



OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT
FACILITIES DEVELOPMENT DIVISION

APPLICATION FOR OSHPD SPECIAL SEISMIC
CERTIFICATION PREAPPROVAL (OSP)

OFFICE USE ONLY

APPLICATION #: OSP – 0168 – 10

OSHPD Special Seismic Certification Preapproval (OSP)

Type: ☐ New ☒ Renewal

Manufacturer Information

Manufacturer: Trane

Manufacturer's Technical Representative: Brad Wickersham

Mailing Address: 3600 Pammel Creek Road, La Crosse WI 54601

Telephone: (608) 790-0887 Email: bwickersham@trane.com

Product Information

Product Name: EarthWise CenTraVac (CTV)

Product Type: Water Cooled Centrifugal Liquid Chiller

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

General Description: Cataloged Shell & Tube Chillers with Single Compressor.

Mounting Description: Base Mounted upon either elastomeric pads or spring vibration isolators.

Applicant Information

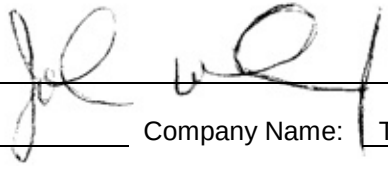
Applicant Company Name: The VMC Group

Contact Person: John Wilson

Mailing Address: 113 Main Street, Bloomingdale, NJ 07403

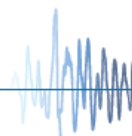
Telephone: 973-838-1780 Email: jwilson@thevmcgroup.com

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:  Date: 4-17-17

Title: CEO Company Name: The VMC Group

"Access to Safe, Quality Healthcare Environments that Meet California's Diverse and Dynamic Needs"





OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT
FACILITIES DEVELOPMENT DIVISION

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

Company Name: The VMC Group

Name: Kenneth Tarlow California License Number: SE2851

Mailing Address: 113 Main Street, Bloomingdale, NJ 07403

Telephone: 973-838-1780 Email: ken.tarlow@thvmcgroup.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

Company Name: UC Berkeley / UCSD / ETL

Contact Name: Clement Barthes

Mailing Address: Richmond CA 94804

Telephone: 510-665-3409 Email: clementbarthes@berkeley.edu

Company Name: UCSD ETL

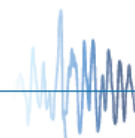
Contact Name: Gianmario Benzoni Brady Richard

Mailing Address: La Jolla CA 92093 Dallas TX 75229

Telephone: NA / 972-247-9657 Email: gbenzoni@ucsd.edu / brady@etldallas.com

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STATE OF CALIFORNIA – HEALTH AND HUMAN SERVICES AGENCY
OSH-FD-759 (REV 12/16/15)



OSHPD

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OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT FACILITIES DEVELOPMENT DIVISION

Seismic Parameters

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

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

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

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

R_p (Equipment or component response modification factor) = 2.0 Spring Isolators, 2.5 Elastomeric Pads

