APPLICATION FOR OSHPD SPECIAL SEISMIC CERTIFICATION PREAPPROVAL (OSP)

OFFICE USE ONLY	
APPLICATION #:	OSP – 0147

OSHPD Special Seismic Certification Preapproval (OSP)

Type: ☐ New ☒ Renewal

Manufacturer Information

Manufacturer: Johnson Controls Incorporated

Manufacturer's Technical Representative: Jeffrey Joseph Ronald

Mailing Address: 100 JCI Way, York, PA 17406

Telephone: (717) 309-7503 Email: Jeffrey.joseph.ronald@jci.com

Product Information

Product Name: Solution® Air Conditioning Units

Product Type: Air Conditioning Equipment

Product Model Number: See Attached.
(List all unique product identification numbers and/or part numbers)

General Description: Johnson Controls Solution® Air Handling Units comprise a custom-sized equipment product line. Units are rigid base mount air conditioning units with internally isolated fan motors. Internal components include: various fan types, discharge/inlet plenums, filter mixing boxes, economizers, various filter types, cooling/heating coils, ultraviolet lighting system, variable frequency drives, and dampers. Seismic enhancements made to the test units and modifications required to address the anomalies observed during the tests shall be incorporated into the production units.

Mounting Description: Units are rigidly base mounted

Applicant Information

Applicant Company Name: DCL Labs

Contact Person: Kelly Laplace

Mailing Address: 1315 Greg St, Ste 109, Sparks, NV 89431

Telephone: (775) 358-5085 Email: kelly@shaketest.com

I hereby agree to reimburse the Office of Statewide Health Planning and Development review fees in accordance with the California Administrative Code, 2016.

Signature of Applicant: K. Laplace Date: 7/12/19

Title: Business Manager Company Name: DCL Labs

California Licensed Structural Engineer Responsible for the Engineering and Test Report(s)

Company Name: The VMC Group

Name: Ken Tarlow California License Number: SE-2851

Mailing Address: 113 Main Street, Bloomingdale, NJ 07403

Telephone: (973) 838-1780 Email: Ken.tarlow@thevmcgroup.com

Supports and Attachments Preapproval

☐ Supports and attachments are preapproved under OPM- _____
(Separate application for OSHPD Preapproval of Manufacturer's Certification (OPM) of Supports and attachments is required)

☒ Supports and attachments are not preapproved

Certification Method

☒ Testing in accordance with: ☒ ICC-ES AC156

☐ Other (Please Specify): _____

Testing Laboratory 1

Company Name: DCL Labs

Contact Name: Josh Sailer

Mailing Address: 1315 Greg Street Suite #109

Telephone: (775) 358-5085 Email: josh@shaketest.com

Testing Laboratory 2

Company Name: Twin City Fan Companies, LTD Test Lab

Contact Name: Matt Settergren

Mailing Address: 5955 Trenton Lane North, Plymouth, MN 55442

Telephone: (763) 551-7500 Email: msettergren@tcf.com

Seismic Parameters

Design in accordance with ASCE 7-10 Chapter 13: ☒ Yes ☐ No

Design Basis of Equipment or Components (F_p/W_p) = 1.09

S_{DS} (Design spectral response acceleration at short period, g) = 1.45

a_p (In-structure equipment or component amplification factor) = 2.5

R_p (Equipment or component response modification factor) = 6.0

Ω_0 (System overstrength factor) = 2.0

I_p (Importance factor) = 1.5

z/h (Height factor ratio) = 1

Equipment or Component Natural Frequencies (Hz) = See Attachment

Overall dimensions and weight (or range thereof) = See Attachment

Equipment or Components @ grade designed in accordance with ASCE 7-10 Chapter 15: ☐ Yes ☒ No

Design Basis of Equipment or Components (V/W) =

S_{DS} (Design spectral response acceleration at short period, g) =

S_{D1} (Design spectral response acceleration at 1 second period, g) =

R (Response modification coefficient) =

Ω_0 (System overstrength factor) =

C_d (Deflection amplification factor) =

I_p (Importance factor) = 1.5

Height to Center of Gravity above base =

Equipment or Component Natural Frequencies (Hz) =

Overall dimensions and weight (or range thereof) =

Tank(s) designed in accordance with ASME BPVC, 2015: ☐ Yes ☒ No

List of Attachments Supporting Special Seismic Certification

☒ Test Report(s) ☒ Drawings ☐ Calculations ☒ Manufacturer's Catalog

☐ Other(s) (Please Specify):

OSHPD Approval (For Office Use Only) – Approval Expires on May 11, 2028

Signature: Date: May 11, 2022

Print Name: Timothy J. Piland Title: SSE

Special Seismic Certification Valid Up to: S_{DS} (g) = 1.45 z/h = 1

Condition of Approval (if applicable):

Table 1.1: Certified Units: Single Tunnel							
Manufacturer: Johnson Controls, Inc.							
Model Line: York Solution Custom Air Handling Units							
Product Construction: Side and top panel construction: 2” galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner Bottom panel construction: 2” galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner							
Mounting Configuration: Rigid base							
Model Line	Number of Walls	Dimensions (in.)			Weight (lb)	PSF	Unit
		Depth	Width	Height			
York Solution Custom Air Handling Units (Single Tunnel) Alternately Branded as: Johnson Controls - Solution XT Enviro-Tec ESL Krueger KAH Titus Revolution TFX PACE PA Mission Critical MC	4 (no walls removed)	No limit	30	27		Lower limit	Extrapolated
		...					Extrapolated
		99	30	27	1,100	53	UUT4
		94	84	60	3,500	64	UUT13
		...					Interpolated
		No limit	84	60		Upper limit <64 psf	Interpolated
	3 (inlet or outlet wall removed)	No limit	30	27		Lower limit	Extrapolated
		...					Extrapolated
		41	39	33	502	45	UUT29
		91	30	27	600	32	UUT3
		54	39	39	760	52	UUT5
		111	39	33	950	32	UUT1
		105	39	33	1,100	39	UUT2
		102	114	120	2,110	26	UUT6
		87	120	90	2,970	41	UUT25
		71	120	90	3,000	51	UUT18
		81	114	120	3,840	60	UUT7
		95	114	120	4,400	59	UUT30
		65	114	120	4,570	89	UUT8
		102	114	120	5,730	71	UUT10
		...					Interpolated
		No limit	114	120		Upper limit <89 psf	Interpolated
	2 (inlet and outlet walls removed)	No limit	45	45		Lower limit	Extrapolated
		...					Extrapolated
		73	139	39	860	12	UUT16
		60	45	45	1,510	81	UUT17
		75	114	120	2,170	37	UUT12
		120	60	60	2,320	46	UUT22
		54	114	120	2,920	68	UUT19
		85	114	120	4,610	69	UUT11
		100	114	120	7,030	89	UUT26
		98	114	120	8,280	107	UUT9
		...					Interpolated
		No limit	114	120		Upper limit <107 psf	Interpolated

Table 1.2: Certified Subcomponents, Single Tunnel: Pipe Chases

Manufacturer		Material	Height (in.)	Length (in.)	Depth (in.)	Weight (lb.)	Unit
JCI	Min	Galvanized carbon steel	27	26	24	96	Extrapolated
			⋮	⋮	⋮	⋮	
			45	46	36	231	UUT17
			⋮	⋮	⋮	⋮	Interpolated
	Max		120	71	48	672	UUT11

Table 1.3: Certified Subcomponents, Single Tunnel: Base Rails

Manufacturer	Base Rail Height (in.)	Material	Standard Construction	Options			Unit
				Curb Rest	Bolted Raceway	Welded Base Rail	
JCI	None	Galvanized carbon steel	Formed raceway with bolted corners	X	X		UUT1, UUT2, UUT3, UUT4, UUT5,UUT18, UUT22
	3		Formed raceway with bolted corners and formed base rail		X		Interpolated
	6		Formed raceway with bolted corners and formed base rail	X	X	X	UUT6, UUT7, UUT8, UUT9, UUT10, UUT12, UUT13, UUT16, UUT17, UUT19, UUT25, UUT26

Table 1.4: Certified Subcomponents, Single Tunnel: Coils

	Steam Coils							
Manufacturer	Coil Height (in.)	Coil Length (in.)	Row Qty	Tube Thick (in.)	Tube Diam (in.)	Number of Coils, Stacked	Weight (lb.)	Unit
JCI	18	17.5	1	0.035	1	1	41	UUT4
	Coils with the following specifications are certified: Height: Minimum Height 18" Maximum Height 108" Width: Minimum Length 17.5" Maximum Length 101"							Interpolated
	108	101	1	0.035	1	2	706	UUT7

Coil Variables:

1. Fin Material: Aluminum
2. Coil Casing: Galvanized Carbon Steel, Stainless Steel
3. Fin Shape: Corrugated
4. Fins per inch: 6, 8, 9, 10, 11, 12, 13, 14
5. All steam coils are single row.
6. Tube Thickness: 0.035", 0.049"
7. Number of Coils Stacked: 1, 2

	Water and DX coils								
Manufacturer	Coil Height (in.)	Coil Length (in.)	Row Qty	Tube Thick (in.)	Tube Diam (in.)	Number of Coils, Stacked	Weight (lb)	Weight w/ Fluid (lb)	Unit
JCI	17.5	18	2	0.016	1/2	1	32	39	Extrapolated
	18	17.5	4	0.016	1/2	1	42	44	UUT4
	22.5	27	2	0.016	1/2	1	49	67	UUT2
	24.25	26	2	0.020	5/8	1	55	76	UUT2
	45	72	4	0.016	1/2	1	282	362	UUT13
	Coils with the following specifications are certified: Height: Minimum Height 18" Maximum Height 107.5" Width: Minimum Length 17.5" Maximum Length 102"								Interpolated
	107.5	102	2	0.016	1/2	3	634	793	UUT7
	105.75	101	12	0.049	5/8	3	4,807	5,687	UUT9

Coil Variables:

1. Fin Material: Aluminum
2. Coil Casing: Galvanized Carbon Steel, Stainless Steel
3. Fin Shape: Corrugated
4. Fins per Inch: 6, 8, 9, 10, 11, 12, 13, 14
5. Number of Rows: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
6. Tube Thickness: 0.016", 0.020", 0.025", 0.032", 0.035", 0.049"
7. Number of Coils Stacked: 1, 2, 3

Table 1.4: Certified Subcomponents, Single Tunnel: Coils (Continued)

	Integral Face and Bypass Coils							
Manufacturer	Coil Height (in.)	Coil Length (in.)	Row Qty	Orientation	Coil Sections	Tube Thick (in.)	Weight (lb.)	Unit
LJ Wing	29	27	4	Horizontal	2	0.035	240	UUT16
	Coils with the following specifications are certified: Height: Minimum Height 29" Maximum Height 98" Width: Minimum Length 27" Maximum Length 101"							Interpolated
	98	101	3	Vertical	1	0.035	1,669	UUT19

Coil Variables:

1. Fin Material: Aluminum, Copper
2. Coil Casing: Galvanized Carbon Steel, Stainless Steel
3. Tube Diameter: 5/8"
4. Fins per Inch: 6, 7, 8, 9, 10, 11, 12
5. Number of Rows: 1, 2, 3, 4
6. Tube Thickness: 0.035", 0.049"
7.Orientation: Vertical, Horizontal

Table 1.5: Certified Subcomponents, Single Tunnel: Fans

Fan Assembly MFR	Type	Drive Arrangement	Fan Wheel Diam (in.)	Material		Voltage	Maximum			Unit
				Fan	Housing & Frame		HP	Frame	Weight (lb) Wheel + Mtr+Skid	
Twin City	DWDI, Airfoil	Belt Arr 3	12.25	5052 H32 Aluminum	A36 Carbon Steel	200/208, 230, 460, 380, 575	15	254T	573	UUT5
			27	A36 Carbon Steel			50	326T	1,914	Interpolated
			30				60	364T	2,740	
			33				75	365T	2,900	UUT8
	Plenum, Airfoil	Direct Arr 4	12.40	5052 H32 Aluminum			5	184T	319	UUT1
		Direct bolted design Arr 4	12.40	5052 H32 Aluminum			5	184T	212	UUT29
			13.98				5	184T	233	Interpolated
			15.75				5	184T	266	
			18.25				20	256T	550	
			20.00				20	256T	575	
			22.25				20	256T	643	
			24.50				20	256T	693	
			27.00				30	286T	902	
			30.00				40	324T	1,180	
			33.00				50	326T	1,363	
			36.50				100	444T	2,125	
			40.25				100	444T	2,350	
			44.50				100	444T	2,640	
			49.00				100	444T	2,847	UUT30
		Belt Arr 3	12.40	5052 H32 Aluminum			5	184T	297	UUT2
			27.00	A36 Carbon Steel			60	364T	1,924	Interpolated
			30.00				75	365T	2,054	
			33.00				75	365T	2,253	
			36.50				100	404T	3,063	
			40.25				100	404T	3,253	
			44.50				100	404T	3,471	
			49.00				100	404T	3,926	UUT10
Comefri	DWDI, Forward Curve	Belt Arr 3	7-7	G90 Galv Steel	A36 Carbon Steel	200/208, 230, 460, 380, 575	5	184T	222	UUT15*
			9-6				5	184T	221	Interpolated
			9-9				5	184T	243	
			10-7				5	184T	237	
			10-10				7.5	213T	322	
			12-9				7.5	213T	336	
			12-12				15	254T	435	
			15-11				15	254T	462	
			15-15				15	254T	474	
			18-13				15	254T	501	
			18-18				20	256T	555	
			20-15				25	284T	913	
			20-20				30	286T	956	
			22-22				30	286T	1,096	
			25-25				30	286T	1,207	
			28-28				30	286T	1,373	
			32-32				30	286T	1,693	
			36-36				30	286T	1,912	
			40-40				30	286T	2,039	UUT18
	DWDI, Airfoil	Belt Arr 3	12-12	A 572 Grade 50 Carbon Steel	A36 Carbon Steel		15	254T	450	Interpolated
			15-15				15	254T	503	
			18-18				20	256T	583	
			20-20				30	286T	1,006	
			22-22				30	286T	1,162	
			25-25				30	286T	1,256	
			28-28				30	286T	1,490	
			32-32				30	286T	1,797	UUT 24*

All fans are internally isolated with horizontal discharge and shaft ground ring

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.6: Certified Subcomponents, Single Tunnel: Multiple Fans

Fan MFR	Type	Fan Wheel Diam (in)	Material		Voltage	Maximum			Unit
			Fan	Housing & Frame		HP	Frame	Weight (lb) Fan + Mtr	
Twin City	Multiple fans, Plenum, Airfoil, Enclosed	12.4	5052 H32 Aluminum	A36 Carbon Steel	200/208, 230, 460, 380, 575	7.5	184T	275	UUT22
		14.0				10	213T	351	Interpolated
		15.8				15	215T	481	
		18.3				30	254T	592	
		20.0				30	254T	678	
		22.3				25	256T	791	
		24.5				30	284T	1,160	
		27.0				30	284T	1,289	UUT26

Certified fans are direct drive horizontal discharge. Fans are a maximum of 2-high.

Table 1.7: Certified Subcomponents, Single Tunnel: Filter Frames

Manufacturer	Type	Cabinet			Weight (lb)	Unit
		Width (in.)	Length (in.)	Height (in.)		
JCI	Aluminum Extruded	39	18	33	39	UUT2
		Minimum cabinet height: 27” Maximum cabinet height: 120" Minimum cabinet width: 30” Maximum cabinet width: 114” Frame used for filter types: rigid, bag, and mini-pleat				Interpolated
		114	18	120	235	UUT9
	Galvanized Carbon Steel Box	30	18	27	28	UUT3
		Minimum cabinet height: 27” Maximum cabinet height: 120" Minimum cabinet width: 30” Maximum cabinet width: 114” Frame used for filter types: rigid, bag, and mini-pleat				Interpolated
		114	18	120	291	
	Galvanized Carbon Steel Angle	30	18	27	33	UUT3
		Minimum cabinet height: 27” Maximum cabinet height: 120" Minimum cabinet width: 30” Maximum cabinet width: 114” Frame used for filter types: pleated, cleanable, and throwaway				Interpolated
		114	20	120	306	UUT7
	Galvanized Carbon Steel Flat	30	10	27	15	UUT3
		Minimum cabinet height: 27” Maximum cabinet height: 120" Minimum cabinet width: 30” Maximum cabinet width: 114” Frame used for filter types: pleated, cleanable, and throwaway				Interpolated
		114	10	120	156	
American Air Filter	Welded Aluminum-HEPA Filters	39	16	33	10	UUT1

Table 1.8: Certified Subcomponents, Single Tunnel: Filters

Manufacturer	Width (in.)	Height (in.)	Depth (in.)	Weight (lb)	Depth (in.)	Weight (lb)	Depth (in.)	Weight (lb)	Unit
American Air Filter	Pleated				Cleanable		Throwaway		
	12	24	2	1.8	2	3	4	0.6	Extrapolated
	16	20		1.8		6.5		0.6	UUT3, UUT7
	20	16		1.8		6.5		0.6	Interpolated
	20	20		2.1		8.1		0.6	UUT9
	20	24		2.5		8.4		0.6	UUT7, UUT9
	24	12		1.8		3		0.6	Interpolated
	24	20		2.5		8.4		0.8	
	24	24	4	2.5	4	10		0.8	UUT2
	Rigid				Bag		Mini-Pleated		
	12	24	12	11.5	22	4.5	4	3.3	Extrapolated
	16	20		12		3.5		3.5	UUT3
	20	16		12		3.5		3.5	Interpolated
	20	20		14		4.8		4.5	UUT9
	20	24		16.5		5.5		5.3	UUT9
	24	12		11.5		4.5		3.3	Interpolated
	24	20		16.5		5.5		5.3	
	24	24		19		8		6.5	UUT2
	HEPA								
	30	15	11.5	38					UUT1

Table 1.9: Certified Subcomponents, Single Tunnel: Attenuators

Manufacturer	Max Bank Height (in.)	Max Bank Width (in.)	Max Weight (lb)	Max Cabinet Size	Unit
Vibro-Acoustic	110	104	1,127	120Hx114W	UUT12

