and procedures.

The fans have been checked for fan data, operating amperage, voltage, rotation, RPM, belt tension, alignment, and operating static pressure. All outlets have been proportioned to ± 10% of the percentage of total airflow of the system unless otherwise noted.

The pump was checked for data, operating amperage, voltage, rotation, RPM, alignment, and operating pressure.

The heating water system is supplied with a Griswold Automatic Flow Limiting balance valve. Griswold Automatic Flow Limiting balance valves maintain an optimal flow rate at constant and fluctuating pressure conditions as long the system pressure is set to maintain a minimum range of 2-psi to 32 psi differential pressure at the valve.

The Griswold Automatic Flow Limiting valve was verified to be operating within the specified differential pressure range of 2-32 psi.

Air Handling Unit

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

SYSTEM/UNIT: AHU-01
AREA:

Tested By: Dennis Hucke
Test Date: May 7th, 2013

Unit Data

Unit Manufacturer	PACE
Unit Model Number	CAHU-14
Unit Serial Number	00-81492-01
Unit Discharge	Top Horizontal
Fan Rotation	Correct
AHU-01 / SF Filter Bank	
Filter Manufacturer	AAF
Filter Type	Pleated
Filter Quantity - Size 1	4
Filter Dimensions - Size 1	24x24x4

Test Data

Total Design Flow	3000 CFM
Total Actual Flow	3015 CFM
OA Design Flow	300 CFM
OA Actual Flow	325 CFM
RA Design Flow	3000 CFM
RA Actual Flow	3000 CFM
AHU-01 / Supply Fan	
Fan RPM Design	1350 RPM
Fan RPM Actual	1345 RPM
Motor RPM Actual	1755 RPM
Motor Volts T1-T2	466 Volts
Motor Volts T2-T3	465 Volts
Motor Volts T1-T3	465 Volts
Motor Amps T1	2.75 Amps
Motor Amps T2	2.65 Amps
Motor Amps T3	2.60 Amps

Motor Data

AHU-01 / Supply Fan	
Motor Manufacturer	Baldor
Drive Type	Belt Drive
Motor Frame	182T
Motor HP	3 HP
Motor RPM	1750 RPM
Motor Rated Volts	230/460 Volts
Motor Phase	3
Motor Hertz	60 Hz
Motor FL Amps	6.8 / 3.2 Amps
Motor Service Factor	1.15
Motor Efficiency	92.1 %
Motor Power Factor	89.8 PF

Sheave Data

AHU-01 / Supply Fan	
Motor Sheave MFG	Browning
Motor Sheave Model	1VP44
Motor Sheave Bore	1 1/8 in.
Motor Sheave Type	Adjustable
Adj Mtr Sheave Pos	Middle
Fan Sheave MFG	Browning
Fan Sheave Model	AK54
Fan Sheave Bore	1 3/16 in.
Number of Belts	1
Belt Size	A-77
Sheave Center Line	24.5 in.
Motor to Extend	2.5 in.
Motor to Retract	1.5 in.

Test Pressures

Pre-Filter Inlet SP	0.25 in. wc
Pre-Filter Outlet SP	0.40 in. wc
Pre Heat Coil Inlet SP	0.40 in. wc
Pre Heat Coil Outlet SP	0.45 in. wc
Clg Coil Inlet SP	0.45 in. wc
Clg Coil Outlet SP	0.55 in. wc
SF Suction SP	0.65 in. wc
SF Discharge SP	1.25 in. wc
SF Design Total SP	2.00 in. wc
SF Actual Total SP	1.90 in. wc

Air Handling Unit

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

SYSTEM/UNIT: AHU-01 (Cont.)
AREA:

Tested By: Dennis Hucke
Test Date: May 7th, 2013

AHU-01 Supply Outlet Summary

System / Unit	Type of Reading	Outlet Type	Size LxW / D	AK	Design Velocity	Design Value	Prelim Reading	Final Reading	Final %	Remarks
Outlet-01	Flowhood	CD	12	1.00	-	500	350	515	103	
Outlet-02	Flowhood	CD	12	1.00	-	500	395	500	100	
Outlet-03	Flowhood	CD	12	1.00	-	500	550	500	100	
Outlet-04	Flowhood	CD	12	1.00	-	500	565	510	102	
Outlet-05	Flowhood	CD	12	1.00	-	500	585	495	99	
Outlet-06	Flowhood	CD	12	1.00	-	500	610	495	99	
Totals :	**-**	**-**	**-**	**-**	**-**	**3,000**	**3,055**	**3,015**	**101 %**	**-**