Ω_0 (System overstrength factor) = 2.0

I_p (Importance factor) = 1.5

z/h (Height factor ratio) = 1.0

Equipment or Component Natural Frequencies (Hz) = See Attachments

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

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

Design Basis of Equipment or Components (VW) = _____

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): _____

OSHDP Approval (For Office Use Only) – Approval Expires on December 31, 2022

Signature: _____

Date: May 2, 2017

Print Name: Timothy J. Piland

Title: SSE

Special Seismic Certification Valid Up to : S_{DS} (g) = See Above

z/h = 1

Condition of Approval (if applicable): _____

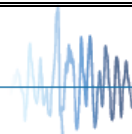


Table 1 - Product Table

Model	Compressor Configuration	Frequency Hz	Comp Size	Shell Sizes	Shell Lengths ^{1,2}	Unit Length	Unit Width	Unit Height	Max Weight (lbs)	Unit Mounting		Spring Isolated			Elastomeric Pads			UUT
										Elastomeric Pads	Spring Isolated	S _{PS}	z/h	Fp/Wp	S _{PS}	z/h	Fp/Wp	
CVHE	3-stage single	60	230-320	032	SS	11' 3"	5' 10-3/8"	7' 9-3/4"	16042	Extended Baseplate w/Pads	Extended Baseplate w/VMC Dunnage and Spring Isolators	0.92 (2B)	1.0	2.07	1.36 (3)	1.0	2.45	2B, 3
		60	230-320	050	SS	11' 3"	6' 10-1/8"	8' 2-1/4"	19360			0.92		2.07	1.16		2.09	interpolated
		60	230-320	032	SL & LL	15' 1/4"	5' 10-3/8"	7' 9-3/4"	17773			0.92		2.07	1.16		2.09	interpolated
		60	230-320	050	SL & LL	15' 1/4"	6' 10-1/8"	8' 2-1/4"	21732			0.92		2.07	1.16		2.09	interpolated
		60	360-500	050	SS	11' 3"	6' 10-1/8"	8' 2-1/4"	20897			0.92		2.07	1.16		2.09	interpolated
		60	360-500	050	SL & LL	15' 1/4"	6' 10-1/8"	8' 2-1/4"	23269			0.92		2.07	1.16		2.09	interpolated
		60	360-500	050/080	SS	11' 3"	6' 10-1/8"	8' 7-3/4"	24500			0.92		2.07	1.16		2.09	interpolated
		60	360-500	050/080	LL	15' 1/4"	6' 10-1/8"	8' 7-3/4"	28000			0.92		2.07	1.16		2.09	interpolated
		60	360-500	080	SS	11' 3"	7' 11-7/16"	9' 6-3/8"	28237			0.92		2.07	1.16		2.09	interpolated
		60	360-500	080	SL & LL	15' 1/4"	7' 11-7/16"	9' 6-3/8"	31840			0.92		2.07	1.16		2.09	interpolated
CVHL (1-Stage CVHF)	1-stage single	60	380-600	050	SS	11' 3"	5' 6"	8' 4"	19587			0.92		2.07	1.16		2.09	interpolated
		60	380-600	050	SL & LL	15' 1/4"	5' 6"	8' 4"	21814			0.92		2.07	1.16		2.09	interpolated
		60	380-600	050/080	SS	11' 3"	5' 6"	8' 2-1/4"	20477			0.92		2.07	1.16		2.09	interpolated
		60	380-600	050/080	LL	15' 1/4"	5' 6"	8' 7-3/4"	27580			0.92		2.07	1.16		2.09	interpolated
		60	380-600	080	SS	11' 3"	7' 10"	9' 6-3/8"	27223			0.92		2.07	1.16		2.09	interpolated
		60	380-600	080	SL & LL	15' 1/4"	7' 10"	9' 6-3/8"	31098			0.92		2.07	1.16		2.09	interpolated
		60	700-950	080	SS	11' 3"	7' 10"	9' 6-3/8"	29579			0.92		2.07	1.16		2.09	interpolated
		60	700-950	080	SL & LL	15' 1/4"	7' 10"	9' 6-3/8"	29355			0.92		2.07	1.16		2.09	interpolated
		60	700-950	080/142	LL	15' 1/4"	9' - 3"	9' 10"	40513			0.92		2.07	1.16		2.09	interpolated
		60	700-950	142	ML & LL	15' 1/4"	9' 9-1/8"	10' 1-1/2"	43422			0.92		2.07	1.16		2.09	interpolated
		60	820-990	080	SS	11' 3"	7' 10"	9' 6-3/8"	29579			0.92		2.07	1.16		2.09	interpolated
		60	820-990	080	SL & LL	15' 1/4"	7' 10"	9' 6-3/8"	29355			0.92		2.07	1.16		2.09	interpolated
		60	820-990	080/142	LL	15' 1/4"	9' - 3"	10' - 1-1/2"	41694			0.92		2.07	1.16		2.09	interpolated