Table 1.10: Certified Subcomponents, Single Tunnel: Dampers

Manufacturer	Damper		Height (in.)	Width (in.)	Weight (lb)	Unit
Ruskin	Airflow Measuring Station	Min	9.5	16.0	16	UUT3
		⋮	⋮	⋮	⋮	Interpolated
		Max	44.0	96.0	440	UUT7
	Control Damper Aluminum	Min	9.5	25.0	5	UUT1
		⋮	⋮	⋮	⋮	Interpolated
		Max	38.3	82.0	147	UUT6
	Control Damper Galvanized Carbon Steel Blade	Min	6.0	25.0	8	UUT21*
			9.5	16.0	8	UUT3
			9.5	25.0	13	UUT1
			15.3	93.0	79	UUT11
			21.0	112.0	131	UUT20
			⋮	⋮	⋮	Interpolated
			38.3	82.0	174	UUT6
			⋮	⋮	⋮	Interpolated
		Max	44.0	96.0	235	UUT7, UUT6
	Back Draft Damper Extruded Aluminum	Min	17.0	17.0	61	UUT22
		⋮	⋮	⋮	⋮	Interpolated
		Max	40.0	40.0	339	UUT26

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.11: Certified Subcomponents, Single Tunnel: Actuators

Manufacturer		Weight (lb)	Unit
JCI	Min	2.9	UUT16
		3.4	UUT1, UUT13
		⋮	Interpolated
	Max	6.4	UUT7, UUT6, UUT16, UUT19

Table 1.12: Certified Subcomponents, Single Tunnel: UV Light Ballasts

Manufacturer		Unit Height (in.)	Unit Width (in.)	UV Fixture Length in. (Qty)	UV Light Core Length (in.)	Weight (lb)	Unit
JCI	Min	27	30	21(1)	10	36	UUT4
		27	42	33(1)		42	Interpolated
		27	45	36(1)		52	
		33	54	18(1), 24(1)		47	
		⋮	⋮	⋮		⋮	
		54	84	36(2)		61	UUT13
		⋮	⋮	⋮		⋮	Interpolated
		108	102	18(3), 36(6)		121	
		114	108	24(3),36(6)		130	
	Max	120	114	18(3), 24(6), 36(3)		138	UUT9

Table 1.13: Certified Subcomponents, Single Tunnel: UV Light Controls

Manufacturer	Panel Description	Height (in.)	Width (in.)	Depth (in.)	UV Light Core Length (in.)	Weight (lb)	Unit
JCI	UV light control panel	18	8	7	NA	29	UUT4, UUT9, UUT13

Application: UV lights < 8 Amps

Table 1.14: Certified Subcomponents, Single Tunnel: Humidifier Grids

Manufacturer		Cabinet		Weight (lb)	Unit
		Height (in.)	Width (in.)		
Nortec	Min	27	30	35	UUT4
		⋮	⋮	⋮	Interpolated
	Max	120	114	363	UUT10

Table 1.15: Certified Subcomponents, Single Tunnel: Diffusers

Manufacturer	Max Fan Wheel Diam (in.)	Cabinet		Max Weight (lb)	Cabinet Size	Unit
		Max Height (in.)	Max Width (in.)			
JCI	33.0	120	114	68	120Hx114W	UUT12

Table 1.16: Certified Subcomponents, Single Tunnel: Transformers

Manufacturer		Size				Unit
	Size (VA)	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
JCI	500 VA	18.50	11.50	7.50	25	UUT15*
	2 K	18.50	11.50	7.50	65	UUT5, UUT8

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.17: Certified Subcomponents, Single Tunnel: Factory Packaged Controls

Manufacturer	Panel Description	Application	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	Unit
JCI	Terminal Strip Panel	Field mounted FEC app	18	8	7	25	UUT13
	FEC / NCE 15x20 Panel	Factory mounted	20	17	7	47	UUT1, UUT2, UUT5, UUT6
	FEC / NCE 16.5x20 Panel	Factory mounted	20	16.5	6.5	50	UUT20*
	FEC / NCE 20x25 Panel	Factory mounted	26	20	7	59	UUT10, UUT8
	FEC / NCE 24x37 Panel	Factory mounted	38	24	7	109	UUT13

All factory packaged control applications are to FEC/NCE configurable standards

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.18: Certified Subcomponents, Single Tunnel: End Devices

Manufacturer	Item	Description	Unit
Kenall	Fixture, Light, 75 Watt, Vr	Light	UUT2, UUT5, UUT8, UUT23
Leviton	Switch, 15 Amp, 120V	Switch	UUT2, UUT5, UUT8
Leviton	Outlet, GFI, 15 Amp	Outlet	UUT2, UUT5, UUT8
JCI	Temperature Sensor	Sensor, 8in. Probe, 1K RTD Temp, Nickel	UUT10, UUT8, UUT2, UUT13
	Averaging Temperature Sensor	Sensor, Avg, 8ft, 1k, Nickel With Molex Connectors, No Enclosure	UUT1, UUT2, UUT13
	Averaging Temperature Sensor	Sensor, Avg., 17ft, 1k, Nickel With Molex Connectors, No Enclosure	UUT6, UUT19
	Current Switch, Spst Relay	1 Amp To 135 Amps,24vac 1/6hp	UUT1, UUT2, UUT5, UUT8, UUT10, UUT13
	Cable, End Dev Sig, Pigtail	Supply Fan Variable Speed Control Signal	UUT1, UUT2, UUT10, UUT13
	Supply Fan VFD "Run" Contact - Fan Proving	Wiring Only	UUT1, UUT2, UUT5, UUT8, UUT10, UUT13
	Low temperature Status	Wiring Only	UUT2, UUT13
	LTC, SPST, Fixed Reset, 20ft		UUT2, UUT13
	Cooling Valve Wiring	Wiring Only	UUT2, UUT13
	Heating Valve Wiring	Wiring Only	UUT2, UUT13
	Low Pressure Status	Wiring Only	UUT2, UUT13
	Switch, Diff, Press, Manual Reset	W/Molex Connectors	UUT10, UUT2, UUT13
	High Pressure Status	Wiring Only	UUT13
	High Static Pressure Switch (Manual Reset)	High Pressure Cutout	UUT2, UUT10, UUT13
	Relay, SPDT, 24vac, Coil, Indicator, LED		UUT10, UUT8, UUT1, UUT2, UUT5, UUT13
	Magnetic Proximity Sensor		UUT4, UUT13
	Switch, Diff, Press, 2CND, L-Bracket		UUT7, UUT9

Table 1.19: Certified Subcomponents, Single Tunnel: Motor Controls

Manufacturer	Panel Description	Frame	Base	Voltage		Enclosure Size				Unit
				200, 230, 460,575						
				Min HP	Max HP	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
JCI	Motor Starters (NEMA3R)	R1	G20	1	15	17.0	10.0	10.0	22	UUT5
		R2	G21	7.5	60	25.0	24.0	12.0	56	UUT18
		R4	G23	25	100	27.0	26.0	12.0	88	UUT8, UUT13
	Manual Motor Protection Panel	N/A		1	30	20.0	16.5	6.5	50	UUT23, UUT26
				1	10	28.0	16.5	6.5	60	UUT22
				Min FLA	Max FLA					
	VFD without Bypass for Energy Wheels	R0	N/A	1.2	1.9	19.2	9.0	8.7	3	UUT20*

*Stacked subcomponents are included here because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.20: Certified Subcomponents, Single Tunnel: Factory Terminated Wiring

Manufacturer		Disconnect Size (A)	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	Unit
JCI	Min	80	17.00	8.00	8.25	25	UUT15*
		80/125	24.00	16.00	10.25	81	Interpolated
		200	27.00	19.18	10.25	105	Interpolated
	Max	400	35.00	22.00	10.25	158	UUT13

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.21: Certified Subcomponents, Single Tunnel: Unit Disconnects

Manufacturer	Type	Disconnect (A)	Enclosure Size				Unit
			Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
RAM Industries by Schneider Electric	Non-Fused Disconnects (NEMA 1, 3R, 4, 12)	30/60	8.0	6.0	4.0	9	UUT15*
		100	10.0	8.0	5.0	9	UUT18

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 1.22: Certified Subcomponents, Single Tunnel: Indirect Gas Heaters

Manufacturer		Furnace Output (BTUs x 10,000)	Furnace Dimensions			Total Furnace Weight (lb)	Unit
			Length (in.)	Width (in.)	Height (in.)		
Jackson & Church	Min	15	42.00	40.13	30.00	580	UUT17
	⋮	⋮	⋮	⋮	⋮	⋮	Interpolated
	Max	200	64.13	100.00	50.00	3,075	UUT11

Table 1.23: Certified Subcomponents, Single Tunnel: Electric Heaters

Manufacturer		Element type	kW	Heater Dimensions		Total Heater Weight (lb)	Unit
				Height (in.)	Width (in.)		
Indeeco	Min	Open	15	18	15.25	55.2	UUT15*
	⋮		⋮	⋮	⋮	⋮	Interpolated
	Max		75	81	101.25	2150.4	UUT25

*Stacked subcomponents are included for bookending purposes because the single tunnel units present a higher seismic capacity than the stacked units.

Table 2.1: Certified Units: Stacked							
Manufacturer: Johnson Controls, Inc.							
Model Line: York Solution Custom Air Handling Units							
Product Construction: Side, top and bottom panel construction: 2” foam filled panels Exterior: galvanized steel 24 ga., 20ga. Interior: galvanized steel 20ga.							
Mounting Configuration: Rigid base							
Model Line	Number of Walls	Dimensions (in.)			Weight (lb)	PSF	Unit
		Depth	Width	Height			
York Solution Custom Air Handling Units (Stacked) Alternately Branded as: Johnson Controls - Solution XT Enviro-Tec ESL Krueger KAH Titus Revolution TFX PACE PA Mission Critical MC	3 (inlet or outlet wall removed)	No limit	30	54		Lower limit	Extrapolated
		…					Extrapolated
		62	30	54	830	64	UUT15
		96	126	144	5,182	62	UUT24
		…					Interpolated
		No limit	126	144		Upper limit <64 psf	Interpolated
	2 (inlet and outlet walls removed)	No limit	39	54		Lower limit	Extrapolated
		…					Extrapolated
		62	39	54	840	50	UUT21
		92	126	144	4,590	57	UUT20
		…					Interpolated
		No limit	126	144		Upper limit <57 psf	Interpolated

Table 2.2: Certified Subcomponents, Stacked Units: Base Rails

Manufacturer	Base Rail Height (in.)	Standard Construction	Options			Unit
			Curb Rest	Bolted Raceway	Welded Base Rail	
JCI	None	Formed raceway with bolted corners	X	X		UUT15, UUT21
	3	Formed raceway with bolted corners and formed base rail		X		Interpolated
	6	Formed raceway with bolted corners and formed base rail	X	X	X	UUT20, UUT24

Table 2.3: Certified Subcomponents, Stacked Units: Coils

	Water and DX coils								
Manufacturer	Coil Height (in.)	Coil Length (in.)	Row Qty	Tube Thick (in.)	Tube Diam (in.)	Number of Coils, Stacked	Weight (lb)	Weight w/ Fluid (lb)	Unit
JCI	17.5	18	2	0.016	1/2	1	32	39	UUT15

Coil Variables:

1. Fin Material: Aluminum
2. Coil Casing: Galvanized
3. Fin Shape: Corrugated

Table 2.4: Certified Subcomponents, Stacked Units: Energy Recovery Wheels

Manufacturer	Model		Diam. (in.)	Depth (in.)	Face Area (ft^2)	Frame W&H (in.)	Frame Depth (in.)	Weight (lb)	Unit
AirXchange	ERC-2510C	Min	25	3	1.7	29	6.97	36	UUT21
	⋮		⋮	⋮	⋮	⋮	⋮	⋮	Interpolated
	ERC-110290C	Max	110	3	33.0	115	20.5	1,100	UUT20

Heat Wheel Media: Polymer, Molecular Sieve

Table 2.5: Certified Subcomponents, Stacked Units: Fans

Fan MFR	Type	Fan Wheel Diam (in.)	Material				Maximum			Unit
			Fan	Housing & Frame	Option	Voltage	HP	Frame	Weight (lb) Wheel + Mtr+Skid	
Comefri	DWDI, Forward Curve	7-7	G90 Galv Steel	A 36 Steel	shaft ground ring	200/208, 230, 460, 380, 575	5	184T	222	UUT15
		9-6					5	184T	221	Interpolated
		9-9					5	184T	243	
		10-7					5	184T	237	
		10-10					7.5	213T	322	
		12-9					7.5	213T	336	
		12-12					15	254T	435	
		15-11					15	254T	462	
		15-15					15	254T	474	
		18-13					15	254T	501	
		18-18					20	256T	555	
		20-15					25	284T	913	
		20-20					30	286T	956	
		22-22					30	286T	1,096	
		25-25					30	286T	1,207	
		28-28					30	286T	1,373	
		32-32					30	286T	1,693	
	DWDI, Airfoil	12-12	A 572 Grade 50 Steel	A 36 Steel	shaft ground ring	200/208, 230, 460, 380, 575	15	254T	450	Interpolated
		15-15					15	254T	503	
		18-18					20	256T	583	
		20-20					30	286T	1,006	
		22-22					30	286T	1,162	
		25-25					30	286T	1,256	
		28-28					30	286T	1,490	
		32-32					30	286T	1,797	UUT 24

All fans are internally isolated with horizontal discharge and belt drive

Table 2.6: Certified Subcomponents, Stacked Units: Filter Frames

Manufacturer	Type	Cabinet			Weight (lb)	Unit
		Width (in.)	Length (in.)	Height (in.)		
JCI	Galvanized Steel Angle	126	17	72	217	UUT24

Table 2.7: Certified Subcomponents, Stacked Units: Filters

Manufacturer	Width (in.)	Height (in.)	Depth (in.)		Weight (lb)	Unit
American Air Filter	Pleated					
	16	20	2	4	1.8	UUT24

Table 2.8: Certified Subcomponents, Stacked Units: Dampers

Manufacturer	Damper		Height (in.)	Width (in.)	Weight (lb)	Unit
Ruskin	Control Damper Galvanized Steel Blade	Min	6.0	25.0	8	UUT21
		⋮	⋮	⋮	⋮	Interpolated
		Max	21.0	112.0	131	UUT20

Table 2.9: Certified Subcomponents, Stacked Units: Actuators

Manufacturer		Weight (lb)	Unit
JCI	Min	3.4	UUT21
	⋮	⋮	Interpolated
	Max	6.4	UUT20

Table 2.10: Certified Subcomponents, Stacked Units: Transformers

Manufacturer		Size				Unit
	Size (VA)	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
JCI	500 VA	18.50	11.50	7.50	25	UUT15

Table 2.11: Certified Subcomponents, Stacked Units: Factory Packaged Controls

Manufacturer	Panel Description	Application	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	Unit
JCI	JCI FEC / NCE 16.5x20 Panel	FEC / NCE configurable standards - Factory mounted	20	16.5	6.5	50	UUT20

Table 2.12: Certified Subcomponents, Stacked Units: End Devices

Manufacturer	Unit Light Fixture	Description	Unit
JCI	Sensor, 8in. 1K RTD Temp, Nickel	Temperature Sensor, Probe, 1k, Type 1, 8 in.	UUT20

Table 2.13: Certified Subcomponents, Stacked Units: Motor Controls

Manufacturer	Panel Description	Frame	Base	Voltage		Enclosure				Unit
				200, 230, 460,575		Size				
				Min HP	Max HP	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
JCI	Motor Starters (NEMA3R)	R1	G20	1	15	17.00	10.00	10.00	22	UUT15
		R2	G21	7.5	60	25.00	24.00	12.00	56	UUT24
				Min FLA	Max FLA					
	VFD without Bypass for Energy Wheels	R0	N/A	1.2	1.9	19.20	9.00	8.70	3	UUT20

Table 2.14: Certified Subcomponents, Stacked Units: Factory Terminated Wiring

Manufacturer	Disconnect Size (A)	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	Unit
JCI	80	17.00	8.00	8.25	25	UUT15

Table 2.15: Certified Subcomponents, Stacked Units: Unit Disconnects

Manufacturer	Type	Disconnect	Enclosure Size				Unit
		Amp	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)	
RAM Industries by Schneider Electric	Non-Fused Disconnects (NEMA 1, 3R, 4, 12)	30/60	8.0	6.0	4.0	9	UUT15

Table 2.16: Certified Subcomponents, Stacked Units: Electric Heaters

Manufacturer	Element type	kW	Dimensions		Weight (lb)	Unit
			Height (in.)	Width (in.)		
Indeeco	Open	15	18	15.25	55.2	UUT15

Table 3: Tested units								
Manufacturer: Johnson Controls								
Product Line: York Solution Custom Air Handling Units								
Model Number	Segment ID	Tag	Dimensions (inches)			Operating Weight (lb)	Sds (g), z/h=1	Unit
			Depth	Width	Height			
XTI-033X039-ASAH146A	HF-HA-EE-FR	SM1A	111	39	33	950	1.93	UUT1
XTI-033X039-NAHA146A	FS-CC-HC-RF	SM1B	105	39	33	1,100	1.93	UUT2
XTI-027X030-AAA0*A	RF-XA-FF-FM	SM2A	91	30	27	600	1.93	UUT3
XTI-027X030-AAAA0*0	DP-HM-CC-HC-IP	SM2B	99	30	27	1,100	1.93	UUT4
XTI-039X039-HAHA146A	FS	SM3A	54	39	39	760	1.93	UUT5
XTI-120X114-AAAA1*A	EE2-EE1	LG2B	102	114	120	2,110	1.93	UUT6
XTI-120X114-AAAA1*A	XA-HC-HC-FM	LG1A	81	114	120	3,840	1.45	UUT7
XTI-120X114-HATA146A	FS	LG2D	65	114	120	4,570	1.45	UUT8
XTI-120X114-AAAA1*A	HF-XA-CC-RF	LG2C	98	114	120	8,280	1.45	UUT9
XTO-120X114-NAVA146A	XA-FS	LG2A	102	114	120	5,730	1.45	UUT10
XTO-120X114-AAAA0*A	IG	LG2E	85	114	120	4,610	1.93	UUT11
XTI-120X114-AAAA0*A	AT-DI	LG2F	75	114	120	2,170	1.93	UUT12
XTI-054X084-FALA017A	FS-XA-CC-XA-MB	AHU01B3	94	84	60	3,500	2.28	UUT13
XTI-027X030-DAGA046A	2 Tiers, FS/VC-EH-XA	SM5	62	30	54	830	2.50	UUT15
XTI-039X039-AAAA0*A	XA-IC	SM6	73	139	39	860	2.50	UUT16
XTO-045X045-AAAA0*A	IG	SM4A	60	45	45	1,510	2.50	UUT17
XTI-090X120-DAPA046A	FS	LG5 (Top)	71	120	90	3,000	1.93	UUT18
XTI-120X114-AAAA1*A	XA-IC	LG6	54	114	120	2,920	1.45	UUT19
XTI-72Hx126Wx92L	2 Tiers, IO-XA/IO-XA	LG7	92	126	144	4,590	1.45	UUT20
XTI-27Hx39Wx62L	2 Tiers, IO-XA/IO-XA	SM7	62	39	54	840	2.50	UUT21
XTI-60Hx60Wx120L	DP-FS	MFA-P1	120	60	60	2,320	1.93	UUT22
XTI-72Hx126Wx96L	2 Tiers, XA-AF-MB/XA-FE	LG7B	96	126	144	5,182	1.85	UUT24
XTI-90Hx120Wx87L	VC-EH-XA	LG5-Bottom	87	120	90	2,970	1.93	UUT25
XTI-120Hx114Wx100L	DP-FS	MFA-P2	100	114	120	7,030	1.93	UUT26
XTI-33Hx39Wx41L	FS	UUT29	41	39	33	502	2.50	UUT29
XTO-120Hx114Wx95L	FS	UUT30	95	114	120	4,400	1.60	UUT30

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT1 (SM1A), XTI-33Hx39Wx111L, (HF-HA-EE-FR)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: None

Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports.

