

**Report By:**

National TAB  
1329 E. KEMPER ROAD  
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**Report: TAB Report**  
**Function: Test, Adjust, & Balance**  
**Date: 11/20/2023**

# PROJECT

## CMS E.E. Waddell High Reno (Charlotte, NC)

730 Nations Ford Rd

Charlotte, NC 28217

### Client

Action Mechanical Inc.

PO Box 7325

CHARLOTTE, NC 28241

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

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# CERTIFICATION

**PROJECT:** CMS E.E. Waddell High Reno (Charlotte, NC)

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.

The air distribution system has been tested and balanced and final adjustments have been made in accordance with NEBB standards and the project specifications.

**NEBB TAB FIRM:** National TAB-Southeast

**REGISTRATION NO:** 3755

**CERTIFIED BY:** J. Scott Springer 23312

**DATE:** 1/6/2023

The hydronic distribution system has been tested and balanced and final adjustments have been made in accordance with NEBB standards and the project specifications.

**NEBB TAB FIRM:** National TAB-Southeast

**REGISTRATION NO:** 3086

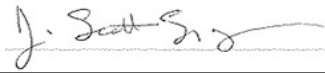
**CERTIFIED BY:** J. Scott Springer 23312

**DATE:** \_\_\_\_\_

## Submitted and Certified by:

**NEBB TAB FIRM:** National TAB-Southeast

**TAB PROFESSIONAL:** J. Scott Springer

**SIGNATURE:** 

**REGISTRATION NO:** 3755 (NTAB) / 23312

**CERTIFICATION EXP:** 12/31/2023





**CMS E.E. Waddell High Reno (Charlotte, NC)**

**PROJECT TEAM MEMBERS**

**Commissioning:** National TAB  
1126 SWIFT STREET  
KANSAS CITY, MO, 64116

**Test, Adjust, & Balance:** National TAB  
1126 SWIFT STREET  
KANSAS CITY, MO, 64116

**Mechanical Contractor:** Action Mechanical Inc.  
3228 Nevada Boulevard  
CHARLOTTE, NC, 28273



# National TAB

## Testing, Adjusting, and Balancing Equipment



Function		Range	Minimum Accuracy	Instrument Information	Calibration Date	Date Due
AIR	AIR PRESSURE	0 in wg to 10 in wg	2% +/- 0.001 in wg	Shortridge ADM 880C - S/N M05066	9/28/2022	9/28/2023
	AIR VELOCITY INSTRUMENT	50 fpm to 3900 fpm	+/- 5 % +/- 7 fpm	Shortridge ADM 880C - S/N M05066	9/28/2022	9/28/2023
	DIRECT HOOD READING	100 cfm to 2000 cfm	+/- 3 % +/- 7 cfm	Shortridge ADM 880C - S/N M05066	9/28/2022	9/28/2023
TEMPERATURE	AIR METER	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - SRH77A S/N 081820093	10/12/2022	10/12/2023
	AIR PROBE	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - PD1388 7-6 S/N 5028	10/12/2022	10/12/2023
	IMMERSION METER	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - SRH77A S/N 081820093	10/12/2022	10/12/2023
	IMMERSION PROBE	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - PD1388 7-6 S/N 1075	10/12/2022	10/12/2023
	CONTACT METER	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - SRH77A S/N 081820093	10/12/2022	10/12/2023
	CONTACT PROBE	-20 F to 240 F	+/- .5 % 2 F	Cooper ATKINS - PD1388 7-6 S/N 4011	10/12/2022	10/12/2023
HUMIDITY	HUMIDITY PROBE	10 % RH to 90 % RH	3% of reading	Cooper ATKINS - SRH77A S/N 090315046	10/12/2022	10/12/2023
ELECTRICAL	VOLTAGE MEASUREMENT	0 VAC to 600 VAC	2 % reading +/- 5 digits	Dwyer CM-1 - S/N 190800099	10/12/2022	10/12/2023
	AMPERAGE MEASUREMENT	0 Amperes to 100 Amperes	2 % reading +/- 5 digits	Dwyer CM-1 - S/N 190800099	10/12/2022	10/12/2023
ROTATION	ROTATION MEASUREMENT	60 rpm to 5000 rpm	2 % reading 2 rpm	Dwyer TAC-L - S/N S1100123	10/12/2022	10/12/2023
HYDRONIC	PRESSURE MEASUREMENT	-30 in Hg to 200 psi	±2% of reading +/- 1 psi	Dwyer 490W-6 - S/N 01L6NK	6/29/2022	6/29/2023
	DIFFERENTIAL PRESSURE MEASUREMENT	0 psi - 80 psi	±2% of reading +/- 1 psi	Dwyer 490W-6 - S/N 01L6NK	6/29/2022	6/29/2023