		60	820-990	142	ML & LL	15' 1/4"	9' 9-1/8"	10' 1-1/2"	43422			0.92		2.07	1.16		2.09	interpolated
		60	1200	080/142	LL	15' 1/4"	9' - 3"	10' - 1-1/2"	41694			0.92		2.07	1.16		2.09	interpolated
		60	1200	142	ML & LL	15' 1/4"	9' 9-1/8"	10' 1-1/2"	41178			0.92		2.07	1.16		2.09	interpolated
		60	1200	142	EL	16' 10-3/4"	9' 9-1/8"	10' 1-1/2"	45186			0.92		2.07	1.16		2.09	interpolated
		60	1200	142/210	EL, ML, & LL	15' 1/4"	10' 6-7/16"	11' 5"	59492			0.92		2.07	1.16		2.09	interpolated
		60	1200	210	LL	15' 1/4"	10' 6-7/16"	11' 5"	56421			0.92		2.07	1.16		2.09	interpolated
		60	1200	250	EL	16' 10-3/4"	11' 6-7/8"	11' 7-1/4"	65158			0.92		2.07	1.16		2.09	interpolated
		60	1550-1800	142/210	EL, ML, & LL	15' 1/4"	10' 6-7/16"	11' 5"	62073			0.92		2.07	1.16		2.09	interpolated
		60	1550-1800	210	LL	15' 1/4"	10' 6-7/16"	11' 5"	56421			0.92		2.07	1.16		2.09	interpolated
		60	1550-1800	250	EL	16' 10-3/4"	11' 6-7/8"	11' 9-1/8"	68597			0.92		2.07	1.16		2.09	interpolated
CVHF	2-stage single	60	350-570	050	SS	11' 3"	6' 10-1/8"	8' 4"	20007			0.92		2.07	1.16		2.09	interpolated
		60	350-570	050	SL & LL	15' 1/4"	6' 10-1/8"	8' 4"	22234			0.92		2.07	1.16		2.09	interpolated
		60	350-570	050/080	SS	11' 3"	6' 10-1/8"	8' 7-3/4"	21150			0.92		2.07	1.16		2.09	interpolated
		60	350-570	050/080	LL	15' 1/4"	6' 10-1/8"	8' 7-3/4"	27037			0.92		2.07	1.16		2.09	interpolated
		60	350-570	080	SS	11' 3"	7' 11-7/16"	9' 6-3/8"	27958			0.92		2.07	1.16		2.09	interpolated
		60	350-570	080	SL & LL	15' 1/4"	7' 11-7/16"	9' 6-3/8"	31833			0.92		2.07	1.16		2.09	interpolated
		60	620-870	080	SS	11' 3"	7' 11-7/16"	9' 6-3/8"	30374			0.92		2.07	1.16		2.09	interpolated
		60	620-870	080	SL & LL	15' 1/4"	7' 11-7/16"	9' 6-3/8"	34249			0.92		2.07	1.16		2.09	interpolated
		60	620-870	080/142	LL	15' 1/4"	9' - 3"	9' 10"	41235			0.92		2.07	1.16		2.09	interpolated
		60	620-870	142	ML & LL	15' 1/4"	9' 9-1/8"	10' 1-1/2"	44300			0.92		2.07	1.16		2.09	interpolated
		60	650-910	080	SS	11' 3"	7' 11-7/16"	9' 6-3/8"	30374			0.92		2.07	1.16		2.09	interpolated
		60	650-910	080	SL & LL	15' 1/4"	7' 11-7/16"	9' 6-3/8"	34249			0.92		2.07	1.16		2.09	interpolated
		60	650-910	080/142	LL	15' 1/4"	9' - 3"	9' 10"	41235			0.92		2.07	1.16		2.09	interpolated
		60	650-910	142	ML & LL	15' 1/4"	9' 9-1/8"	10' 1-1/2"	44300			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	080/142	LL	15' 1/4"	9' - 3"	10' - 1-1/2"	42416			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	142	ML & LL	15' 1/4"	9' 11-1/8"	10' 1-1/2"	44787			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	142	EL	16' 10-3/4"	9' 11-1/8"	10' 1-1/2"	46064			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	142/210	EL, ML, & LL	15' 1/4"	10' 6-7/16"	11' 3-1/4"	60915			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	210	LL	15' 1/4"	10' 6-7/16"	11' 3-1/4"	54233			0.92		2.07	1.16		2.09	interpolated
		60	1070-1300	250	EL	16' 10-3/4"	11' 6-7/8"	11' 7-1/4"	65616			0.92		2.07	1.16		2.09	interpolated
		60	1470-1720	142/210	EL, ML, & LL	15' 1/4"	10' 6-7/16"	11' 3-1/4"	63496			0.92		2.07	1.16		2.09	interpolated
		60	1470-1720	210	LL	15' 1/4"	10' 6-7/16"	11' 5"	57299			0.92		2.07	1.16		2.09	interpolated
		60	1470-1720	250	EL	16' 10-3/4"	11' 6-7/8"	11' 9-1/8"	69475	Extended Baseplate w/Pads	Extended Baseplate w/VMC Dunnage and Spring Isolators	1.16 (1B)	1.0	2.61	1.16 (1A)	1.0	2.09	1A, 1B