AHU-01 Return Inlet Summary

System / Unit	Type of Reading	Outlet Type	Size LxW / D	AK	Design Velocit	Design Value	Prelim Readin	Final Reading	Final %	Remarks
Inlet-01	Flowhood	RG-1	14	1.00	-	750	875	755	101	
Inlet-02	Flowhood	RG-1	14	1.00	-	750	920	755	101	
Inlet-03	Flowhood	RG-1	14	1.00	-	750	555	740	99	
Inlet-04	Flowhood	RG-1	14	1.00	-	750	800	750	100	
Totals :	**-**	**-**	**-**	**-**	**-**	**3,000**	**3,150**	**3,000**	**100 %**	**-**

*** Notes**

Duct Traverse

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

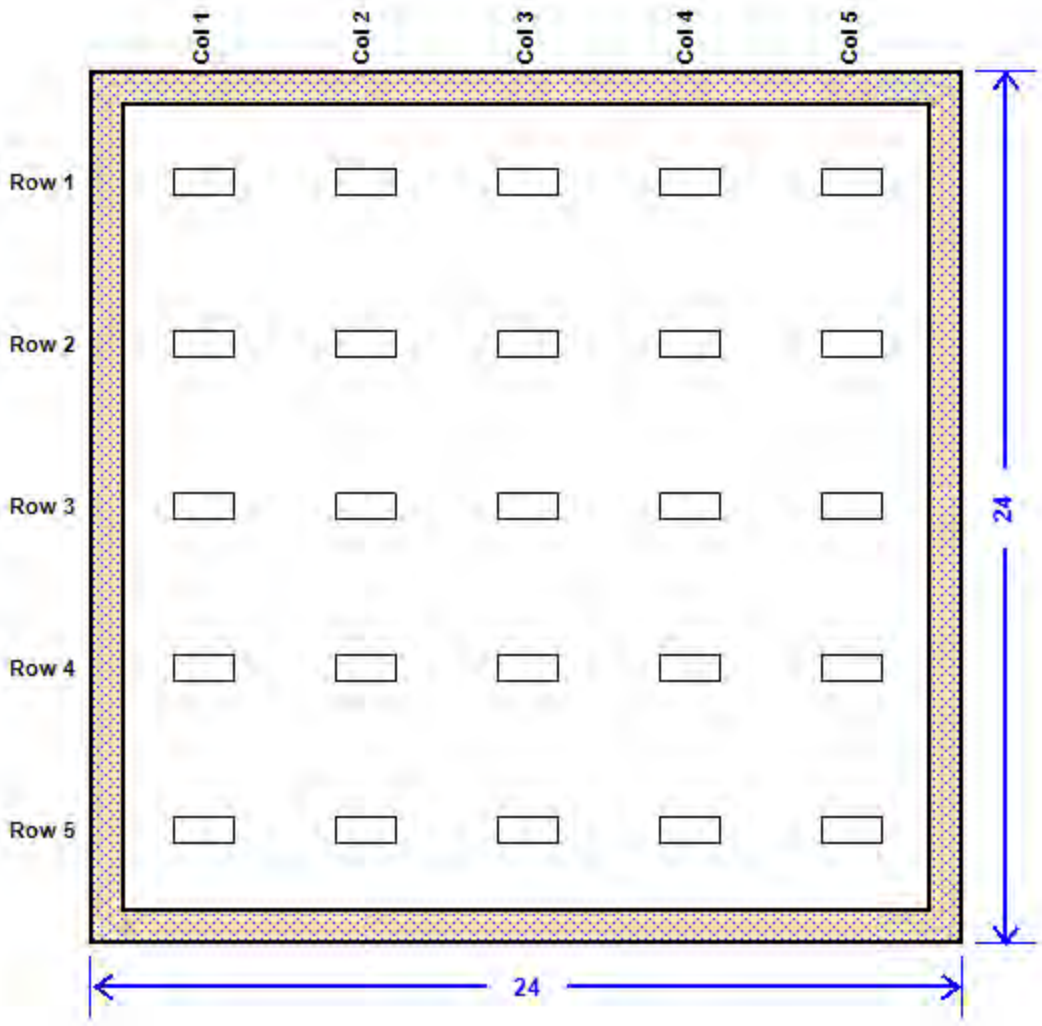
SYSTEM/UNIT: Supply Duct-01

Tested By: Dennis Hucke
Test Date: May 7th, 2013

Unit Data	
Type of Traverse	Rectangular
Outer Height	24 in.
Outer Width	24 in.
Insulation Width	1.00 in.
Air Flow Area	3.36 sq. ft.
Number Of Rows	5
Readings Per Row	5
Total Readings	25
Location of Holes 1	Left
Location of Holes 2	Bottom