Dampers and Louvers: (2) control dampers with galvanized carbon steel blade, 9.5"Hx25"W (actuated); (1) control damper aluminum, 9.5"Hx25"W (actuated)

Doors: (2) door, galvanized, no viewport, 27"Hx12"W; (2) door, galvanized, no viewport, 27"Hx18"W

Wall Location Summary

3 walls: outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	10.8	14.6	26.0	

Seismic Test Parameters

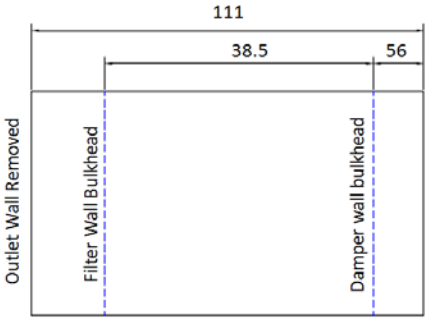
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	111	39	33	950	

VFD without Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R1, Base G11, 460V, 5hp; JCI FEC / NCE 15x20 Panel; Actuator (Mixing, Exhaust,and Return Air); Sensor, Avg, 8ft, 1k, Nickel (Averaging Temperature); Cable, End Dev Sig, Pigtail (Fan Variable Speed Control Signal); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, Spdt, 24vac, Coil, Ind, Led (Fan Safeties Contact); Welded Aluminum-HEPA Filter Frame with filters; Plenum Airfoil Fan, Direct Drive, 122 Wheel, 56T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-SM-1A, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT1 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT2 (SM1B), XTI-33Hx39Wx105L, (FS-CC-HC-RF)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: None
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Dampers and Louvers: None
Doors: (3) doors, galvanized, no viewport 27"Hx18'W

Wall Location Summary
3 walls: inlet wall removed

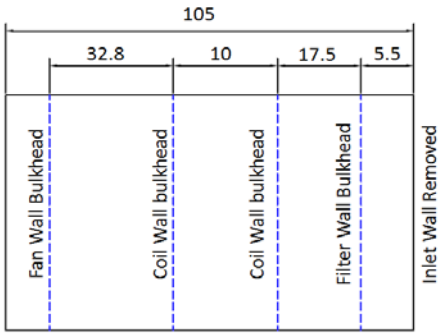
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	14.4	13.1	23.2		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	105	39	33	1,100	

VFD without Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R1, Base G11, 460V, 5hp; JCI FEC / NCE 15x20 Panel; Sensor, 8in. 1K RTD Temp, Nickel (Probe Temperature); Sensor, Avg, 8ft, 1k, Nickel (Averaging Temperature); Cable, End Dev Sig, Pigtail (Fan Variable Speed Control Signal); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, SPDT, 24VAC, Coil, Indicator LED (Fan Safeties Contact); High Static Pressure Switch (Manual Reset); LTC, SPST, Fixed Reset, 20ft (Low Temperature Cutout); Wiring only (Low Temperature - Status); Heating Valve Wiring; Cooling Valve Wiring; Fixture, Light, 75 Watt, Vr; Switch, 15 amp, 120V; Outlet, GFI, 15 amp; Aluminum Extruded - Rigid Filter Frame with filters; Water Coil, 1/2" dia, 2 rows, 0.016 TW, 1 stack; Water Coil, 5/8" dia, 2 rows, 0.020 TW, 1 stack; Plenum Airfoil, Belt Drive, 122 Wheel, 184T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-SM-1B, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT2 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT3 (SM2A), XTI-27Hx30Wx91L, (RF-XA-FF-FM)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: None
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Dampers and Louvers: (1) control damper galvanized carbon steel blades 9.5Hx16W (non-actuated); (1) outside airflow measuring station w/ control damper galvanized carbon steel blades 9.5Hx16W (non-actuated)
Doors: (1) door, galvanized, no viewport 21Hx10W; (1) door ,galvanized, no viewport 21Hx18W; (1) door, galvanized, no viewport 21Hx31W.
Wall Location Summary
3 walls: outlet wall removed

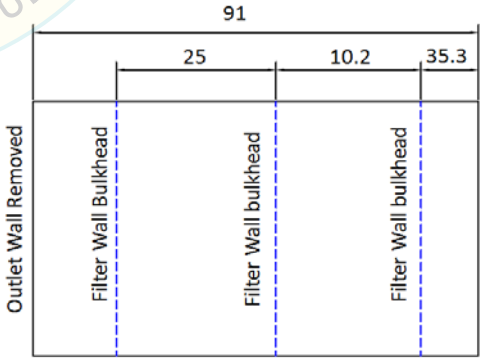
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	22.4	17.8	31.7		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	91	30	27	600	

Galvanized Carbon Steel Sheet Metal-Angle Filter Frame with filters, Flat Filter Frame with filters; Galvanized Carbon Steel Box - Rigid Filter Frame with filters

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-SM-2A, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT3 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT4 (SM2B), XTI-27Hx30Wx99L, (DP-HM-CC-HC-IP)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: None
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Pipe Chase: 27"H x 39"L x 24"D
Dampers and Louvers: None
Doors: (2) door, galvanized, no viewport 21Hx12W; (1) door, galvanized, no viewport 21Hx18W; (1) door, galvanized, no viewport 24Hx26W
Wall Location Summary
4 walls: no walls removed

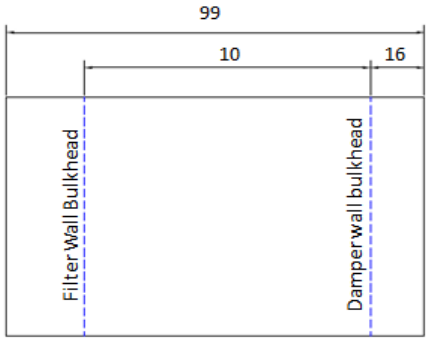
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	23.3	15.8	32.3		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	99	30	27	1,100	

UV light control panel, UV Lights < 8 Amps; humidifier grid; UV Light Ballast Length(Qty): 21(1); Magnetic Proximity Sensors 1 for each door; DX Coil, 1/2" dia, 4 rows, ,0.016 TW, 1 stack; Steam Coil, 1" dia, 1 rows,0.035 TW, 1 stack

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-SM-2B, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT4 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center. The unit was tested full of operating fluid.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT5 (SM3A), XTI-39Hx39Wx54L , (FS)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: None

Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports

Dampers and Louvers: None

Doors: (1) door, galvanized, with viewport 33Hx18W

Wall Location Summary

3 walls: inlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	15.1	12.4	28.1	

Seismic Test Parameters

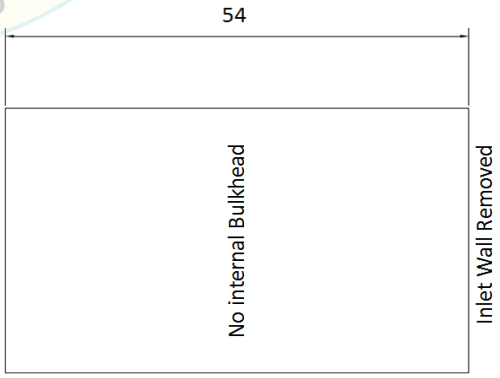
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	54	39	39	760	

Motor Starter (NEMA 3R) Frame R1, Base G20, 460v, 5hp; JCI FEC / NCE 15x20 Panel; Transformer, 460/120 Volt, 2kva W/Gfi Receptacle & Switch; Sensor, 8in. 1K RTD Temp, Nickel (Probe Temperature); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, SPDT, 24VAC, Coil, Indicator LED (Fan Safeties Contact); Fixture, Light, 75 Watt, Vr; Switch, 15 amp, 120V; Outlet, GFI, 15 amp; DWDI Airfoil Fan, Belt Drive, 122 Wheel, 184T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-SM-3A, was attached directly to the shake table using M12 threaded rod at a minimum of 18 inches on center. UUT5 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT6 (LG2B), XTI-120Hx114Wx102L, (EE2-EE1)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Dampers and Louvers: (1) control damper galvanized steel blade 44Hx96W (actuated), (2) control damper galvanized steel blade 38.25Hx82W (actuated)
Doors: (2) doors, galvanized, no viewport 114Hx24W

Wall Location Summary
3 walls: inlet wall removed

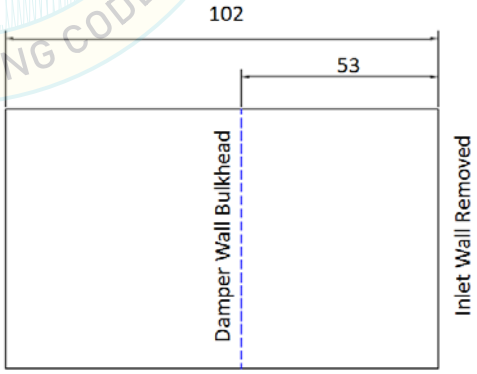
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	4.8	4.8	12.7		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	102	114	120	2,110	

JCI FEC / NCE 15x20 Panel; Actuator (Mixing, Exhaust,and Return Air); Sensor, Avg, 17ft, 1k, Nickel (Averaging Temperature)

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-2B, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT6 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT7 (LG1A), XTI-120Hx114Wx81L, (XA-HC-HC-FM)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports

Dampers and Louvers: (1) control damper galvanized steel blades 44Hx96W (actuated); (1) outside airflow measuring station w/ control damper galvanized steel blades 44Hx96W

Doors: (1) door, galvanized, with viewport 114Hx40W

Wall Location Summary

3 walls: outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	3.0	2.9	12.2	

Seismic Test Parameters

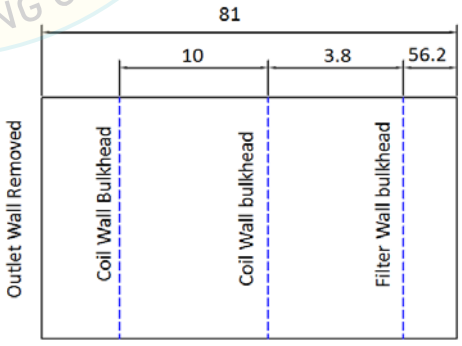
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	81	114	120	3,840	

Actuator (Outside and Return Air); Switch, Diff, Press, 2CND, L-Bracket (Dirty Filter Alarm); Steam Coil, 1" dia, 1 rows,0.035 TW, 2 stack; Water Coil, 1/2" dia, 2 rows, 0.016 TW, 3 stack; Galvanized Carbon Steel Sheet Metal-Angle Filter Frame with filters

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

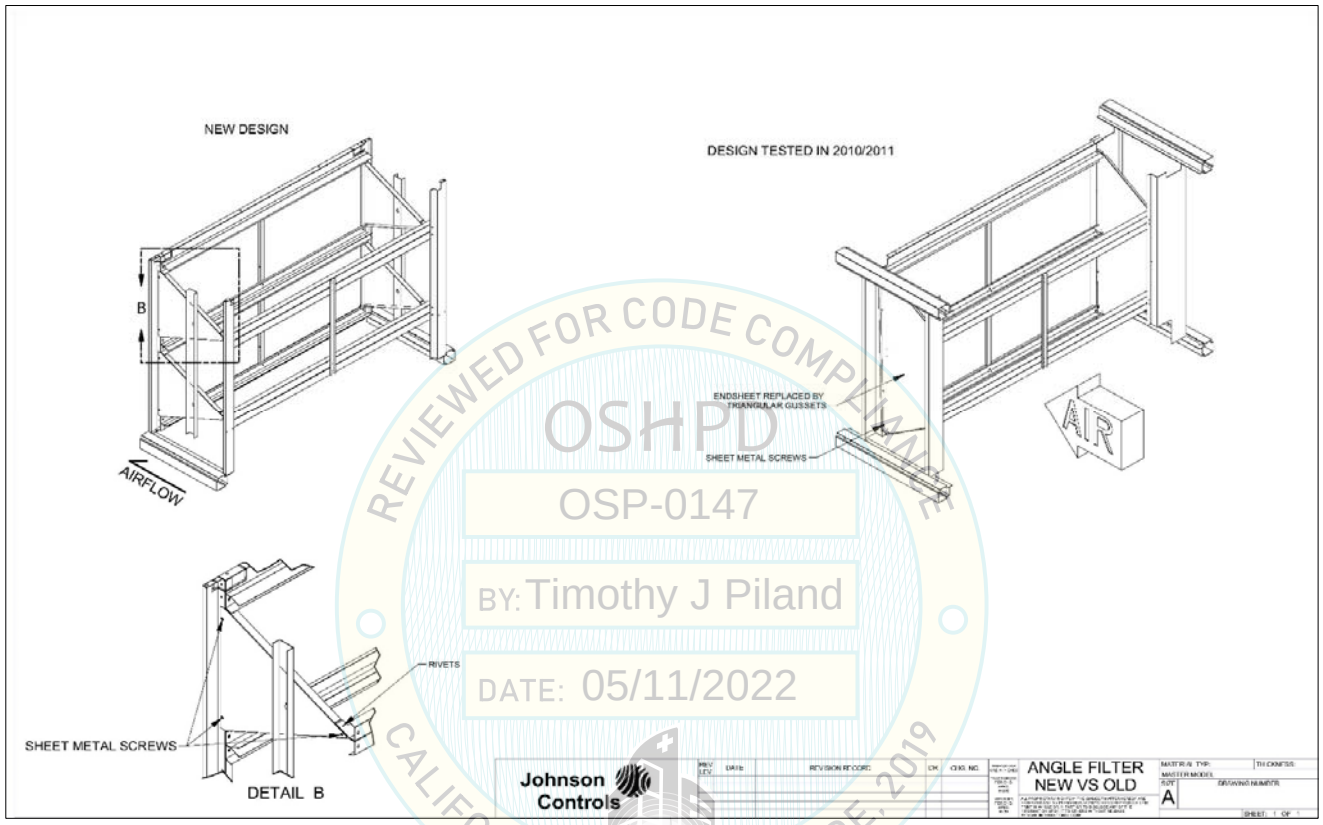
Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-1A, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT7 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors

UUT7 (LG1A), XTI-120Hx114Wx81L, (XA-HC-HC-FM)

UUT7 Production Unit Design Change to Address Anomaly Observed During Test:

The original filter rack endsheet was installed with sheet metal screws. The filters at either end butted up to the endsheet. The filter rack endsheet has been replaced by triangular gussets comprised of 16 gage galvanized carbon steel. There is a small one that is riveted to the filter tracks and a larger one which is attached via .25-14 x 1.00 sheet metal screws. The filters at either end have a lip to rest on and seal against. The triangular gussets are more rigid and tie the upstream and downstream tracks together in a way that the endsheet could not.



Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT8 (LG2D), XTI-120Hx114Wx65L, (FS)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Dampers and Louvers: None
Doors: (1) door, galvanized, no viewport 114Hx24W

Wall Location Summary
3 walls: inlet wall removed

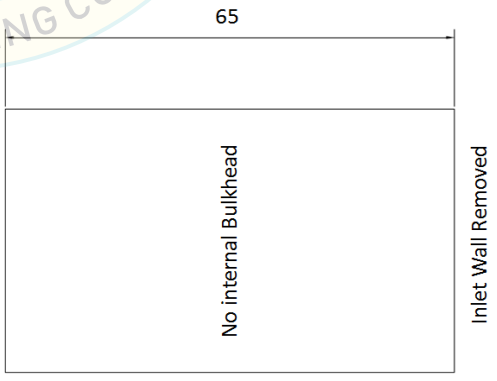
Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	3.7	4.7	14.5	

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	65	114	120	4,570	

Motor Starter (NEMA 3R) Frame R4, Base G23, 460v, 75hp; JCI FEC / NCE 20x25 Panel; Transformer, 460/120 Volt, 2kva W/Gfi Receptacle & Switch; Sensor, 8in. 1K RTD Temp, Nickel (Probe Temperature); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, SPDT, 24VAC, Coil, Indicator LED (Fan Safeties Contact); Fixture, Light, 75 Watt, Vr; Switch, 15 amp, 120V; Outlet, GFI, 15 amp; DWDI Airfoil, Belt Drive, 330 Wheel, 365T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-2D, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT8 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT9 (LG2C), XTI-120Hx114Wx98L, (HF-XA-CC-RF)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports

Dampers and Louvers: None

Doors: (1) door, galvanized, no viewport 114Hx12W; (2) doors, galvanized, no viewport 114Hx18W

Wall Location Summary

2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	2.0	2.3	7.4	

Seismic Test Parameters

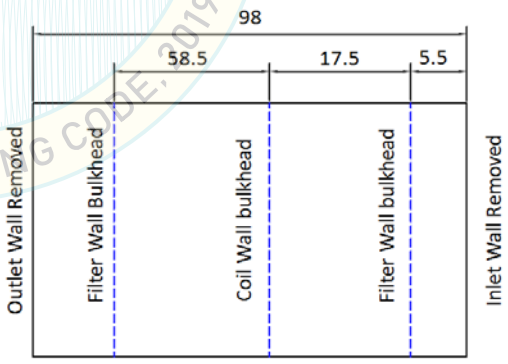
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	98	114	120	8,280	

UV light control panel, UV Lights < 8 Amps; Switch, Diff, Press, 2CND, L-Bracket (Dirty Filter Alarm); Aluminum Extruded - Rigid Filter Frame with filters; UV Light Ballast Length(Qty): 18(3), 24(6), 36(3); Magnetic Proximity Sensors 1 for each door; Water Coil, 5/8" dia, 12 rows, 0.049 TW, 3 stack

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-2C, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT9 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
1) Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.
2) Added 5/16-inch bolts with rivet nuts at 12-inch spacing with 1/4-inch drill screws halfway between along the right and top bulkhead-to-cabinet connections.
3) Added 12 gage top bulkhead to down-side of the coil.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT10 (LG2A), XTO-120Hx114Wx105L, (HM - FS)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: 24" H, 14 gage welded assembly, 48" max between supports across width, 48" max between vertical supports
Dampers and Louvers: None
Doors: (1) door, multi latch, galvanized, out swing, no veiwport 114Hx24W
Wall Location Summary
3 walls: outlet wall removed

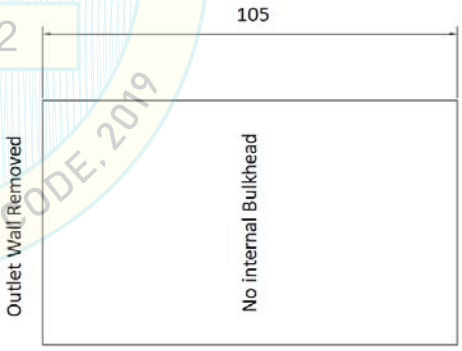
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	2.5	2.3	12.7		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	105	114	120	5,730	

VFD with and without Bypass Fused and Non-Fused Disconnect (NEMA3R Self Ventilated) Frame R6, 460V, 100hp; JCI FEC / NCE 20x25 Panel; Sensor, 8in. 1K RTD Temp, Nickel (Probe Temperature); Cable, End Dev Sig, Pigtail (Fan Variable Speed Control Signal); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, SPDT, 24VAC, Coil, Indicator LED (Fan Safeties Contact); High Static Pressure Switch (Manual Reset); Humidifier Grid; Plenum Airfoil Fan Skid, Belt Drive, 490 Wheel, 404T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-2A, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT10 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
1) Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.
2) Replaced existing screws connecting fan skid to floor of unit with 5/16-inch bolts with rivet nuts (4 at each of 4 connection locations).
3) Humidifier support screws pulled out during shipping, so the top support bracket was revised for each vertical support to add structural supports at end of the skid next to the humidifier.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT11 (LG2E), XTI-120Hx114Wx85L, (IG)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: 14" H, 14 Gage Welded Assembly, 48" Max between supports across width, 48" Max between vertical supports.

Pipe Chase: 120"H x 71"L x 48"D

Dampers and Louvers: Control Damper Galvanized Steel Blades 15.25Hx93W (With Manual Locking Quadrant)

Doors: (1) Door, Galvanized, no Viewport 117Hx48W

Wall Location Summary

2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	4.5	4.1	14.8	

Seismic Test Parameters

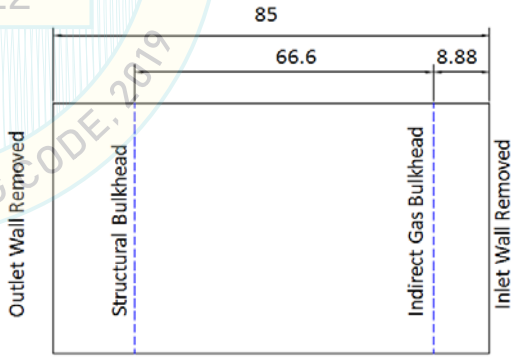
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	85	114	120	4,610	

Burner Control Module, 10:1 Full Modulation; Heater, Indirect Gas, 2,000,000 BTUs; Gas Burner Piping, Underwriters Laboratories; Flue Pipe System, Double Wall, Air Insulated, SST, Direct Drive Inducer Fan

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: A MicroMetl 14 gage rigid curb, model CW-LG-2E, was attached to the interface frame using 1/2-inch bolts at a minimum of 18 inches on center. UUT11 was attached to its MicroMetl curb using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT12 (LG8), XTI-120Hx114Wx75L, (AT-DI)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: Mounted directly to shake table structural tubing test fixture
Dampers and Louvers: None
Doors: None

Wall Location Summary
2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	6.9	4.3	24.6	

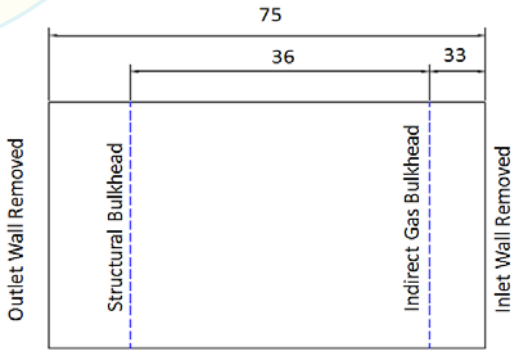
Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	75	114	120	2,170	

Perforated Plate Diffuser for Fan: DWDI Airfoil, Belt Drive, 330 Wheel; Galvanized Carbon Steel, Standard Packing Material

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT12 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT13 (AHU01B3), XTI-54Hx84Wx94L, (FS-XA-CC-XA-MB)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: 20" H, structural steel welded isolated curb, 45" max between supports across width
Dampers and Louvers: Control damper galvanized steel blades 21Hx66W (actuated)
Doors: (2) Door, galvanized, no viewport 48Hx18W

Wall Location Summary
4 walls: no walls removed

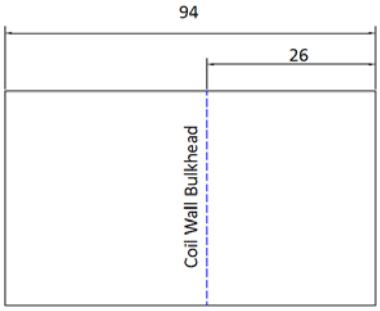
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	7.6	11.3	19.7		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.28	3.65	2.74	1.52	0.61

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	94	84	60	3,500	

VFD without Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R1, Base G11, 460V, 5hp; JCI FEC / NCE 15x20 Panel; JCI Terminal Strip Panel; JCI FEC / NCE 24x37 Panel; VFD with Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R1, Base B1, 460V, 1-1.5hp; VFD with and without Bypass Fused and Non-Fused Disconnect (NEMA3R Self Ventilated) Frame R4, 460V, 50hp; Motor Starter (NEMA 3R) Frame R4, Base G23, 460v, 100HP; Factory Terminated Wiring Enclosure, 2 Circuit, Nema 3R, 400A; UV light control panel, UV Lights < 8 Amps; Transformer, 460/120 Volt, 2kva W/Gfi Receptacle & Switch; Actuator (Outside Air); Sensor, Avg, 8ft, 1k, Nickel (Averaging Temperature); Cable, End Dev Sig, Pigtail (Fan Variable Speed Control Signal); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Relay, Spdt, 24vac, Coil, Ind, Led (Fan Safeties Contact); LTC, SPST, Fixed Reset, 20ft (Low Temperature Cutout); Wiring only (Low Temperature - Status); Cooling Valve Wiring; Sensor, 8in. 1K RTD Temp, Nickel (Probe Temperature); High Static Pressure Switch (Manual Reset); Wiring only (High Pressure - Status); Low Static Pressure Switch (Manual Reset); Wiring only (Low Temperature - Status); Fixture, Light, 75 Watt, Vr; Switch, 15 amp, 120V; Outlet, GFI, 15 amp; UV Light Ballast Length(Qty): 36(2); Magnetic Proximity Sensors 1 for each door; DX Coil, 1/2" dia, 4 rows, 0.016 TW, 1 stack; DWDI Airfoil, Belt Drive, 20-20 Wheel, 254T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: The UUT was mounted to a VMC Group rigid curb, Drawing #VMA-45860A Rev. A (an isolated curb, but the isolators were locked out for this shake test). The UUT was welded to the curb with a 4-inch weld above each spring.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT15 (SM5), XTI-27Hx30Wx40L/62L, (FS)/(VC-EH-XA)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: None

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: None

Doors: (1) Door, Galvanized, No Viewport 21Hx18W, (1) Door, Galvanized, No Viewport 21x27W

Wall Location Summary

3 walls: VC-EH-XA (Bottom Skid): Inlet wall removed; no top panel on VC segment
FS (Top Skid): All four side walls in place; no bottom panel

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	22.3	11.0	>33.0	

Seismic Test Parameters

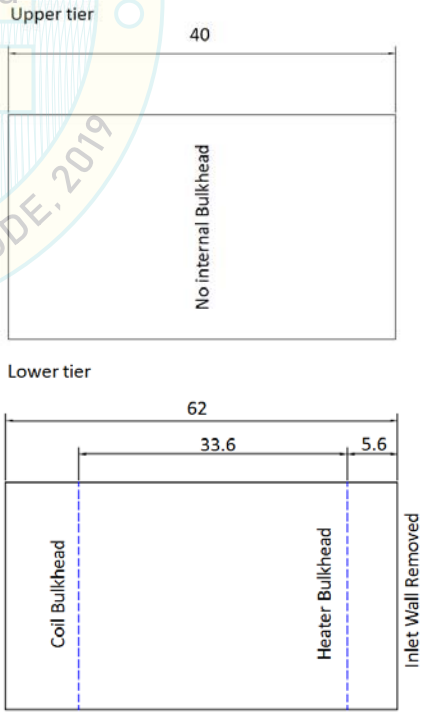
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.50	4.00	3.00	1.67	0.67

Component Summary

Item	Dimensions (in)			Weight	
	Length	Width	Height	(lb)	
Cabinet	62	30	54	830	

Motor Starter (NEMA 3R) Frame R1, Base G20, 460v, 3hp; Factory Terminated Wiring Enclosure, 2 Circuit, Nema 3R, 80A; Unit Disconnect Enclosure,Non-Fused, Nema 1, 30A; Electric heat open element, 15 kW 460/3/60, w/ Protective Screen; Electric Heat Control Enclosure, 2 stage, Magnetic Disconnecting Contactors, Airflow Switch and Fan Interlock, 24 Volts Control Voltage; Water Coil, 1/2" dia, 2 rows, 0.016 TW, 1 stack; DWDI FC Fan, Belt Drive, 7-7 Wheel, 182T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT15 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT16 (SM6), XTI-39Hx139Wx73L, (XA-IC)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: None

Doors: (1) Door, Galvanized, No Viewport 33Hx24W

Wall Location Summary

2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	23.5	13.8	26.8	

Seismic Test Parameters

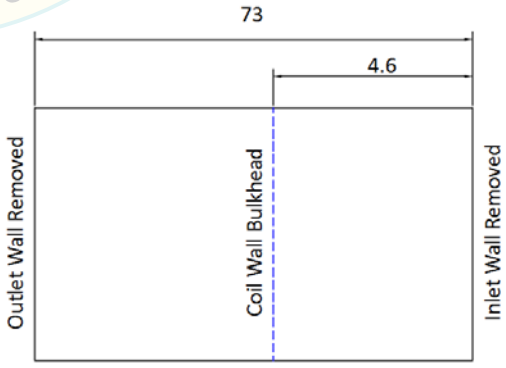
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.50	4.00	3.00	1.67	0.67

Component Summary

Item	Dimensions (in)			Weight (lb)	Sds (g), z/h=1
	Length	Width	Height		
Cabinet	73	39	39	860	2.50

Actuator (Damper Bypass Air - Proportional Control); Coil, Integral Face & Bypass,B18, IFB Steam, 4 row, 0.035 TW, 2 sections

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT16 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT17 (SM4A), XTI-45Hx45Wx60L, (IG)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: Mounted directly to shaker table structural tubing test fixture.
Pipe Chase: 45"H x 46"L x 36"D
Dampers and Louvers: None
Doors: (1) Door, Galvanized, no Viewport 42Hx36W
Wall Location Summary
2 walls: inlet and outlet wall removed

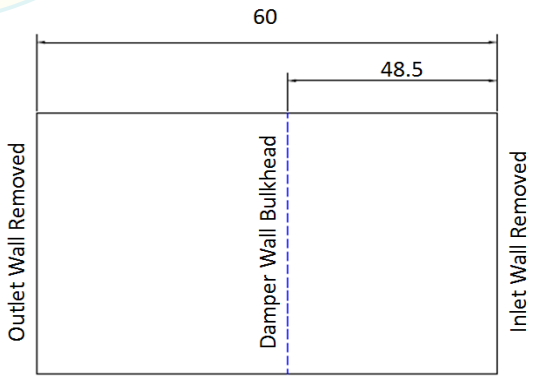
Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	20.8	13.0	>33.0	

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.50	4.00	3.00	1.67	0.67

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	60	45	45	1,510	

Burner Control Module, 10:1 Full Modulation; Heater, Indirect Gas, 150,000 BTUs; Gas Burner Piping, ANSI; Flue Pipe System, Double Wall, Air Insulated, SST, Direct Drive Inducer Fan

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT17 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT18 (LG5-top), XTI-90Hx120Wx71L (FS)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: None

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: None

Doors: (1) Door, Galvanized, No Viewport 84x24W

Wall Location Summary

3 walls: inlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	4.5	6.5	17.0	

Seismic Test Parameters

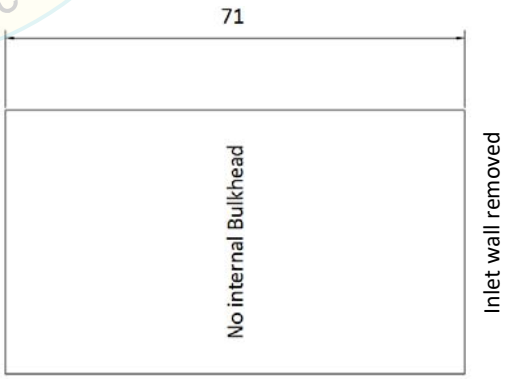
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	71	120	90	3,000	

Motor Starter (NEMA 3R) Frame R2, Base G21, 460v, 30hp; Factory Terminated Wiring Enclosure, 2 Circuit, Nema 3R, 200A; DWDI FC, Belt Drive, 40-40 Wheel, 286T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT18 was attached directly to the structural steel tube interface frame at four locations with the manufacturer-provided brackets with bolts spaced approximatley 3 inches on center per bracket, using two (2) 3/8-inch diameter Grade 5 bolts per bracket (total of eight (8) bolts). The brackets were spaced approximately 122 inches on center widthwise and approximately 68 inches on center lengthwise.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT19 (LG6), XTI-120Hx114Wx54L, (XA-IC)

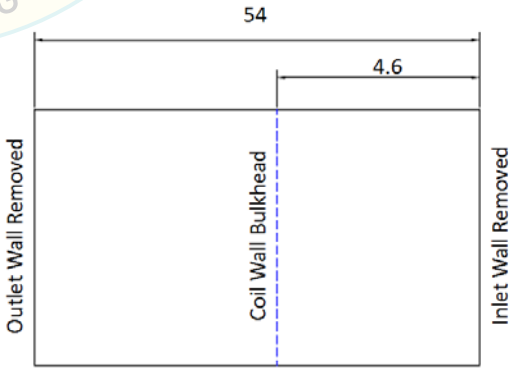
Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: Mounted directly to shaker table structural tubing test fixture.
Dampers and Louvers: None
Doors: (1) Door, Galvanized, No Viewport 78Hx18W
Wall Location Summary
2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	3.5	3.3	17.0		
Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	54	114	120	2,920	

Actuator (Damper Bypass Air - Proportional Control); Sensor, Avg, 17ft, 1k, Nickel (Averaging Temperature); Coil, Integral Face & Bypass,VE9TX, VIFB Steam 3 row, 0.035 TW, 1 section

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT19 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT20 (LG7), XTI-72Hx126Wx92L, (2) Tiers, (IO)(HW1)(XA)\(IO)(HW2)(XA)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: (1) Control Damper Galvanized Steel Blade 21Hx112W (actuated)

Doors: (2) Door, Galvanized, No Viewport 66Hx26W

Wall Location Summary

2 walls: inlet and outlet walls removed

Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	4.0	2.8	14.5		

Seismic Test Parameters

Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.45	2.32	1.74	0.97	0.39

Component Summary

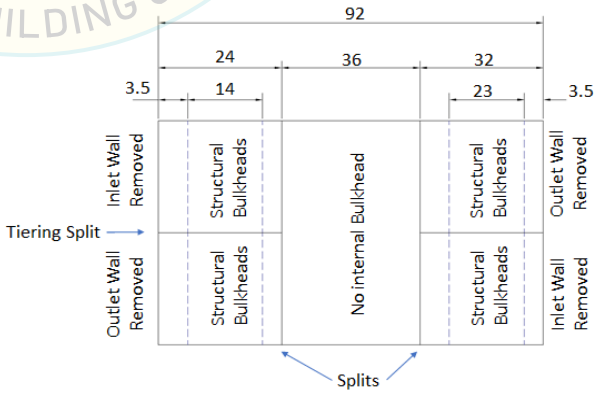
Item	Dimensions (in)			Weight (lb)	Sds (g), z/h=1
	Length	Width	Height		
Cabinet	92	126	144	4,590	1.45

VFD without Bypass and with Trailing Fuse Disconnect (NEMA 1) Frame R0, 380-480V,1.9fla, 50/60 Hz,3PH; JCI FEC / NCE 16.5x20 Panel; Actuator (Mixing, Ehaust,and Return Air); Sensor, Avg, 8ft, 1k, Nickel (Averaging Temperature); Cable, End Dev Sig, Pigtail (Fan Variable Speed Control Signal); Cable, End Dev Sig, Pigtail (Fan Start/Stop Contact); Cable, End Dev Sig, Pigtail (Fan Proving); Heat Wheel: Wheel,Heat,110290C-T,M10, Double Wall, LT, Ch/Matrix ERC, 3" Cass; Motor: 460-3-60, 1.70 FLA, 865 RPM

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.