# NEBB Fundamental Formulas

## NEBB ABBREVIATIONS

A = Area (ft <sup>2</sup> ) IP, (m <sup>2</sup> ) SI	M = Mass (lb) IP, (kg) SI
ACH = Air Changes per Hour	ma = Mixed Air
A <sub>k</sub> = Effective Area	m = meter (metre)
AV = Average	m <sup>3</sup> /s = Volumetric Flow: Cubic Meters Per Second
BHP = Brake Horsepower (IP) HP	NLA = No Load Amperage
BP = Brake Power (SI) kW	NPSHA = Net Positive Suction Head Available
Btu = British Thermal Unit	oa = Outside Air
Btu/h = Btuh = BTUH = BTU/Hour	% <sub>oa</sub> = % of Outside Air
ϕ = Center Distance (used in belt formula)	Ω = Ohm
°C = Degrees Celsius, °C	P = Pressure
C = Friction Loss Coefficient (For Duct Fittings)	P <sub>a</sub> = Atmospheric Pressure
CCF = 100 Cubic Feet	P <sub>ab</sub> = Absolute Pressure (Atmospheric Pressure + Gauge Pressure)
CFM = Volumetric Flow: Cubic Feet Per Minute	Pa = Pascals, Pressure SI
C <sub>p</sub> = Specific Heat	π = 3.14
C <sub>v</sub> = Flow Constant (IP)	PD = Sheave Pitch Diameter
ρ = Density (lb/ft <sup>3</sup> ) IP, (kg/m <sup>3</sup> ) SI	P <sub>ϕ</sub> = Pressure at Pump Centerline
d = Diameter (in.) IP, (mm) SI	ppm = parts per million
Δ = Difference or Change (Final - Initial)	psi = Pounds Per Square Inch
d <sub>imp</sub> = Impeller Diameter	psia = Pounds Per Square Inch Absolute
E = Volts	psig = Pounds Per Square Inch Gauge
Eff = Efficiency	P <sub>vp</sub> = Absolute Vapor Pressure
EP = Pump Efficiency	Q (flow) = Volumetric Fluid Flow Rate: (i.e. CFM, GPM, m <sup>3</sup> /s, l/s, etc.)
°F = Degrees Fahrenheit, °F	Q (heat) = Heat Flow Rate (BTU/Hour) IP, (W or kW) SI
f = Friction Factor	°R = °Rankin = Degrees Rankin, °R
FLA = Full Load Amps	r = Radius (in) IP, (mm) SI
fpm = Feet per Minute (fpm)	% <sub>ra</sub> = % of Return Air
ft = Foot	R = Resistance
g = Acceleration of Gravity	ra = Return Air
gal = Gallons	rad = Radians
GPM = Gallons Per Minute (GPM)	RH = Relative Humidity
h = Enthalpy (BTU/lb dry air) IP, (kJ/kg dry air) SI	RPM = Revolutions Per Minute
H = Head (in wc, ft wc, psi) IP, (Pa, kPa) SI	R <sub>value</sub> = Thermal Resistance
Hg = Mercury	s = second
h <sub>ma</sub> = Mixed Air Enthalpy	SHR = Sensible Heat Ratio
h <sub>oa</sub> = Outside Air Enthalpy	SME = Sash Movement Effect Performance Rating (SME-XX yyy)
HP = Horsepower	SP = Static Pressure
hr = Hour	Sp Gr = Specific Gravity (for water use 1.00)
h <sub>ra</sub> = Return Air Enthalpy	T = Temperature
HT = Height (in) IP, (mm) SI	T <sub>a</sub> = Absolute Temperature (460° + T) or °R
I = Amps	T <sub>ma</sub> = Mixed Air Temperature
J = Joules	T <sub>oa</sub> = Outside Air Temperature
K = Kelvin, K	TP = Total Pressure
K <sub>v</sub> = Flow constant (SI)	T <sub>ra</sub> = Return Air Temperature
kg = Kilogram	TS = Tip Speed (fpm) IP, (m/s) SI
kJ = Kilojoule	U = Heat Transfer Coefficient
kPa = Kilopascal	μ = viscosity, dynamic
kW = Kilowatt = 1000 Watts	V = Velocity
l = Liter (Litre)	VP = Velocity Pressure
l/s = Volumetric Flow: Liters Per Second	W = Watt
lb = Pounds	WD = Width (in) IP, (mm) SI
lm = Lumens	wg = wc = water gauge = water column
ln = natural log	WHP = Water Horsepower (IP)
LG = Length (in) IP, (mm) SI	WP = Water Power (SI)
lx = Lux	ω = Humidity Ratio (lb or grains of water/lb of dry air) (g H <sub>2</sub> O/kg dry air)

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## VAV - Single Duct



Comfort. Under control.

