APPLICATION FOR OSHPD SPECIAL SEISMIC CERTIFICATION PREAPPROVAL (OSP)

OFFICE USE ONLY	
APPLICATION #:	OSP – 0414 – 10

OSHPD Special Seismic Certification Preapproval (OSP)

Type: ☒ New ☐ Renewal

Manufacturer Information

Manufacturer: Krueger HVAC (Air System Components)

Manufacturer's Technical Representative: Justin Anderson

Mailing Address: 1401 North Plano Road, Richardson TX 75081

Telephone: 972-497-0416 Email: janderson@krueger-hvac.com

Product Information

Product Name: Single Duct

Product Type: Air Terminal Units

Product Model Number: Single Duct (LMHS)
(List all unique product identification numbers and/or part numbers)

General Description: Suspended cataloged terminal units. Seismic enhancements made to the test units and modifications required to address anomalies observed during the tests shall be incorporated into the production units.

Mounting Description: Rigidly suspended units & vibration isolated suspended units, restrained with seismic cable kits.

Applicant Information

Applicant Company Name: The VMC Group

Contact Person: John Giuliano

Mailing Address: 113 Main Street, Bloomingdale, NJ 07403

Telephone: 973-838-1780 Email: john.giuliano@thevmcgroup.com

I hereby agree to reimburse the Office of Statewide Health Planning and Development review fees in accordance with the California Administrative Code, 2013.

Signature of Applicant: Joel P Giuliano Date: 10/17/14

Title: President Company Name: The VMC Group

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@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

Company Name: UC Berkeley

Contact Name: Wesley Neighbour

Mailing Address: 1301 South 46th Street, Building 420, Richmond, CA 94804

Telephone: 510-665-3409 Email: wdn@berkeley.com

Testing Laboratory

Company Name: _____

Contact Name: _____

Mailing Address: _____

Telephone: _____ Email: _____

Seismic Parameters

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

Design Basis of Equipment or Components (F_p/W_p) = 3.60

S_{DS} (Design spectral response acceleration at short period, g) = 2.00

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

R_p (Equipment or component response modification factor) = 2.5

Ω_0 (System overstrength factor) = 2.5

I_p (Importance factor) = 1.5

z/h (Height factor ratio) = 1.0

Equipment or Component Natural Frequencies (Hz) = See Attached Matrix

Overall dimensions and weight (or range thereof) = See Attached Matrix

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, 2010: ☐ 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 December 31, 2019

Signature: Date: August 14, 2015

Print Name: Timothy J. Piland Title: SSE

Special Seismic Certification Valid Up to : S_{DS} (g) = 2.00 z/h = 1

Condition of Approval (if applicable):

Krueger Air Terminal Units
Certified Product Table

Table 1 - Certified Cabinet Sizes

								Mounting Configuration				
Product Family	**Model**	**Manufacturer**	**Inlet Size (in)**	**Height (in)**	**Width (in)**	**Max Length (in)**	**Max Weight (lbs)**	**Suspended w/ Isolators**	**Suspended Rigidly**	**SDS**	**z/h**	**UUT**
Single Duct	LMHS (Clone of Titus ESV)	Krueger	4	8	15.5	39.5	68	X	X	2.00	1.00	extrapolated
			5	8	15.5	39.5	68	X	X	2.00	1.00	extrapolated
			6	8	15.5	39.5	68	X	X	2.00	1.00	extrapolated
			7	10	15.5	39.5	70	X	X	2.00	1.00	extrapolated
			8	10	15.5	39.5	70	X	X	2.00	1.00	6
			9	12.5	15.5	39.5	80	X	X	2.00	1.00	interpolated
			10	12.5	15.5	39.5	80	X	X	2.00	1.00	interpolated
			12	15	16	39.5	90	X	X	2.00	1.00	interpolated
			14	17.5	20	39.5	110	X	X	2.00	1.00	interpolated
			16	18	24	39.5	130	X	X	2.00	1.00	interpolated
			24x16	18	38	39.5	245	X	X	2.00	1.00	7

UUT's labeled 'A' and 'B' are for isolated and non-isolated tests.