UUT20 front view:

UUT20 rear view:



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT20 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT21 (SM7), XTI-27Hx39Wx62L, (2) Tiers, (IO)(HW1)(XA)\(IO)(HW2)(XA)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: None

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: (1) Control Damper Galvanized Steel Blade 6Hx25W (actuated)

Doors: (2) Door, Galvanized, No Viewport 21Hx15W

Wall Location Summary

2 walls: inlet and outlet walls removed

Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	22.0	14.0	>33.3		

Seismic Test Parameters

Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.50	4.00	3.00	1.67	0.67

Component Summary

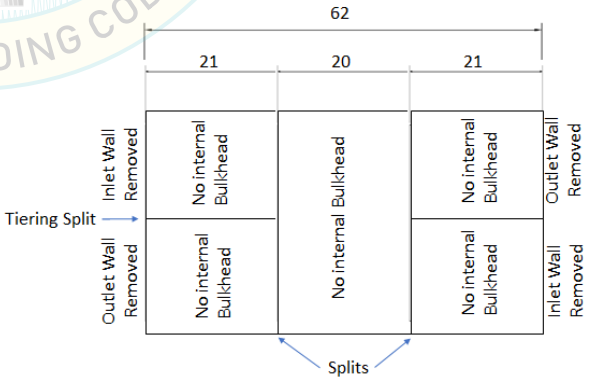
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	62	39	54	840	

Actuator (Mixing, Ehaust,and Return Air); Heat Wheel: Wheel,Heat,2510C-T,M01, Double Wall, Lt, Ch/Matrix Erc, 3" Cass; Motor: 120-1-60, 0.70 FLA, 0 HP, 1050 RPM

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.

UUT21 front view:

UUT21 rear view:



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT21 was attached directly to the structural steel tube interface frame using No. 14, 1-1/2-inch sheet metal screws, spaced approximately 7.5-inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT22 (MFA-P1), XTI-60Hx60Wx120L, (DP-FS)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: (4) Backdraft Damper With Counterbalance, 17.00hx17.00w, Airfoil extruded aluminum blades

Doors: (1) Door,Multi Latch,Galvanized,Out Swing, with Veiwport 54Hx24W

Wall Location Summary

2 walls: inlet and outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	11.5	8.8	19.8	

Seismic Test Parameters

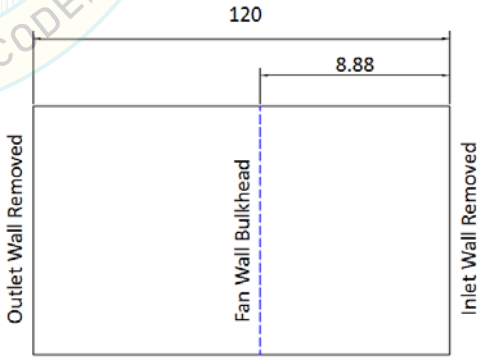
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	120	60	60	2,320	

VFD without Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R2, Base G12, 460V, 15hp; Enclosure, MMP, 6 circuit, 16x28, 150 amp, with (9) Manual Motor Protector, Range 4.00 - 6.30 amps; (4) Plenum Airfoil, Direct Drive, 122 Wheel, 284T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT22 was attached directly to the structural steel tube interface frame with sixteen 1/2-inch diameter Grade 5 bolts. Both long sides of the UUT have 8 bolts, spaced approximately 12 inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT24 (LG7B), XTI-72Hx126Wx96L, (2) Tiers, (XA-AF-MB)\(XA-FE)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: 6" galvanized, 10 gage carbon steel

Curb Support: Mounted directly to shaker table structural tubing test fixture.

Dampers and Louvers: (1) Control Damper Galvanized Steel Blade 26.75Hx108W

Doors: (2) Door,Multi Latch,Galvanized,Out Swing, No Veiwport 66Hx24W; (1) Door,Multi Latch,Galvanized,Out Swing, No Veiwport 66Hx17W

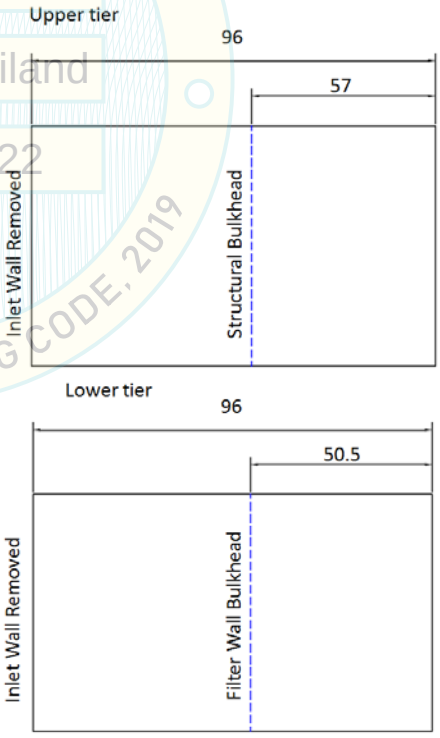
Wall Location Summary

3 walls: inlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	2.5	2.8	15.8		
Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.85	2.96	2.22	1.23	0.49
Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	96	126	144	5,182	

Motor Starter (NEMA 3R) Frame R2, Base G21, 460v, 30hp; Galvanized Carbon Steel Sheet Metal-Angle Filter Frame with filters; DWDI AF, Belt Drive, 32-32 Wheel, 286T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT24 was attached directly to the structural steel tube interface frame with twenty 1/2-inch diameter Grade 5 bolts spaced at approximately 20 inches on center.

Additional "Seismic Kit" Utilized for Pre-Approval:

Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors. At each of the four corners, a 1/4"x6" fillet weld was added connecting the base rail to the raceway.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT25 (LG5-Bottom), XTI-90Hx120Wx87L, (VC-EH-XA)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: None
Curb Support: Mounted directly to shaker table structural tubing test fixture.
Dampers and Louvers: None
Doors: (2) Door, Galvanized, No Viewport 84Hx18W, (1) Door, Galvanized, No Viewport 84x24W

Wall Location Summary
3 walls: inlet wall removed

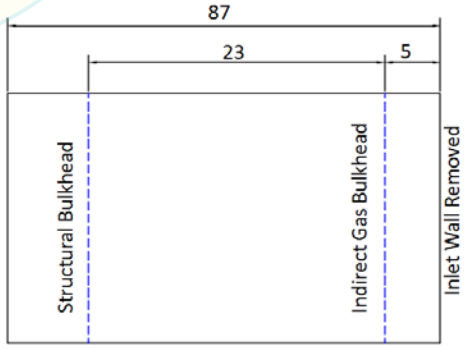
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	5.0	3.5	11.0		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	87	120	90	2,970	

Unit Disconnect Enclosure,Non-Fused, Nema 1, 100A; Electric heat open element, 75 kW 460/3/60, w/Protective Screen; Electric Heat Control Enclosure, 2 stage, Magnetic Disconnecting Contactors, Airflow Switch and Fan Interlock, 24 Volts Control Voltage; Water Coil, 1/2" dia, 6 rows, 0.016 TW, 2 stack

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting:Rigid base mount: UUT25 was attached to the structural steel tube interface frame via a 90 degree L-bracket with a thickness of approximately 3/16 inch galvanized carbon steel with eight 3/8-inch diameter Grade 5 bolts spaced approximately 3 inches apart on the bracket, with each bracket approximatly 70 inches inches apart on center on each side.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT26 (MFA-P2), XTI-120Hx114Wx100L, (DP-FS)

Cabinet Construction Summary
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner
Base Rails: 6" galvanized, 10 gage carbon steel
Curb Support: Mounted directly to shaker table structural tubing test fixture.
Dampers and Louvers: (4) Backdraft Damper With Counterbalance, 40.00hx40.00w, Airfoil extruded aluminum blades
Doors: (1) Door,Multi Latch,Galvanized,Out Swing, with Veiwport 78Hx24W

Wall Location Summary
2 walls: inlet and outlet wall removed

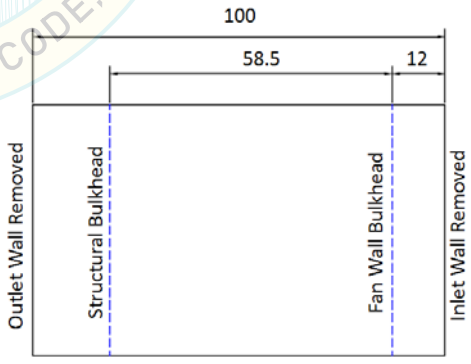
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	3.5	3.5	11.3		

Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.93	3.09	2.32	1.29	0.51

Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	100	114	120	7,030	

VFD without Bypass and with Fused and Non-Fused Disconnects (NEMA 1) Frame R6, Base G25, 460V, 100hp; Enclosure, MMP, 3 circuit, 16x20, 40 - 50 amp range, with (3) Manual Motor Protector, Range 40.0 - 50.0 amps; Enclosure, MMP, 6 circuit, 16x20, 150 amp, with (6) Manual Motor Protector, Range 25.0 - 32.0 amps; (4) Plenum Airfoil, Direct Drive, 270 Wheel, 284T Frame

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.



Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: UUT26 was attached directly to the structural steel tube interface frame with twenty-eight 1/2-inch diameter Grade 5 bolts spaced approximately 15 inches apart on center.

Additional "Seismic Kit" Utilized for Pre-Approval:
Four (4) 1/2-inch by 1-inch long Grade 2 bolts were installed at the base rail to the raceway through the corner connectors. At each of the four corners, a 1/4"x6" fillet weld was added connecting the base rail to the raceway.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT26 (MFA-P2), XTI-120Hx114Wx100L, (DP-FS)

UUT26 - MFA-P2 Re-Test Unit Strengthening Measures

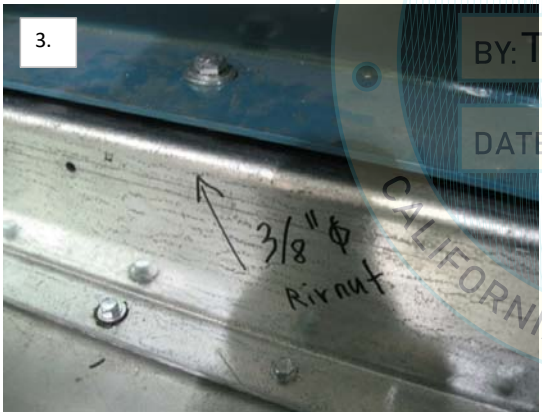
Notes:

1. Added four 5/16-inch diameter rivet-nuts to the four corners of each of the hat channels
2. 3M VHB tape was used to connect the fan wall to the cabinet walls. The tape was used on the two vertical walls and the one horizontal wall across the top.
3. The fans were connected to the hat channels with 3/8-inch diameter rivet nuts.
4. The outdoor control panel was connected with six 3/8-inch diameter rivet nuts.
5. The indoor panel was attached with 3M VHB tape on the top and bottom edges.

1.

2.

3.



4.

5.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT29, XTI-33Hx39Wx41L, (FS)

Cabinet Construction Summary

Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner

Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner

Base Rails: none

Curb Support: n/a

Dampers and Louvers: none

Doors: (1) door, galvanized, with viewport 27Hx18W

Wall Location Summary

3 walls: outlet wall removed

Lowest Natural Frequency (Hz)	F-B	S-S	V	
Cabinet	23.0	29.2	17.5	
Fan Subassembly	6.0	7.9	7.2	

Seismic Test Parameters

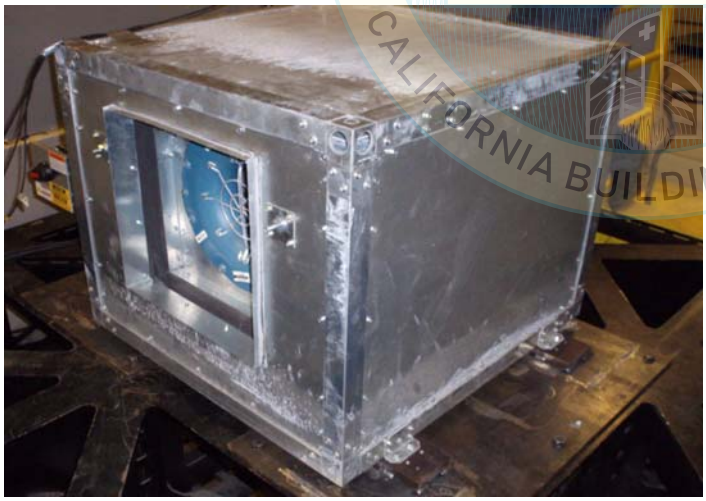
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	2.50	4.00	3.00	1.67	0.67

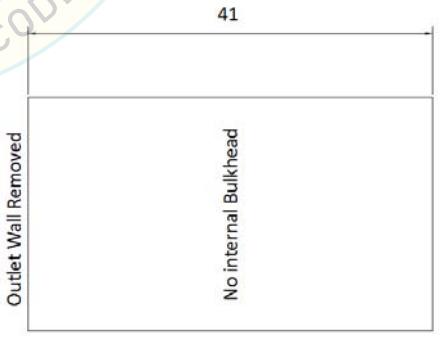
Component Summary

Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	41	39	33	502	

VFD,NF Disc,460V,5hp Grp11,Frame R1,Non-Fused Disconnect,80A, NEMA1; Twin City EPLFN 122 SWSI, Direct Drive; Teco-Westinghouse, TEFC Premium, 460-3-60, 5 HP, 3600 RPM; Shaft Grounding Ring

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.





Transverse bracing distances
(elevation view, dimensions are in inches)

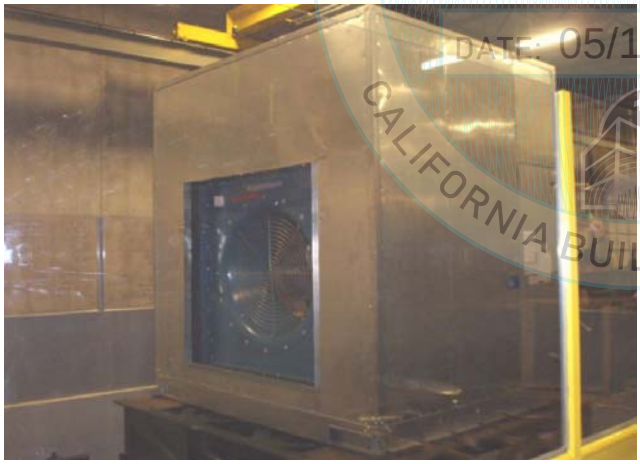
Mounting: Rigid base mount: The fan rested on four steel pads underneath each mounting bracket. UUT-29 was rigidly mounted to the pads using the (2) supplied brackets on each side of the skid, (4) total. The skid was attached to each pad using (2) grade 5, 3/8-11 UNC bolts spaced at approximately 15 inches on center. The brackets were located on opposite sides of the AHU module. The pads were welded to adaptor plates that also sat under the AHU module.

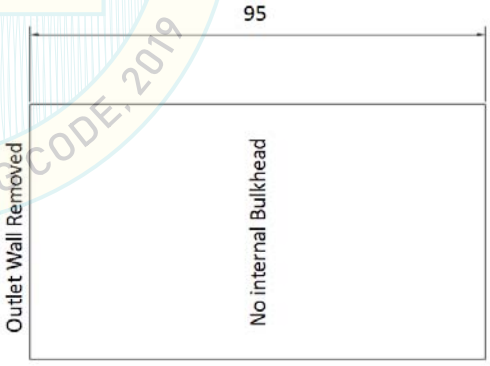
Production Level Requirement: Two grade-five jam nuts shall be installed at the top of each isolator housing.

Solution Air Handling Units
Unit Under Test (UUT) Summary

UUT30, XTO-120Hx114Wx95L, (FS)					
Cabinet Construction Summary					
Side and Top Panel Construction: 2" galvanized carbon steel foam filled panels with 20 gage outer and 20 gage liner					
Bottom Panel Construction: 2" galvanized carbon steel foam filled panels with 24 gage outer and 20 gage liner					
Base Rails: 6" galvanized, 10 gage carbon steel					
Curb Support: n/a					
Dampers and Louvers: none					
Doors: (1) door, galvanized, with viewport 78Hx24W					
Wall Location Summary					
3 walls: outlet wall removed					
Lowest Natural Frequency (Hz)	F-B	S-S	V		
Cabinet	4.4	3.1	5.0		
Fan Subassembly	4.6	3.1	5.0		
Seismic Test Parameters					
Building Code: CBC 2019	Sds (g)	AflxH (g)	ArigH (g)	AflxV (g)	ArigV (g)
Test Criteria: ICC-ES AC156, Ip = 1.5, z/h = 1.0	1.60	2.56	1.92	1.07	0.43
Component Summary					
Item	Dimensions (in)			Weight (lb)	
	Length	Width	Height		
Cabinet	95	114	120	4,400	

Note: The UUT was operational before and after shaking and was full of operating content during the tests. The structural integrity of the component attachment system and force-resisting systems was maintained.





Transverse bracing distances
(elevation view, dimensions are in inches)

Mounting: Rigid base mount: The fan rested on two flat rails of steel plate that ran the axial length of the AHU module. UUT-30 was rigidly mounted to the rails using the (7) supplied holes on each side of the skid, (14) total. The (14) bolts used were a Grade 5, 5/8-11 UNC bolt spaced at approximately 15 inches on center. The holes were located on opposite sides of the AHU module and were oriented parallel with the axis of the fan shaft. The rails were welded to adaptor plates that also ran the entire axial length of the AHU module.