NOTES:

Duct Traverse Data Points



Duct Traverse

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

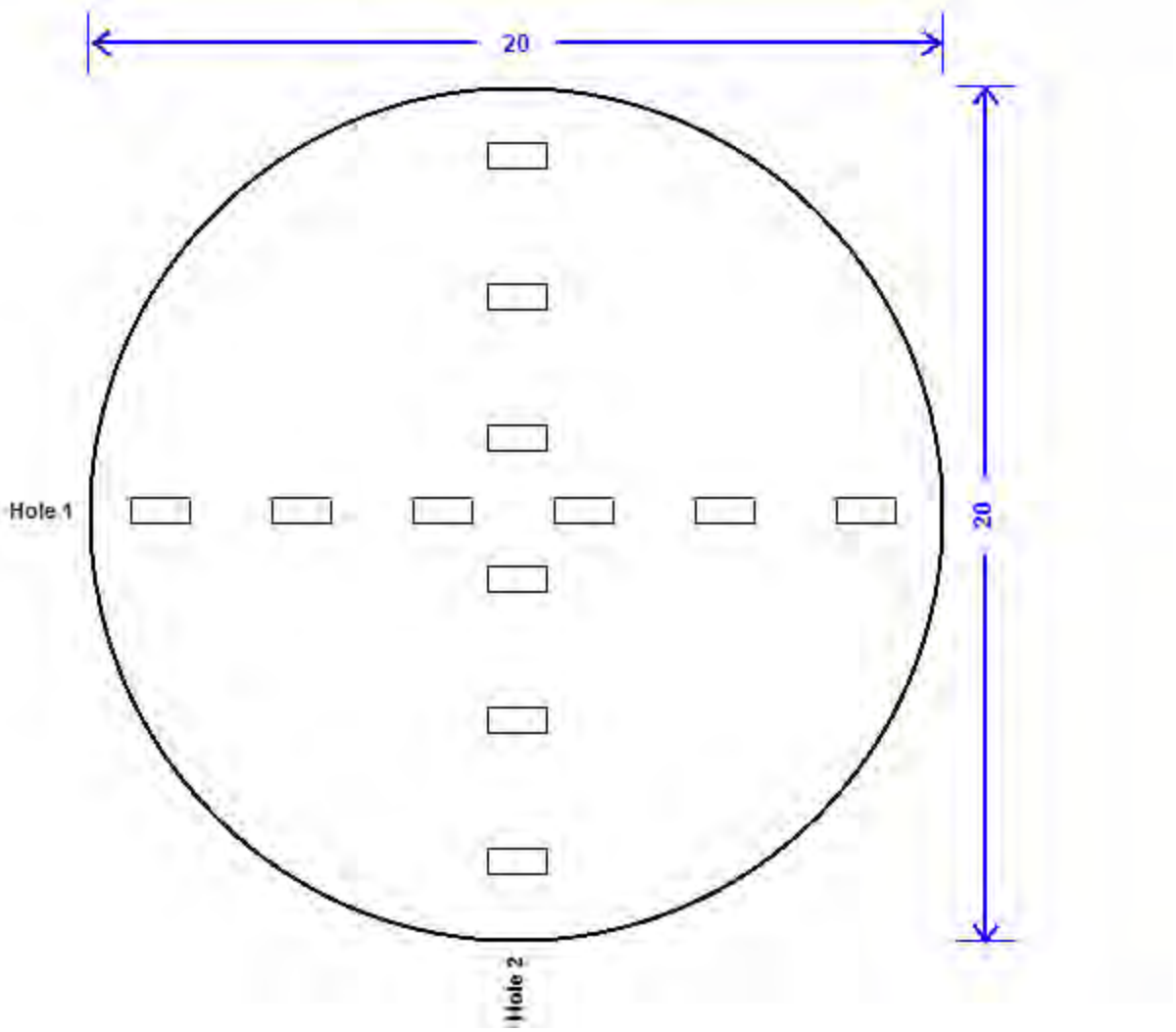
SYSTEM/UNIT: Return Duct-02

Tested By: Dennis Hucke
Test Date: May 7th, 2013

Unit Data	
Type of Traverse	Round
Diameter	20 in.
Insulation Width	0 in.
Air Flow Area	2.18 sq. ft.
Number Of Rows	2
Readings Per Row	6
Total Readings	12
Location of Holes 1	Left
Location of Holes 2	Bottom