### VAV/

Asset								
Asset Name	Type	Inlet Size	Design Max CFM	Max CFM	Design Min CFM	Min CFM	Design Heat CFM	Heat CFM
VAV-1	VAV	10"	1250	674	320	322	630	674

Completed By: Scott Springer on 01/05/2023

### Diffuser Supply (GRD)

### VAV-1/301A

Asset								
Asset Name	Location	Type	Size	DESIGN CFM	AK	CFM(1)	FINAL CFM	% to design
3.1-1	301A	A	12"12"	400		257	257	64.3
3.1-2	301A	A	12"12"	400		166	166	41.5
3.1-3	301A	A	12"12"	400		251	251	62.8
Total				1200		674	674	56.17%

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)



Comfort. Under control.

## Diffuser Supply (GRD)

### RTU-3 DIFFUSER/

Asset									
Asset Name	Location	Type	Size	DESIGN CFM	AK	CFM(1)	FINAL CFM	% to design	
3-1	301	A	12	460		239	239	52.0	
Total				460		239	239	51.96%	

Completed By: Scott Springer on 01/05/2023

Asset	Notes	Date	Written By
3-1	AHU 3 at full speed		

### VAV-1/301A

Asset									
Asset Name	Location	Type	Size	DESIGN CFM	AK	CFM(1)	FINAL CFM	% to design	
3.1-1	301A	A	12"12"	400		257	257	64.3	
3.1-2	301A	A	12"12"	400		166	166	41.5	
3.1-3	301A	A	12"12"	400		251	251	62.8	
Total				1200		674	674	56.17%	

### UVs OA/

Asset											
Asset Name	Location	Type	Size	DESIGN CFM	AK	CFM(1)	FINAL CFM	% to design	VEL(1)	VEL(2)	
SGRD1	216	duct	14	900	1.07	56	60	56	60	6.7	
SGRD2	217	duct	14	900	1.07	112	120	112	120	13.3	
SGRD3	223	duct	14	900	1.07	239	256	239	256	28.4	
Total				2700		0	0	0%			

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF1

AREA:

Unit Data		
	Design	Actual
<b>MFG</b>	GREENHECK	GREENHECK
<b>Model Num</b>	USF-12	USF-12
<b>Serial Num</b>	-	20512849
<b>Type</b>	-	UTILITY SET

Motor Data		
	Design	Actual
<b>Motor MFG</b>	-	WEG
<b>Frame</b>	-	56
<b>Horsepower</b>	-	0.25
<b>Motor Rpm</b>	-	1740
<b>Phase</b>	-	1
<b>Voltage (rated)</b>	-	115
<b>Amperage (rated)</b>	-	2.9
<b>Service Factor</b>	-	1.35

Drive Data		
	Design	Actual
<b>Motor Sheave Size</b>	-	VL34
<b>Motor Bore Size</b>	-	0.625
<b>Fan Sheave Size</b>	-	AK58
<b>Fan Sheave Bore</b>	-	1.0
<b>Belt CL Distance</b>	-	7.75
<b>Num of Belts</b>	-	1
<b>Belt Size</b>	-	3L280

Test Data		
	Design	Actual
<b>CFM</b>	870	716
<b>Fan RPM</b>	1187	1070
<b>RL Voltage</b>	-	118
<b>RL Amperage</b>	-	2.5
<b>Suction ESP</b>	-	0.45
<b>Discharge ESP</b>	-	0.05
<b>Total ESP</b>	0.50	0.50
<b>Brake Horse Power</b>	-	0.22

Completed By: Scott Springer on 01/05/2023

Notes:  
725 CFM required for 100 FPM at sash opening

Written By: on

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF2

AREA:

Unit Data		
	Design	Actual
MFG	GREENHECK	GREENHECK
Model Num	USF-12	USF-12
Serial Num	-	20512850
Type	-	UTILITY SET

Motor Data		
	Design	Actual
Motor MFG	-	WEG
Frame	-	56
Horsepower	-	0.25
Motor Rpm	-	1740
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	2.9
Service Factor	-	1.35

Drive Data		
	Design	Actual
Motor Sheave Size	-	VL34
Motor Bore Size	-	0.625
Fan Sheave Size	-	AK58
Fan Sheave Bore	-	1.0
Belt CL Distance	-	7.75
Num of Belts	-	1
Belt Size	-	3L280

Test Data		
	Design	Actual
CFM	870	750
Fan RPM	1187	1061
RL Voltage	-	118
RL Amperage	-	2.5
Suction ESP	-	0.43
Discharge ESP	-	0.05
Total ESP	0.50	0.48
Brake Horse Power	-	.22

Completed By: Scott Springer on 01/05/2023

Notes:  
725 CFM required for 100 FPM at sash opening

Written By: on

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF3

AREA:

Unit Data		
	Design	Actual
MFG	GREENHECK	GREENHECK
Model Num	USF-12	USF-12
Serial Num	-	20512851
Type	-	UTILITY SET

Motor Data		
	Design	Actual
Motor MFG	-	WEG
Frame	-	CRE
Horsepower	-	0.25
Motor Rpm	-	1740
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	2.9
Service Factor	-	1.35

Drive Data		
	Design	Actual
Motor Sheave Size	-	VL34
Motor Bore Size	-	0.625
Fan Sheave Size	-	AK58
Fan Sheave Bore	-	1.0
Belt CL Distance	-	7.75
Num of Belts	-	1
Belt Size	-	3L280

Test Data		
	Design	Actual
CFM	870	726
Fan RPM	1187	1098
RL Voltage	-	118
RL Amperage	-	2.5
Suction ESP	-	0.44
Discharge ESP	-	0.05
Total ESP	0.50	0.49
Brake Horse Power	-	0.22

Completed By: Scott Springer on 01/05/2023

Notes:  
725 CFM required for 100 FPM at sash opening

Written By: on

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-4

AREA:GENERAL EXHAUST

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	G-140-VG
Serial Num	-	20518303
Type	-	CRE

Test Data		
	Design	Actual
CFM	1300	1348
RL Voltage	-	284
RL Amperage	-	2.0
Total ESP	0.50	0.42

Motor Data		
	Design	Actual
Motor MFG	-	VARIGREEN
Horsepower	-	0.50
Motor Rpm	-	300-1750
Phase	-	1
Voltage (rated)	-	277
Amperage (rated)	-	3.2

Completed By: Scott Springer on 01/05/2023

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-5

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A510

Test Data		
	Design	Actual
CFM	350	400

Motor Data		
	Design	Actual
Horsepower	-	224 W
Motor Rpm	-	1015
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	3.3

Completed By: Scott Springer on 01/05/2023

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-6

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A390-VG

Test Data		
	Design	Actual
CFM	175	212

Motor Data		
	Design	Actual
Horsepower	-	26 W
Motor Rpm	1099	1099
Phase	1	1
Voltage (rated)	115	115
Amperage (rated)	-	1.5

Completed By: Scott Springer on 01/05/2023

Notes:  
fan speed controller at lowest setting

Written By: on

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-7

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A390-VG

Test Data		
	Design	Actual
CFM	175	206

Motor Data		
	Design	Actual
Horsepower	-	26 W
Motor Rpm	1099	1099
Phase	1	1
Voltage (rated)	115	115
Amperage (rated)	-	1.5

Completed By: Scott Springer on 01/05/2023

Notes:  
fan speed controller at lowest setting

Written By: on

# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-8

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A90-130-VG

Test Data		
	Design	Actual
CFM	129	131

Motor Data		
	Design	Actual
Motor MFG	-	Baldor
Horsepower	-	12 W
Motor Rpm	-	1041
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	0.29

Completed By: Scott Springer on 01/05/2023

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Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-9

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A90-130-VG

Test Data		
	Design	Actual
CFM	129	132

Motor Data		
	Design	Actual
Horsepower	-	12 W
Motor Rpm	-	1041
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	0.29

Completed By: Scott Springer on 01/05/2023

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Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-10

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A90-130-VG

Test Data		
	Design	Actual
CFM	129	115

Motor Data		
	Design	Actual
Horsepower	-	12 W
Motor Rpm	-	1041
Phase	-	1
Voltage (rated)	-	115
Amperage (rated)	-	0.29

Completed By: Scott Springer on 01/05/2023

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Project: CMS E.E. Waddell High Reno (Charlotte, NC)

## System/Unit: FAN - Exhaust



Comfort. Under control.

Asset: EF-11

AREA:

Unit Data		
	Design	Actual
MFG	NA	GREENHECK
Model Num	NA	SP-A90-130-VG

Test Data		
	Design	Actual
CFM	129	122

Motor Data		
	Design	Actual
Horsepower	-	12 W
Motor Rpm	1041	1041
Phase	1	1
Voltage (rated)	115	115
Amperage (rated)	-	0.29

Completed By: Scott Springer on 01/05/2023



# National TAB

Project: CMS E.E. Waddell High Reno (Charlotte, NC)

Comfort. Under control.

## Diffuser Supply (GRD)

### UVs OA/

Asset										
Asset Name	Location	Type	Size	DESIGN CFM	AK	VEL(1)	CFM(1)	VEL(2)	FINAL CFM	% to design
SGRD1	216	duct	14	900	1.07	56	60	56	60	6.7
SGRD2	217	duct	14	900	1.07	112	120	112	120	13.3
SGRD3	223	duct	14	900	1.07	239	256	239	256	28.4
Total				2700			436		436	16.15%