Additional "Seismic Kit" Utilized for Pre-Approval:
Additional self-tapping screws were added to the front panels of the AHU. Two screws were added at the panel junctions near each corner of the fan inlet. Stiffener plates were added internally to the front panel of the AHU. A total of (4) 16 gauge mild steel plates were added, one at each junction of the AHU front panels. They were attached using (10) self-tapping screws.

UUT30 - Production Requirements

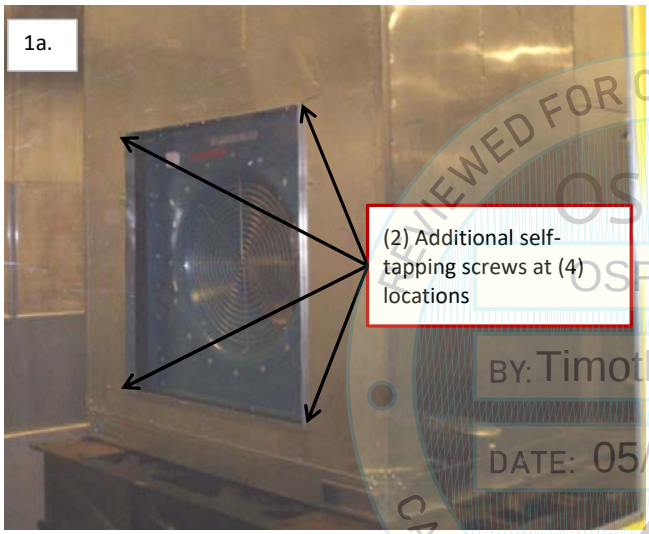
In between the resonant search testing and the seismic test, it was requested by the manufacturer to make alterations to the unit, listed in items 1 and 2 below. A third production level requirement is also listed in item 3. All three items noted below need to be incorporated as production level requirements for construction of certified units.

1. Additional self-tapping screws were added to the front panels of the AHU. Two screws were added at the panel junctions near each corner of the fan inlet. See photographs 1a and 1b below.

2. Stiffener plates were added internally to the front panel of the AHU. A total of (4) 16 gauge mild steel plates were added, one at each junction of the AHU front panels. They were attached using (10) self-tapping screws. See photograph 2 below.

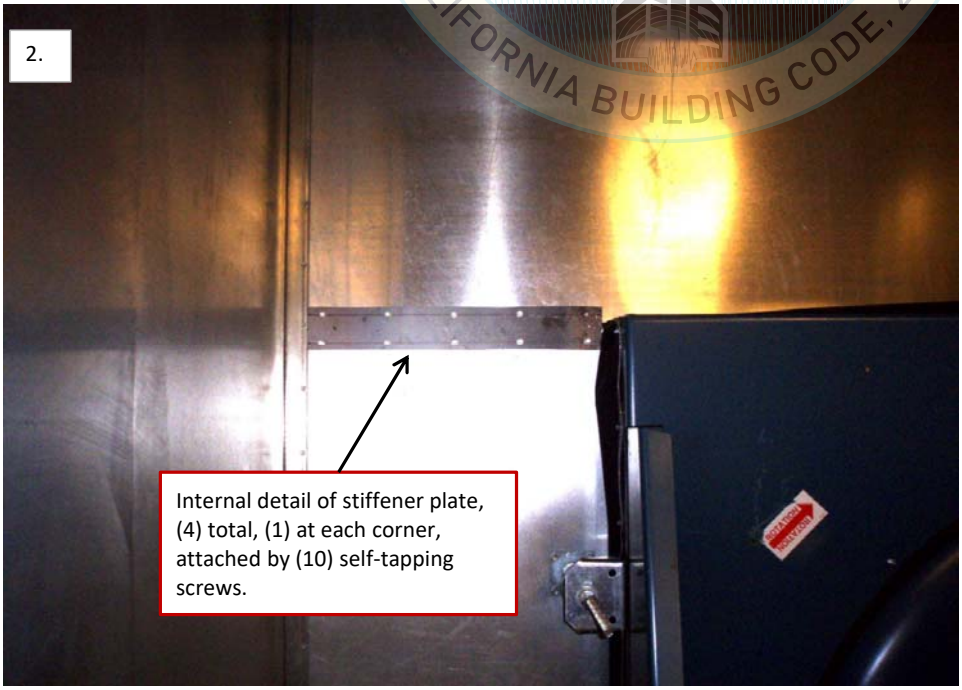
3. The shake test was performed in the original design configuration which used a single, grade-two nut on the top of each isolator mounting bracket. The assembly must now incorporate two grade-five jam nuts on the top of each isolator mounting bracket, as a production-level requirement.

1a.

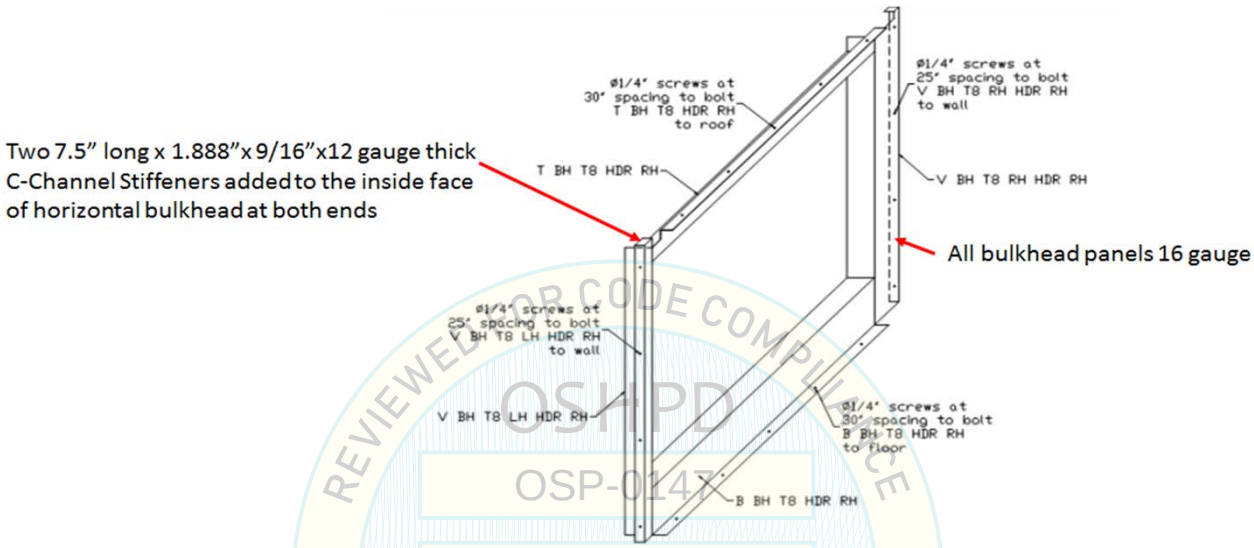


1b.

2.

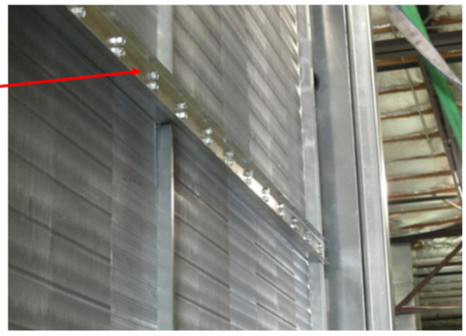


Filter Bulkhead Detail

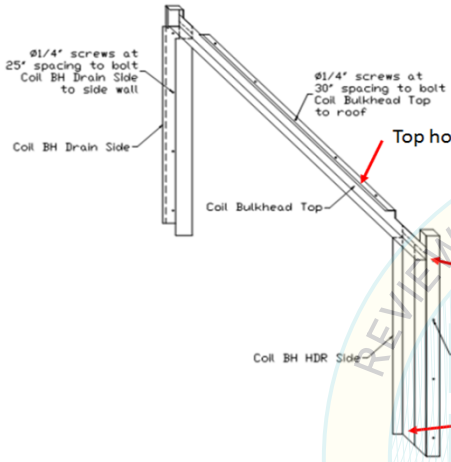


Coil Bulkhead Detail

Add 12 ga top horizontal bulkhead to downstream side of the coil



12 ga sheet metal C-Section coil support between stacked heating coils (upstream side)



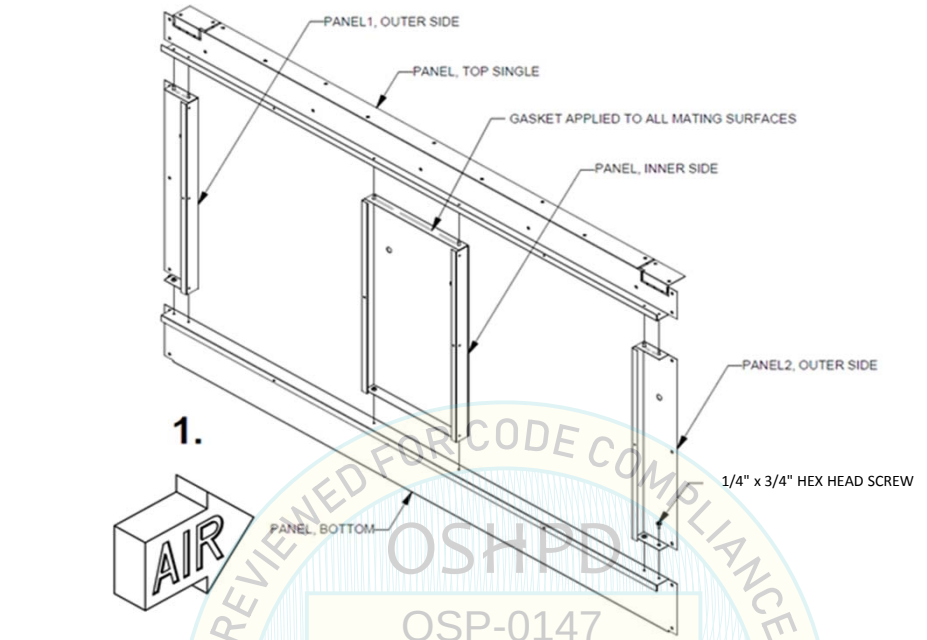
Top horizontal Coil bulkhead 10 gauge

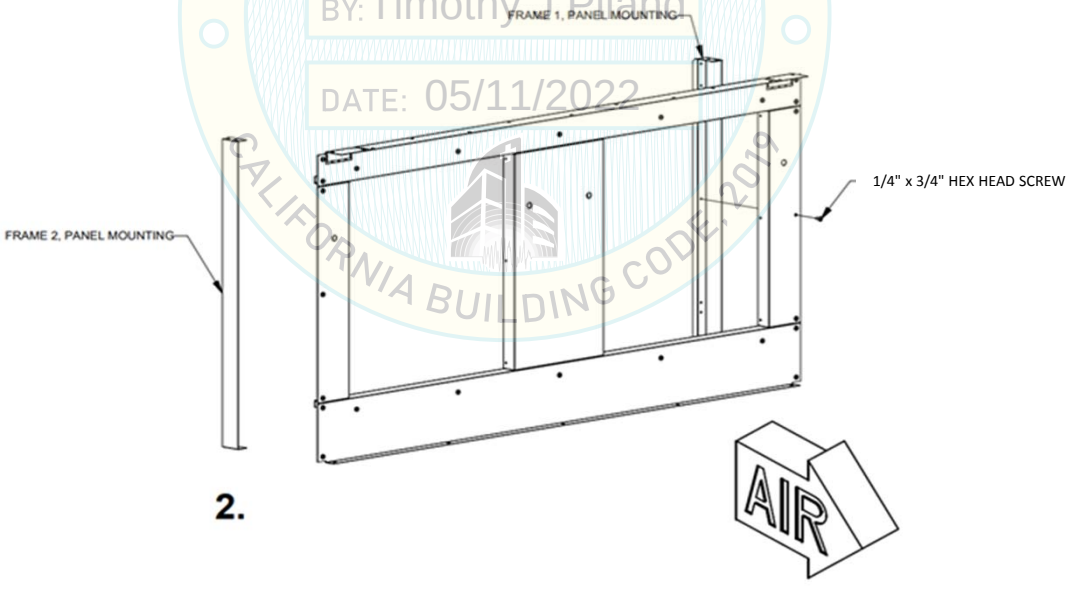
Two 7.5" long x 1.888"x 9/16"x12 gauge thick C-Channel Stiffeners added to the inside face of horizontal bulkhead at both ends

Side bulkhead 12 gauge

Coil Support Detail

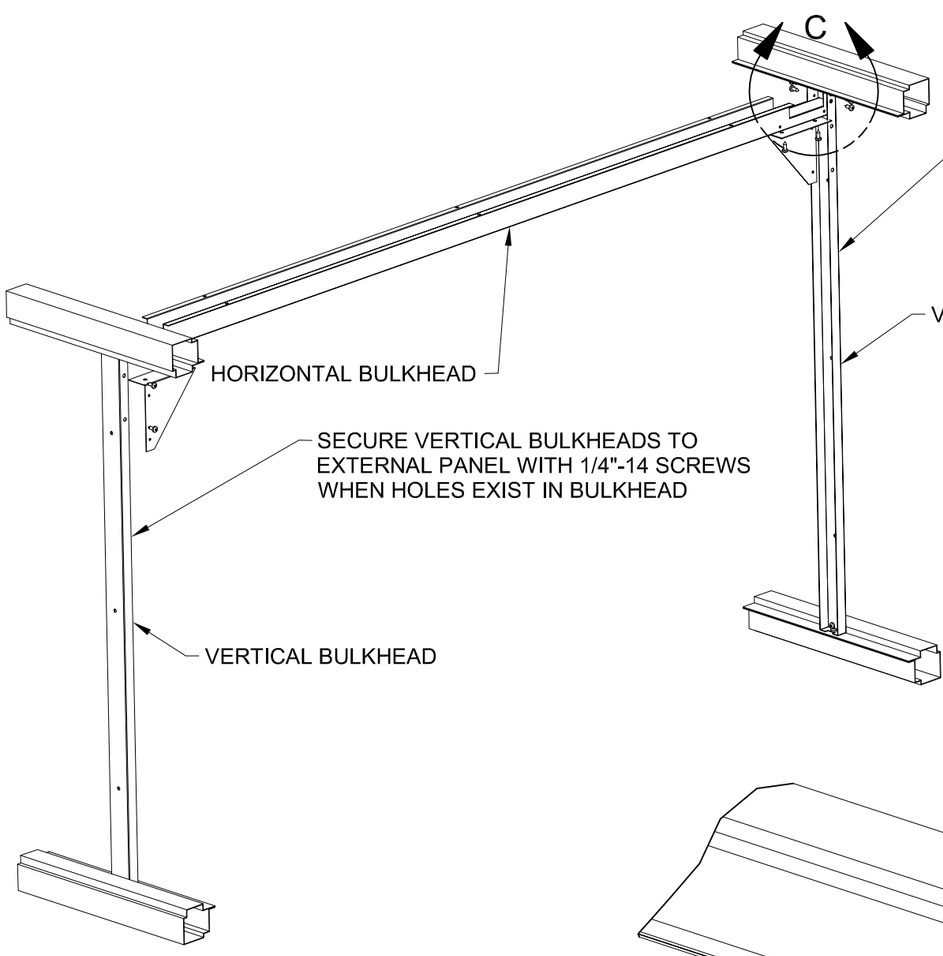
General Bulkhead Detail
(Also Applies to Damper Wall, Fan Wall, Indirect Gas and Heater Bulkheads)

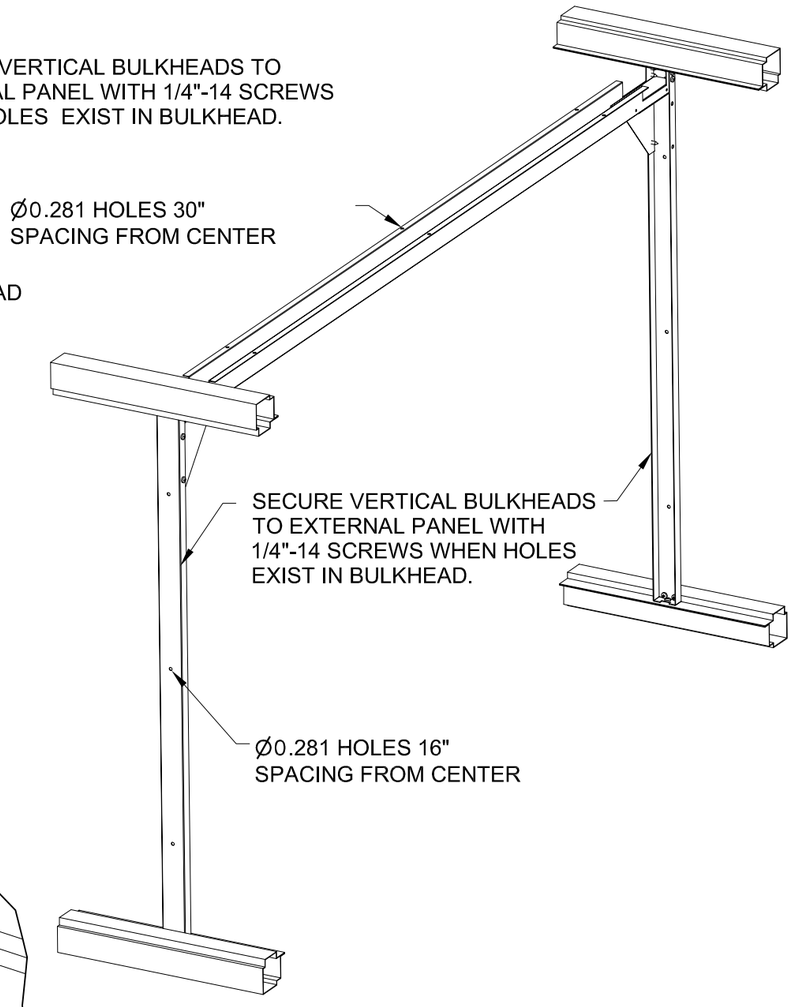


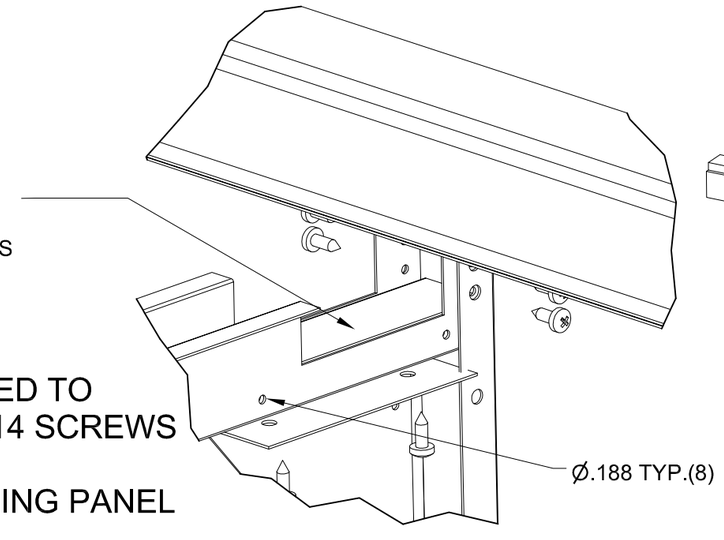


All bulkhead panels 16 gauge

Max screw spacing 16.25”







NOTES:
1.HORIZONTAL BULKHEAD SCREWED TO VERTICAL BULKHEADS WITH 1/4" -14 SCREWS

2.HORIZONTAL BULKHEAD TO CEILING PANEL WITH 1/4"-14 SCREWS.