Table 2 - Shells

	Size	Dimensions (in)			Dimensions (in)			Dimensions (in)			Materials	UUT	Manufacturer
		Evaporator			Condenser			Economizer					
		OD	L	Weight (lbs)	OD	L	Weight (lbs)	OD	L	Weight (lbs)			
Shells	032S	27.75	135	2900	19.938	135	2460	14	47.75	404	A36 steel or better	2B, 3	Trane
	032L	27.75	180	3500	19.938	180	3006	14	47.75	404	A36 steel or better	interpolated	
	050S	35	135	4900	24.938	135	3526	17.5	58.875	420	A36 steel or better	interpolated	
	050L	35	180	6000	24.938	180	4436	17.5	58.875	420	A36 steel or better	interpolated	
	080S	48.312	135	7200	30.75	135	5280	22	73.75	420	A36 steel or better	interpolated	
	080L	48.312	180	9000	30.75	180	6776	22	73.75	420	A36 steel or better	interpolated	
	142M	52.312	160	11036	n/a	n/a	n/a	25.5	139.56	878	A36 steel or better	interpolated	
	142L	52.312	180	11938	40.5	180	10995	25.5	139.56	878	A36 steel or better	interpolated	
	142E	52.312	203	12921	n/a	n/a	n/a	25.5	139.56	878	A36 steel or better	interpolated	
	210L	59.812	180	14755	45.062	180	14154	25.5	139.56	878	A36 steel or better	interpolated	
	250E	66.312	203	20068	n/a	n/a	n/a	25.5	139.56	878	A36 steel or better	1A, 1B	
	250L	n/a	n/a	n/a	49.312	180	17341	25.5	139.56	878	A36 steel or better	1A, 1B	

1. S = Short Length, M = Medium Length, L = Long Length, E = Extended Length (Longest)

2. First Letter = Evaporator Shell Length, Second Letter = Condenser Shell Length

Table 3 - Starters

Unit Mounted Starters	Type	Manufacturer	Materials	Input Voltage	Input Phase	Input Current	Output HP	Dimensions (in)				UUT
								Max L	Max W	Max H	Max Weight (lbs)	
	LV	PSI	Carbon Steel	up to 600V	3 PH	up to 1316A	N/A	13	36	48	600	2B
	MV	Eaton	Carbon Steel	600V-13800V	3 PH	up to 360A	N/A	20	38	60	557	2B, 3

Table 4 - AFD's

AFD's	Product Series / Model	Manufacturer	Materials	Input Voltage	Input Phase	Input Current	Output HP	Dimensions (in)				UUT
								Max L	Max W	Max H	Max Weight (lbs)	
	Liqui-flo2 / Frame 4	Rockwell	Carbon Steel	575	3	1530	400	20	98	70.5	2800	1A, 1B

Table 5 - Compressors

Compressors	Configuration	Frequency hz	Size	Manufacturer	Body/Impeller Materials	Dimensions (in)				UUT
						L	W	H	Weight (lbs)	
	1- stage single	60	380-600 (350-570)	Trane	Cast Iron/Aluminum	78.5	51.5	51	4628	extrapolated
	2-stage single	60	620-870	Trane	Cast Iron/Aluminum	81.5	55	55.5	5756	extrapolated
	1- stage single	60	700-950 (620-870)	Trane	Cast Iron/Aluminum	81.5	55	55.5	6045	extrapolated
	1- stage single	60	820-990 (650-910)	Trane	Cast Iron/Aluminum	81.5	55	55.5	6155	extrapolated
	2-stage single	60	350 - 570	Trane	Cast Iron/Aluminum	78.5	51.5	51	8013	extrapolated
	3-stage single	60	230 - 320	Trane	Cast Iron/Aluminum	85	49.5	48.5	8185	2B, 3
	1- stage single	60	1200 (1070-1300)	Trane	Cast Iron/Aluminum	80.5	59.5	59.5	8736	interpolated
	3-stage single	60	360 - 500	Trane	Cast Iron/Aluminum	88	52	49.5	8803	interpolated
	2-stage single	60	650 - 910	Trane	Cast Iron/Aluminum	81.5	55	55.5	9900	interpolated
	2-stage single	60	1070 - 1300	Trane	Cast Iron/Aluminum	80.5	59.5	59.5	10714	interpolated
	1- stage single	60	1550-1800 (1470-1720)	Trane	Cast Iron/Aluminum	93.5	63.5	63.5	11360	interpolated
	2-stage single	60	1470 - 1720	Trane	Cast Iron/Aluminum	93.5	63.5	63.5	13932	1A, 1B