Krueger Air Terminal Units
Certified Product Subcomponent Tables

Table 2 - Certified External Sheeting

EXTERIOR Wall/Roof/Floor Panel Material	Thickness	Manufacturer	UUT
Galvanized Carbon Steel	20 ga	Krueger	1,2,3,4,5,6,7

Table 3 - Certified Liners

Material	Manufacturer	UUT
No Liner	n/a	extrapolated
Standard 1/2"	Johns-Manville	1, 6
1"	Johns-Manville	2
Sterliner	Johns-Manville	3
SterilWall	Johns-Manville	7
Cellular	Johns-Manville	interpolated

Table 4a - Certified Hydronic Coils

	Height (in)	Width (in)	MFR	Model Number	UUT
Dimensions	10"	12"	Great American Coil	W4-1087	6
	10"	18-1/2"		interpolated	interpolated
	12 1/2"	20-1/2"		W4-7165	2
	12 1/2"	20-1/2"		interpolated	interpolated
	17-1/2"	25"		W4-1372	4
	17-1/2"	25"		interpolated	interpolated
	18"	38"		W4-1080	7

Table 4b - Certified Hydronic Coil Options

		UUT
Casing Material	Galvanized Carbon Steel	2,4,6,7
Tube Material	Copper	2,4,6,7
Tube Outer Diameter	0.5"	2,4,6,7
Tube Wall Thickness	0.032"	2,4,6,7
Fin Material	Aluminum	2,4,6,7
Fin Thickness	0.0045"	2,4,6,7
Fin Pitch	10	2,4,6,7
	12	extrapolated
Pipe Qty	2	2,4,6,7
Tube Rows	1	2, 6
	2	4, 7
	3	extrapolated
	4	extrapolated
Header Material	Copper	2,4,6,7

Krueger Air Terminal Units
Certified Product Subcomponent Tables

Table 5 - Certified Electric Heat

Code	Model Availability	Electric Coil				MFR	UUT
		Voltage	Phase	Stage	kW Range		
E11	LMHS	120	1	1	0.5 - 13.0	Krueger	Extrapolated
E12	LMHS	120	1	2	0.5 - 13.0	Krueger	Extrapolated
E13	LMHS	120	1	3	0.5 - 13.0	Krueger	Extrapolated
E21	LMHS	208	1	1	0.5 - 13.0	Krueger	Extrapolated
E22	LMHS	208	1	2	0.5 - 13.0	Krueger	Extrapolated
E23	LMHS (Clone of Titus TFS)	208	1	3	0.5 - 13.0	Krueger	1
E31	LMHS (Clone of Titus ESV)	240	1	1	0.5 - 13.0	Krueger	6
E32	LMHS	240	1	2	0.5 - 13.0	Krueger	Interpolated
E33	LMHS	240	1	3	0.5 - 13.0	Krueger	Interpolated
E41	LMHS (Clone of Titus TFS)	277	1	1	0.5 - 13.0	Krueger	5
E42	LMHS	277	1	2	0.5 - 13.0	Krueger	Interpolated
E43	LMHS (Clone of Titus TFS)	277	1	3	0.5 - 13.0	Krueger	3
E61	LMHS	208	3	1	0.5 - 18.0	Krueger	Interpolated
E62	LMHS	208	3	2	0.5 - 18.0	Krueger	Interpolated
E63	LMHS	208	3	3	0.5 - 18.0	Krueger	Interpolated
E71	LMHS	240	3	1	0.5 - 18.0	Krueger	Interpolated
E72	LMHS	240	3	2	0.5 - 18.0	Krueger	Interpolated
E73	LMHS	240	3	3	0.5 - 18.0	Krueger	Interpolated
E91	LMHS	480	3	1	0.5 - 36.0	Krueger	Interpolated
E92	LMHS	480	3	2	0.5 - 36.0	Krueger	Interpolated
E93	LMHS (Clone of Titus ESV)	480	3	3	0.5 - 36.0	Krueger	7

Notes

1) All heaters are sized in increments of 0.5 kW
2) SCR heat option also certified
2) UUT-01 was 4 kW
3) UUT-03 was 4 kW
4) UUT-05 was 11 kW SCR
5) UUT-06 was 7 kW
6) UUT-07 was 35 kW

Krueger Air Terminal Units
Certified Product Subcomponent Tables

Table 6 - Certified Controls

Type	Model Number	Height [in]	Width [in]	Depth [in]	Voltage	MFR	UUT
Pneumatic (actuator)	MCP-8031	4.25 dia	4.25 dia	5.5	N/A	Krueger	3, 6
Pneumatic (controller)	CSC-3004	3.5 dia	3.5 dia	4	N/A	Krueger	3
Pneumatic (controller)	CSC-3017	3.5	4.25	2	N/A	Krueger	6
Digital (controller / actuator)	BAC-8005-03	6.5	4.25	2.25	24	Krueger	1,2,4,5,7