DETAIL C

Johnson Controls

REV LEV	DATE	REVISION RECORD	DR.	CHG. NO.
-	3/04/11	NEW	AJM	11-2509

DIMENSIONS ARE IN INCHES

TOLERANCES: PER ENG. SPEC. M-282

WELDING: PER ENG. SPEC. M-30

STRUCTURAL BULKHEAD ASSEMBLY (ENHANCED SEISMIC CONSTRUCTION)

MATERIAL TYP: | THICKNESS:

MASTER MODEL:

SIZE A | DRAWING NUMBER 134-011

ASSEMBLY NOTES:

1. WELD APPLIED TO CORNERS AND SPLICE ON A SKID.

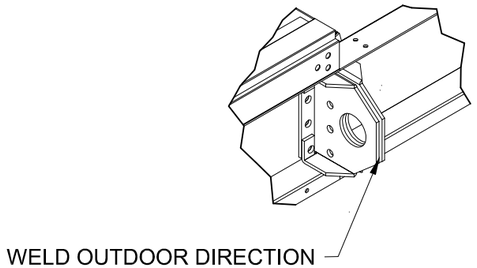
2. 1/2" HARDWARE MOUNTS TO ALL 4 CORNER CONNECTORS. SEE DETAIL A

SHIPPING SPLIT NOTES:

SPLITS >>>> SKID STARTS OR ENDS WITH BASERAIL

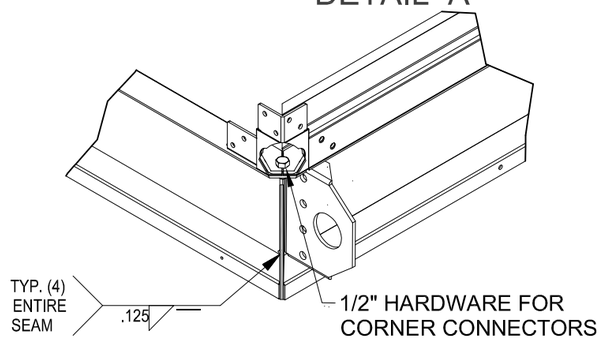
FIRST IN AIRFLOW SEGMENTS->>> SKID STARTS WITH BASERAIL

LAST IN AIRFLOW SEGMENTS ->>>> SKID ENDS WITH BASERAIL



DETAIL B

DETAIL A



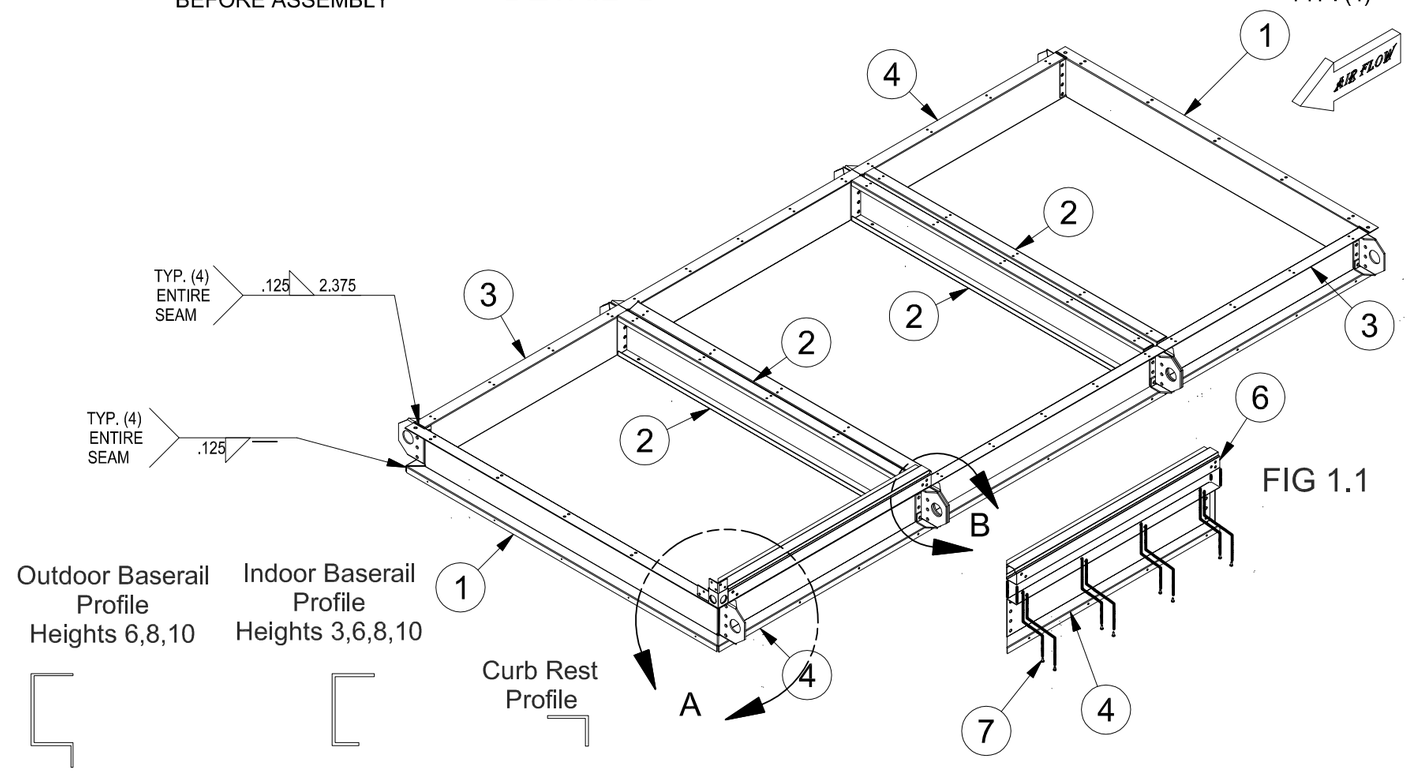


FIG 1.1

Parts List	
ITEM	DESCRIPTION
1	BASERAIL END
2	BASERAIL INTERMEDIATE
3	BASERAIL DIRECTION OF AIRFLOW
4	BASERAIL DIRECTION OF AIRFLOW
6	RACEWAY
7	SCREW, 1/4"-14
8	LIFTING LUG
12	NUT, HEX , 1/2" -13
13	SCREW, HEX, GR5, 1/2" -13
14	WASHER, LOCK, 1/2"
15	CONER CONNNECTOR

Johnson Controls

REV LEV	DATE	REVISION RECORD	DR.	CHG. NO.
-	3/04/11	NEW	AJM	11-2509

DIMENSIONS ARE IN INCHES

TOLERANCES: PER ENG. SPEC. M-282

WELDING: PER ENG. SPEC. M-30

BASERAIL ASSEMBLY (ENHANCED SEISMIC CONSRTUCTION)

MATERIAL TYP: | THICKNESS:

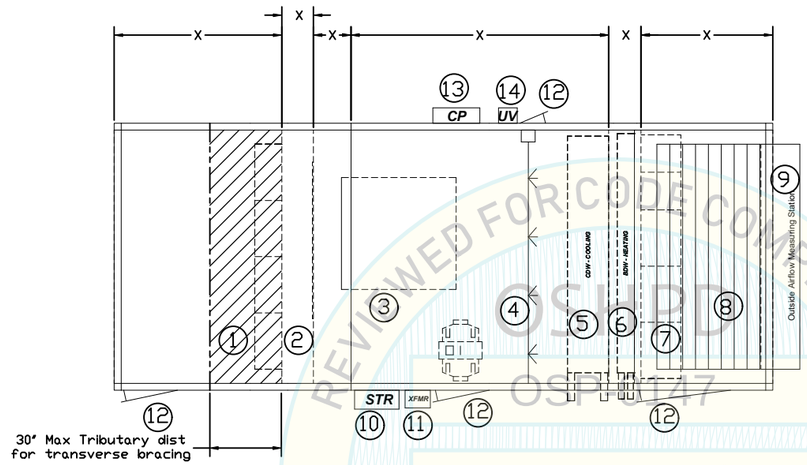
MASTER MODEL:

SIZE A | DRAWING NUMBER 134-010

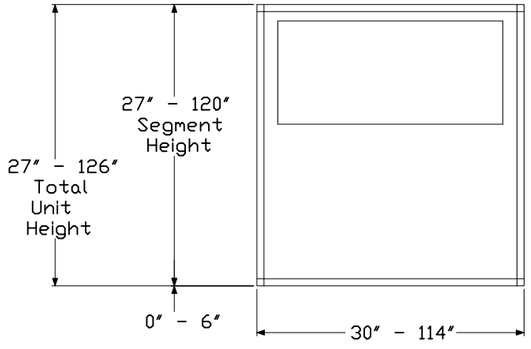
See Appendix A - Component List

1. HEPA Filter
2. Diffuser
3. Fan (DWDI Airfoil)
4. UV Light
5. Cooling Coil
6. Heating Coil
7. Angle Filter
8. Return Air Control Damper
9. Outside Air Airflow Measuring Station
10. Starter, Motor Control
11. Transformer
12. Access Door
13. FEC/NEC Control Panel
14. UV Light Control Panel
15. No Baserail

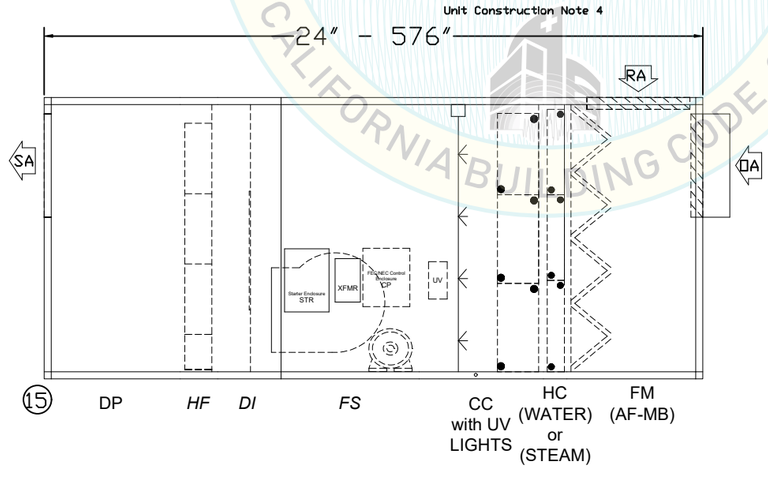
SINGLE TUNNEL UNIT



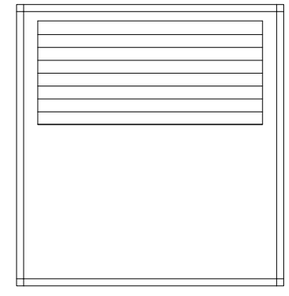
PLAN VIEW



REAR (OUTLET) END VIEW



ELEVATION VIEW



FRONT (INLET) END VIEW

Unit Construction Information:

1. Side and Top Panel Construction
Foam filled panels 2" thick.
Exterior : Galvanized Steel 20, 18, or 16 ga.
Interior: Galvanized 20, 18, or 16 ga

2. Bottom Panel Construction
Foam filled panels 2" thick.
Exterior: Galvanized Steel 24 ga.
Interior: Galvanized 20, 18, 16, or 14 ga

3. All Dimension are in inches unless otherwise specified.

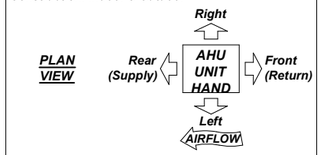
4. Unit length may vary depending on the number of segments that are required to form the Air Handling Unit. Length shown is for single piece unit.

5. Doors are provided for access to segments. Maximum door height 117".

6. . Seismic Construction Details
   a. Structural Bulkheads. See detail 134-011
   b. Transverse bracing required when 'X" dimension exceeds 60"
   c. Maximum tributary length = 30"
   d. Transverse bracing is considered any structural bulkhead and any component bulkheads including fan bulkheads, filter bulkheads, coil bulkheads,economizer bulkheads, attenuator bulkheads.

UNIT CONSTRUCTION

Model: Solution-XT
Construction: Indoor & Outdoor



NOTES

Units with a baserail and a bottom opening: Duct connection flush with the bottom of unit, not flush with bottom of baserail.

Refer to performance report for shipping split details.

Allow sufficient space around the unit for removing the access panels and various parts of the unit. A minimum clearance equal to the width of the unit must be provided on both sides of the unit for removing the coil or fan assembly.

Contractor responsible for penetrations and connections of all electrical boxes and internal coil connections.

Certain items may extend beyond cabinet dimensions including: door handles, light switches, electrical boxes, lifting lugs, etc.

Dimension tolerances: Unit (+/- 1/2"); Piping (+/- 2")

Drain pan connection size 1 1/4" MPT SCH 40

SEGMENT LIST

SEGMENT	DESCRIPTION
DP	Discharge Plenum
HF	Hepa Filter
DI	Diffuser
FS	Supply Fan
CC	Cooling Coil with UV Light Option
HC	Heating Coil
FM	Filter/Mixing Box

PRODUCT DRAWING
SOLUTION AIR HANDLING UNIT DETAIL
MODEL: Solution-XT
05/11/2022

Project Name: Typical Supply Fan with Inlet Mixing box Without Baserails

UNIT TAG: *OSHPD, Unit A* OSP-0147

Date: 3/04/2011

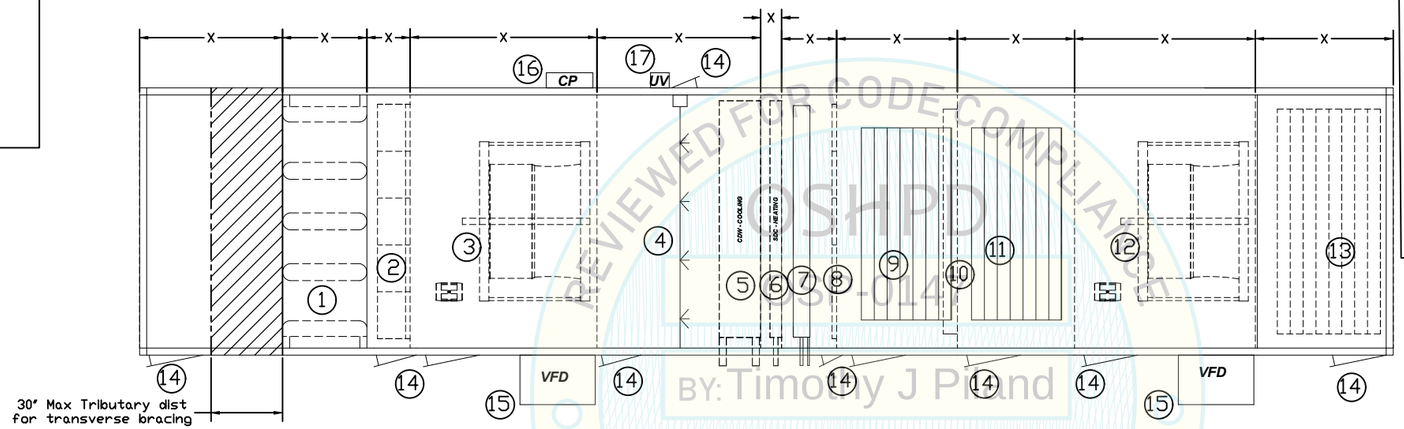
DRAWING NUMBER
134-007

Johnson Controls

See Appendix A - Component List

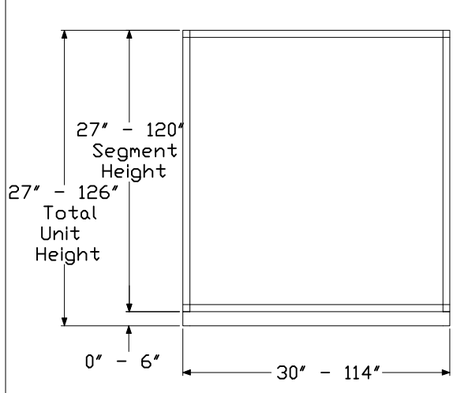
1. Attenuator
2. Rigid Filter
3. Fan (Plenum Airfoil)
4. UV Light
5. Cooling Coil
6. Heating Coil
7. Humidifier Grid
8. Flat Filter
9. Control Damper, Outside Air
10. Control Damper, Mixed Air
11. Control Damper, Exhaust Air
12. Fan (Plenum Airfoil)
13 Control Damper, Return Air
14. Access Door
15. VFD, Motor Control
16. FEC/NEC Control Panel
17. UV Light Control Panel
18. Baserail.