Table 6 - Control Panels

Control Panels	Manufacturer	Materials	Dimensions (in)				UUT
			L	W	H	Weight (lbs)	
	Trane	Carbon Steel	6	30	36	131	1A, 1B, 2B, 3

Table 7 - Purge

Purge	Manufacturer	Materials	Dimensions (in)				UUT
			L	W	H	Weight (lbs)	
	Trane	Carbon Steel	27.5	21.75	25.75	140	1A, 1B, 2B, 3



UNIT UNDER TEST (UUT) Summary Sheet

UUT -1A

VMA-45074-01

Model Line	Model Number	Manufacturer
CTV	CVHF1470T	Trane

Product Construction Summary

Carbon Steel Base Frame

Options / Subcomponent Summary

Evaporator: Trane ; Condenser: Trane ; Economizer: Trane ; Compressor: Trane ; AFD: Rockwell ; Control Panel: Trane ; Purge: Trane

UUT Properties

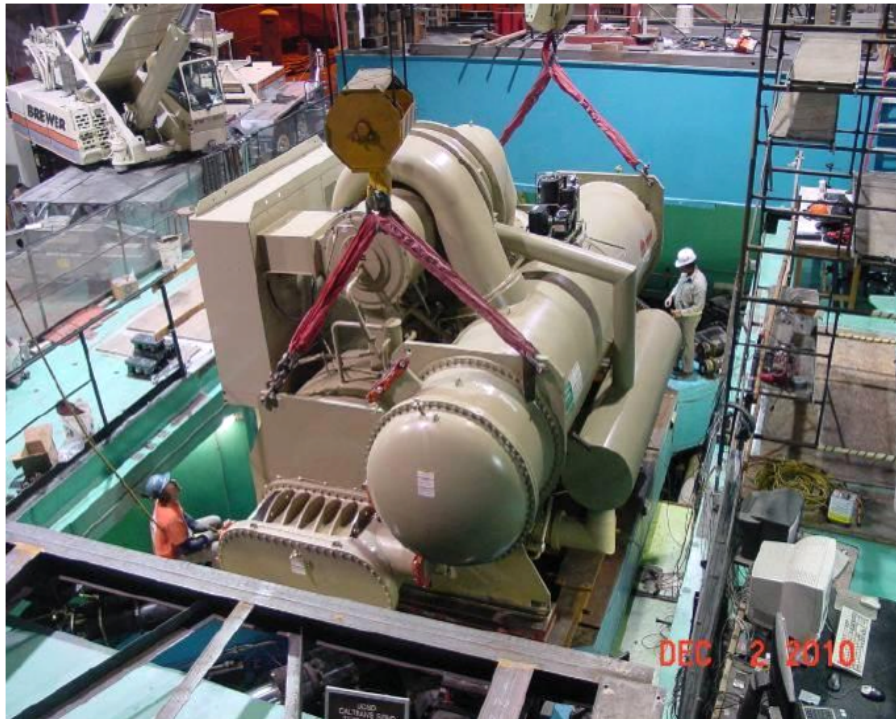
Weight [lbs]	Dimensions [in]			Lowest Nat. Freq. [Hz]		
	Length	Width	Height	F-B	S-S	V
69,234	274	158	142	11.43	8.17	20.26

UUT Highest Passed Seismic Run Information

Building Code	Test Criteria	S _{DS(g)}	z/h	I _p	A _{FLX-H(g)}	A _{RIG-H(g)}	A _{FLX-V(g)}	A _{RIG-V(g)}
CBC 2016	ICC-ES AC156	1.16	1	1.5	1.86	1.39	0.77	0.31

Test Mounting Details

UUT Bolted to VMC Shear-Flex Black 165 PSI Elastomeric Pads. VMC Black 165 PSI Shear-Flex Elastomeric Pads bolted to shake table.