NOTES:

Duct Traverse Data Points



Fan Unit

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

SYSTEM/UNIT: EF-01
AREA:

Tested By: Dennis Hucke
Test Date: May 7th, 2013

Unit Data	
Fan Manufacturer	Cook
Fan Model Number	XX 12UB-CW
Fan Serial Number	15489RTC
Fan Rotation	Correct
Drive Type	Direct Drive

Test Data	
Total Design Flow	200 CFM
Total Actual Flow	210 CFM
Fan RPM Design	1725 RPM
Fan RPM Actual	1725 RPM
Motor RPM Actual	1725 RPM
Motor Volts T1-T2	120 Volts
Motor Amps T1	1.9 Amps

Motor Data	
Motor Manufacturer	Baldor
Motor Frame	48
Motor HP	1/4 HP
Motor RPM	1725 RPM
Motor Rated Volts	120 Volts
Motor Phase	1
Motor Hertz	60 Hz
Motor Full Load Amps	2.00 Amps
Motor Service Factor	1.25

Test Pressures	
Fan Suction SP	0.66 in. wc
Fan Discharge SP	0.05 in. wc
Actual External SP	0.71 in. wc

EF-01 Exhaust Inlet Summary

System / Unit	Type of Reading	Outlet Type	Size LxW / D	AK	Design Velocity	Design Value	Prelim Reading	Final Reading	Final %	Remarks
Inlet-01	Flowhood	EG-1	6	1.00	-	50	55	55	110	
Inlet-02	Flowhood	EG-1	6	1.00	-	50	50	50	100	
Inlet-03	Flowhood	EG-1	6	1.00	-	50	50	50	100	
Inlet-04	Flowhood	EG-1	6	1.00	-	50	55	55	110	
Totals :	-	-	-	-	-	**200**	**210**	**210**	**105 %**	-

*** Notes**

Hydronic Pump

PROJECT: Sample Project
LOCATION: Portland, OR

DATE: 5/7/2013
CONTACT: Dennis Hucke
AUTHOR: Dennis Hucke

SYSTEM/UNIT: HW Pump-01
AREA:

Tested By: Dennis Hucke
Test Date: May 7th, 2013

Unit Data	
Pump Manufacturer	Armstrong
Pump Model Number	EBGD2256.4-25
Pump Serial Number	125689011
Pump Flowrate	8.00 GPM
TDH/FT	15.0
Pump Rotation	Correct

Final Test Data	
Final DP	13.20 ft
Final SP	1.95 ft
Final Press. Diff. Actual	15.15 ft
Final Design Flow	8.00 GPM
Final Actual Flow	8.20 GPM
Motor Volts T1-T2	465 Volts
Motor Volts T2-T3	465 Volts
Motor Volts T1-T3	470 Volts
Motor Amps T1	3.75 Amps
Motor Amps T2	3.75 Amps
Motor Amps T3	3.95 Amps

Motor Data	
Motor Manufacturer	Baldor
Motor Frame	143T
Motor HP	1 1/2 HP
Motor RPM	1750 RPM
Motor Rated Volts	230/460 Volts
Motor Phase	3
Motor Hertz	60 Hz
Motor F.L. Amps	8.40 / 4.20 Amps
Motor S.F.	1.15
Motor Seal Type	Mechanical
Pump Impeller Diam.	4.20

Measured Data	
Pump Off Pressure	35 PSI
Valve Shut DP	16.20 ft
Valve Shut SP	2.10 ft
Valve Shut Diff.	18.30 ft
Valve Open DP	13.2 ft
Valve Open SP	1.95 ft
Valve Open Diff.	15.15 ft
Valve Open Flow	8.20 GPM
Ind. Valve Sett.	100 %
Ind. Imp. Diam.	4.20 in.

HW Pump-01 Autoflow Valve Summary

System / Unit	Manufacturer	Model Number	Valve Size	Design Flow	Actual Flow	Design D.P.	Actual D.P.
HWC Autoflow Valve-01	Griswold	Autoflow	3/4"	8.00	8.20	2.0 - 32.0	6.00
Totals :	-	-	-	**8**	**8.2**	-	-

*** Notes**