SINGLE TUNNEL UNIT

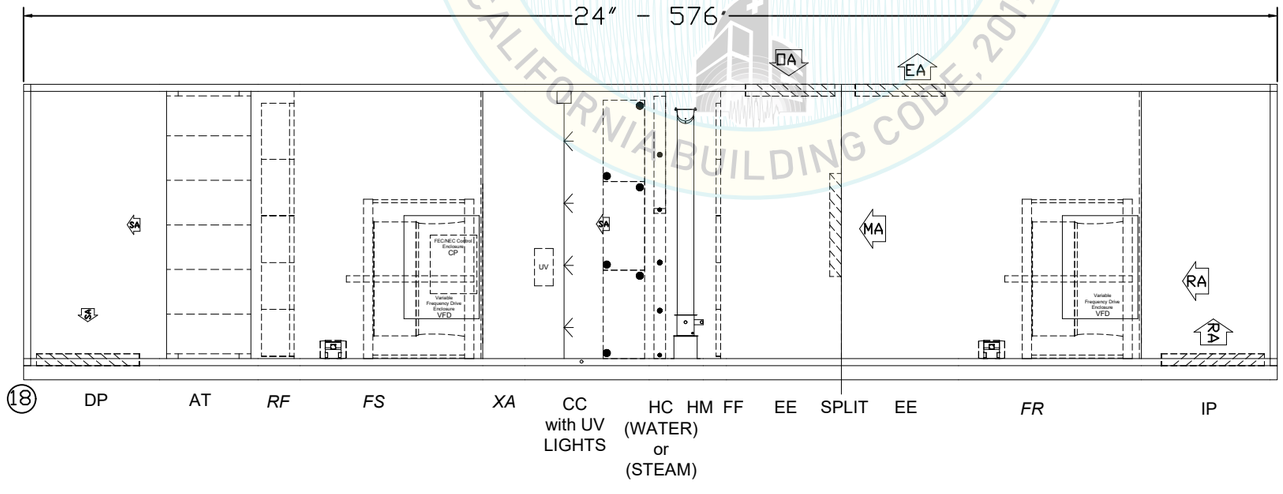


PLAN VIEW

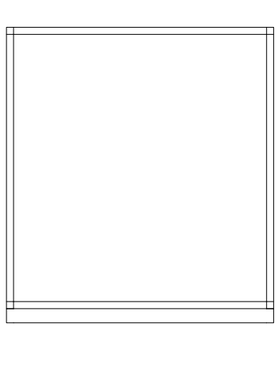
Unit Construction Note 4



REAR (OUTLET) END VIEW



ELEVATION VIEW



FRONT (INLET) END VIEW

Unit Construction Information:

1. Side and Top Panel Construction
Foam filled panels 2" thick.
Exterior : Galvanized Steel 20, 18, or 16 ga.
Interior: Galvanized 20, 18, or 16 ga

2. Bottom Panel Construction
Foam filled panels 2" thick.
Exterior: Galvanized Steel 24 ga.
Interior: Galvanized 20, 18, 16, or 14 ga

3. All Dimension are in inches unless otherwise specified.

4. Unit length may vary depending on the number of segments that are required to form the Air Handling Unit. Length shown is for single piece unit.

5. Doors are provided for access to segments. Maximum door height 117".

6. Seismic Construction Details
a. Structural Bulkheads. See detail 134-011
b. Transverse bracing required when 'X" dimension exceeds 60"
c. Maximum tributary length = 30"
d. Transverse bracing is considered any structural bulkhead and any component bulkheads including fan bulkheads, filter bulkheads, coil bulkheads,economizer bulkheads, attenuator bulkheads.

UNIT CONSTRUCTION

Model: Solution-XT
Construction: Indoor & Outdoor

PLAN VIEW — Rear (Supply) / Front (Return) / Right / Left — AHU UNIT HAND — AIRFLOW

NOTES

Units with a baserail and a bottom opening: Duct connection flush with the bottom of unit, not flush with bottom of baserail.

Refer to performance report for shipping split details.

Allow sufficient space around the unit for removing the access panels and various parts of the unit. A minimum clearance equal to the width of the unit must be provided on both sides of the unit for removing the coil or fan assembly.

Contractor responsible for penetrations and connections of all electrical boxes and internal coil connections.

Certain items may extend beyond cabinet dimensions including: door handles, light switches, electrical boxes, lifting lugs, etc.

Dimension tolerances: Unit (+/- 1/2"); Piping (+/- 2")

SEGMENT LIST

SEGMENT	DESCRIPTION
DP	Discharge Plenum
AT	Attenuator
RF	Rigid Filter
FS	Supply Fan
XA	Access Variable Length
CC	Cooling Coil with UV Light Option
HC	Heating Coil
HM	Humidifier
FF	Flat Filter
EE	Economizer
FR	Return Fan
IP	Inlet Plenum

PRODUCT DRAWING
SOLUTION AIR HANDLING UNIT DETAIL
MODEL: Solution-XT 05/11/2022

Project Name: Typical Return Fan Economizer With Baserail

UNIT TAG: OSHPD, Unit B OSP-0147

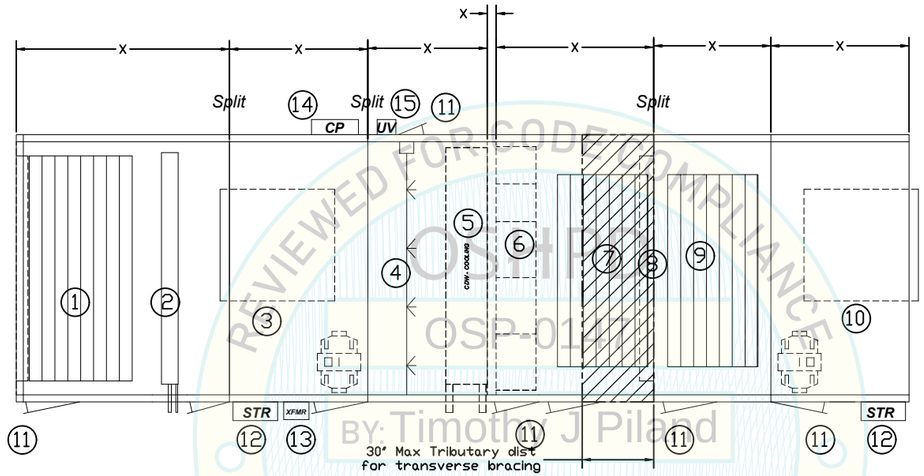
Date: 2/10/2011

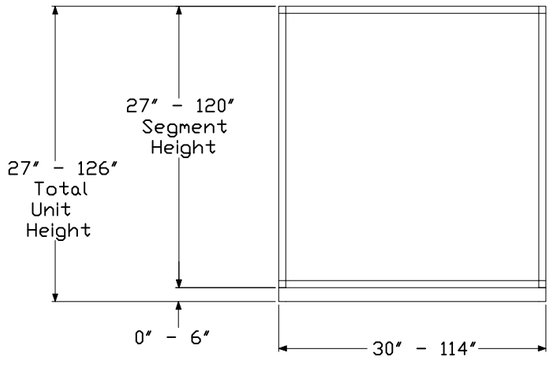
DRAWING NUMBER
134-008

See Appendix A - Component List

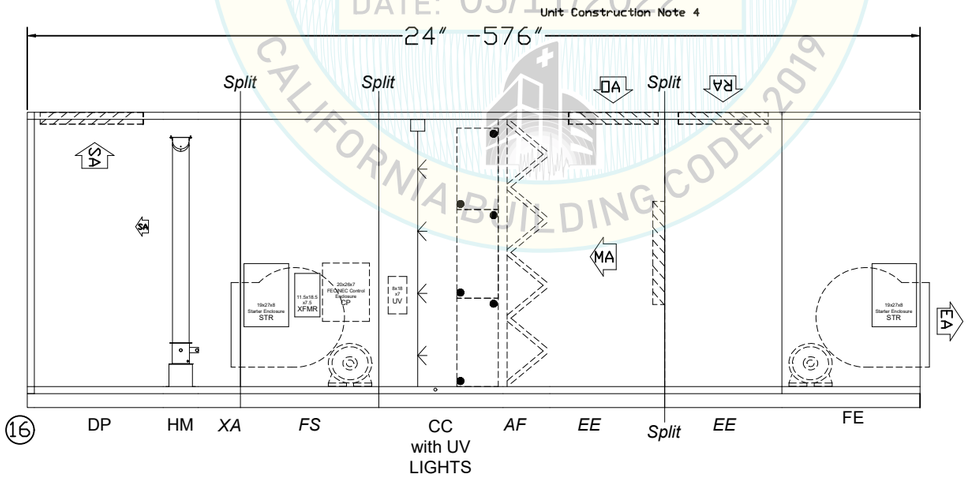
1. Control Damper, Supply Air
2. Humidifier Grid
3. Fan (DWDI Airfoil)
4. UV Light
5. Cooling Coil
6. Angle Filter
7. Control Damper, Outside Air
8. Control Damper, Mixed Air
9. Control Damper, Return Air
10. Fan (DWDI Airfoil)
11. Access Door
12. Starter, Motor Control
13.Transformer Panel
14. FEC/NEC Control Panel
15.UV Light Control Panel
16. Baserail

SINGLE TUNNEL UNIT WITH SPLITS

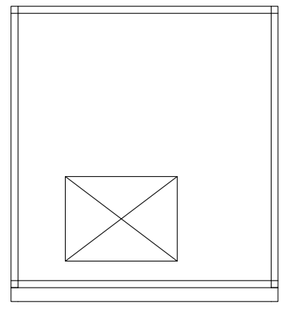




REAR (OUTLET) END VIEW



ELEVATION VIEW



FRONT (INLET) END VIEW

Unit Construction Information:

1. Side and Top Panel Construction
Foam filled panels 2" thick.
Exterior : Galvanized Steel 20, 18, or 16 ga.
Interior: Galvanized 20, 18, or 16 ga

2. Bottom Panel Construction
Foam filled panels 2" thick.
Exterior: Galvanized Steel 24 ga.
Interior: Galvanized 20, 18, 16, or 14 ga

3. All Dimension are in inches unless otherwise specified.

4. Unit length may vary depending on the number of segments that are required to form the Air Handling Unit. Length shown is for single piece unit.

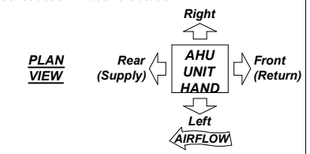
5. Doors are provided for access to segments. Maximum door height 117".

6. Seismic Construction Details
a. Structural Bulkheads. See detail 134-011
b. Transverse bracing required when 'X" dimension exceeds 60"
c. Maximum tributary length = 30"
d. Transverse bracing is considered any structural bulkhead and any component bulkheads including fan bulkheads, filter bulkheads, coil bulkheads,economizer bulkheads, attenuator bulkheads.

UNIT CONSTRUCTION

Model: Solution-XT
Construction: Indoor & Outdoor

PLAN VIEW



NOTES

Units with a baserail and a bottom opening: Duct connection flush with the bottom of unit, not flush with bottom of baserail.

Refer to performance report for shipping split details.

Allow sufficient space around the unit for removing the access panels and various parts of the unit. A minimum clearance equal to the width of the unit must be provided on both sides of the unit for removing the coil or fan assembly.

Contractor responsible for penetrations and connections of all electrical boxes and internal coil connections.

Certain items may extend beyond cabinet dimensions including: door handles, light switches, electrical boxes, lifting lugs, etc.

Dimension tolerances: Unit (+/- 1/2"); Piping (+/- 2")

SEGMENT LIST

SEGMENT	DESCRIPTION
DP	Discharge Plenum
HM	Humidifier
XA	Access Variable Length
FS	Supply Fan
CC	Cooling Coil with UV Light Option
AF	Angle Filter
EE	Economizer
FE	Exhaust Fan

PRODUCT DRAWING
SOLUTION AIR HANDLING UNIT DETAIL
MODEL: Solution-XT
05/11/2022

Project Name: Typical Exhaust Fan Economize With Baserail

UNIT TAG: OSHPD, Unit C OSP-0147

Date: 2/10/2011

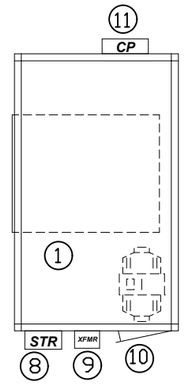
DRAWING NUMBER
134-009

Johnson Controls

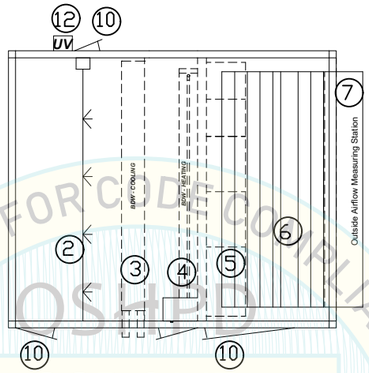
See Appendix A - Component List

1. Fan (DWDI Airfoil / FC)
2. UV Light
3. Cooling Coil
4. Electric heater
5. Angle Filter
6. Return Air Control Damper
7. Outside Air Airflow Measuring Station
8. Starter, Motor Control
9. Transformer
10. Access Door
11. FEC/NEC Control Panel
12.UV Light Control Panel
13. Baserail

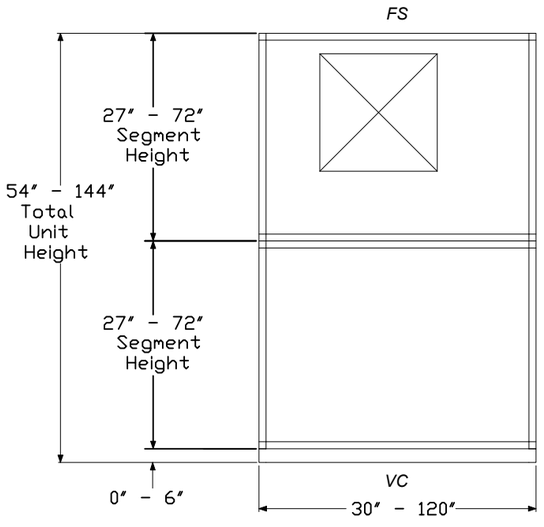
SINGLE TUNNEL STACKED SUPPLY FAN UNIT



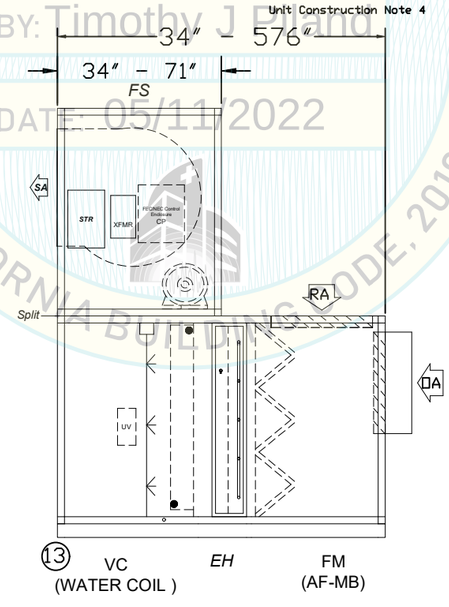
PLAN VIEW
TIER 2 - OUTLET END



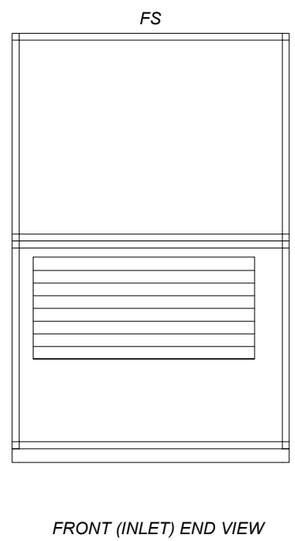
PLAN VIEW
TIER 1



REAR (OUTLET) END VIEW



ELEVATION VIEW



FRONT (INLET) END VIEW

Unit Construction Information:

1. Side and Top Panel Construction
Foam filled panels 2" thick.
Exterior : Galvanized Steel 20, 18, or 16 ga.
Interior: Galvanized 20, 18, or 16 ga

2. Bottom Panel Construction
Foam filled panels 2" thick.
Exterior: Galvanized Steel 24 ga.
Interior: Galvanized 20, 18, 16, or 14 ga

3. All Dimension are in inches unless otherwise specified.

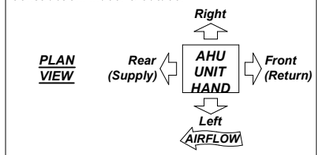
4. Unit length may vary depending on the number of segments that are required to form the Air Handling Unit. Length shown is for single piece unit.

5. Doors are provided for access to segments. Maximum door height 117".

6. Seismic Construction Details
Baserail Assembly. See detail
Structural Bulkheads. See detail
Maximum distance between bulkheads: 60"
Bulkheads include fan wall, filter rack, coil rack,economizer wall, attenuator wall, and structural bulkhead.

UNIT CONSTRUCTION

Model: Solution-XT
Construction: Indoor & Outdoor



NOTES

Units with a baserail and a bottom opening: Duct connection flush with the bottom of unit, not flush with bottom of baserail.

Refer to performance report for shipping split details.

Allow sufficient space around the unit for removing the access panels and various parts of the unit. A minimum clearance equal to the width of the unit must be provided on both sides of the unit for removing the coil or fan assembly.

Contractor responsible for penetrations and connections of all electrical boxes and internal coil connections.

Certain items may extend beyond cabinet dimensions including: door handles, light switches, electrical boxes, lifting lugs, gas fuel system, etc.

Dimension tolerances: Unit (+/- 1/2"); Piping (+/- 2")

Drain pan connection size 1 1/4" MPT SCH 40

SECTION LIST
(LENGTHS INCLUDE END CHANNELS)

SECT	DESCRIPTION
FS	Supply Fan
VC	Vertical Coil with UV Light Option
EH	Electric Heat
FM	Filter/Mixing Box

PRODUCT DRAWING
SOLUTION AIR HANDLING UNIT DETAIL
MODEL: Solution-XT
05/11/2022

Project Name: Typical Stacked Supply Fan with Vertical Coil, and Inlet Mixing Box With Baserails

UNIT TAG: *OSHPD, Unit D* OSP-0147

Date: 7/21/2011

DRAWING NUMBER
134-012

Johnson Controls