All units were filled with contents and maintained structural integrity and functionality



UNIT UNDER TEST (UUT) Summary Sheet

UUT -1B

VMA-45074-01

Model Line	Model Number	Manufacturer
CTV	CVHF1470T	Trane

Product Construction Summary

Carbon Steel Base Frame

Options / Subcomponent Summary

Evaporator: Trane ; Condenser: Trane ; Economizer: Trane ; Compressor: Trane ; AFD: Rockwell ; Control Panel: Trane ; Purge: Trane

UUT Properties

Weight [lbs]	Dimensions [in]			Lowest Nat. Freq. [Hz]		
	Length	Width	Height	F-B	S-S	V
69,234	274	158	142	2.89	2.41	5.06

UUT Highest Passed Seismic Run Information

Building Code	Test Criteria	S _{DS} (g)	z/h	I _p	A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2016	ICC-ES AC156	1.16	1	1.5	1.86	1.39	0.77	0.31

Test Mounting Details

UUT Bolted to Dunnage. Dunnage bolted to (10) VMC M6SH-1E Spring Vibration Isolators. VMC M6SH-1E Spring Vibration Isolators bolted to shake table.



All units were filled with contents and maintained structural integrity and functionality



UNIT UNDER TEST (UUT) Summary Sheet

UUT -2B

VMA-45074-01

Model Line	Model Number	Manufacturer
CTV	CVHE320T	Trane

Product Construction Summary

Carbon Steel Base Frame

Options / Subcomponent Summary

Evaporator: Trane ; Condenser: Trane ; Economizer: Trane ; Compressor: Trane ; Starter: PSI ; Starter: Eaton ; Control Panel: Trane ; Purge: Trane

UUT Properties

Weight [lbs]	Dimensions [in]			Lowest Nat. Freq. [Hz]		
	Length	Width	Height	F-B	S-S	V
14,371	154	93	94	2.28	1.34	3.97

UUT Highest Passed Seismic Run Information

Building Code	Test Criteria	S _{DS} (g)	z/h	I _p	A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2016	ICC-ES AC156	0.92	1	1.5	1.47	1.1	0.62	0.25

Test Mounting Details

UUT Bolted to Dunnage. Dunnage bolted to (4) VMC M2SSH-1E Spring Vibration Isolators. VMC M2SSH-1E Spring Vibration Isolators bolted to shake table.



All units were filled with contents and maintained structural integrity and functionality



UNIT UNDER TEST (UUT) Summary Sheet

UUT -3

VMA-45074-01

Model Line	Model Number	Manufacturer
CTV	CVHE320T	Trane

Product Construction Summary

Carbon Steel Base Frame

Options / Subcomponent Summary

Evaporator: Trane ; Condenser: Trane ; Economizer: Trane ; Compressor: Trane ; Starter: PSI ; Starter: Eaton
Control Panel: Trane ; Purge: Trane

Notes on test: UUT3 is the same unit as UUT2, retested at a second lab to meet the vertical spectrum.

UUT Properties

Weight [lbs]	Dimensions [in]			Lowest Nat. Freq. [Hz]		
	Length	Width	Height	F-B	S-S	V
14,371	154	93	94	8.59	5.37	8.59

UUT Highest Passed Seismic Run Information

Building Code	Test Criteria	S _{DS} (g)	z/h	I _p	A _{FLX-H} (g)	A _{RIG-H} (g)	A _{FLX-V} (g)	A _{RIG-V} (g)
CBC 2016	ICC-ES AC156	1.35	1	1.5	2.16	1.62	0.9	0.36

Test Mounting Details

UUT Bolted to VMC Shear-Flex Black 165 PSI Elastomeric Pads. VMC Black 165 PSI Shear-Flex Elastomeric Pads bolted to shake table. (16) 3/4" dia SAE Grade 8 bolts.



All units were filled with contents and maintained structural integrity and functionality