Table 7 - Certified Disconnect

Type	Model Number	Height [in]	Width [in]	Depth [in]	Amperes	Voltage	MFR	UUT
Non-fusable, 3 poles	ABBOTPN63EP	2.89	2.07	3.25	30 - 60	600	ABB	1, 2, 3, 4, 5

Table 8 - Certified Fusing

Type	Height [in]	Width [in]	Depth [in]	Amperes	Voltage	MFR	UUT
KLK, Fast Acting, Line Fuse	0.41	0.41	1.5	8	600	Little fuse	1
KLK, Fast Acting, Line Fuse	0.41	0.41	1.5	16	600	Little fuse	2
KLK, Fast Acting, Line Fuse	0.41	0.41	1.5	24	600	Little fuse	3
KLK, Fast Acting, Line Fuse	0.41	0.41	1.5	32	600	Little fuse	4
KLK, Fast Acting, Line Fuse	0.41	0.41	1.5	40	600	Little fuse	5

Table 9 - Certified Contactors

Type	Model Number	Height [in]	Width [in]	Depth [in]	HP	Voltage	MFR	UUT
Magnetic	3100-20Q334	2.44	1.63	3.25	11/16	277/480V	Hartland Cntrls	1
Magnetic	3100-20T334	2.44	1.63	3.25	11	120V	Hartland Cntrls	2,4,5
Magnetic	3100-20U334	2.44	1.63	3.25	11/16	277/480V	Hartland Cntrls	3

Table 10 - Certified Transformers

Type	Model Number	Height [in]	Width [in]	Depth [in]	VA	Voltage	MFR	UUT
AirCore Class 2	HCT-01D0BB06132	3.125	2.125	3.5	.07 or 50VA	120/24V	Hartland Cntrls	extrapolated
AirCore Class 2	HCT-03D0BB06132	3.125	2.125	3.5	.07 or 50VA	277/24V	Hartland Cntrls	3,5
AirCore Class 2	HCT-04D0BB06132	3.125	2.125	3.5	.07 or 50VA	480/24V	Hartland Cntrls	7
AirCore Class 2	HCT-09D0BB06132	3.125	2.125	3.5	.07 or 50VA	208/240/24V	Hartland Cntrls	1,6
AirCore Class 2	HCT-60D0BB06132	3.125	2.125	3.5	.07 or 50VA	24V/24V	Hartland Cntrls	1,6
AirCore Class 2	HCT-01J2BB07132	3.125	2.125	3.5	75VA	120/24V	Hartland Cntrls	1,6
AirCore Class 2	HCT-03J2BB07132	3.125	2.125	3.5	75VA	277/24V	Hartland Cntrls	1,6
AirCore Class 2	HCT-04J2BB07132	3.125	2.125	3.5	75VA	480/24V	Hartland Cntrls	1,6
AirCore Class 2	HCT-09J2BB07132	3.125	2.125	3.5	75VA	208/240/24V	Hartland Cntrls	1,6

Krueger Air Terminal Units
Certified Product Subcomponent Tables

Table 11 - Certified Relays

Type	Height [in]	Width [in]	Depth [in]	HP	Voltage	MFR	UUT
SPST	2.37	2.1	2.1	0.75	277V	Hartland Cntrls	1, 2, 3, 4, 5

Table 12 - Certified Airflow Switches

Type	Height [in]	Width [in]	Depth [in]	HP	Voltage	MFR	UUT
ElectroPneumatic	2.94	3.25	6.12	5.6	277V	Cleveland Controls	1,2,3,4,5,6,7

Table 13 - Certified Dampers

Unit Size	Height	Width	Qty	MFG	UUT
6	5.875 dia	5.875 dia	1	Krueger	1
10	9.875	9.875	1		interpolated
12	11.875 dia	11.875 dia	1		3
14	13.875	13.875	1		interpolated
16	15.875 dia	15.875 dia	1		5
8	7.875 dia	7.875 dia	1		6
24 X 16 (40)	16	24	1	Ruskin	7

Damper Material		UUT
Frame	Blades	
N/A	Galvanized Carbon Steel	1,2,3,4,5,6
Aluminum	Aluminum	7

Actuator MFR	UUT
ref table 9	1,2,3,4,5,6,7

UUT #1a

Manufacturer: Krueger

Model Series: TFS-A Unit A Size 6"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

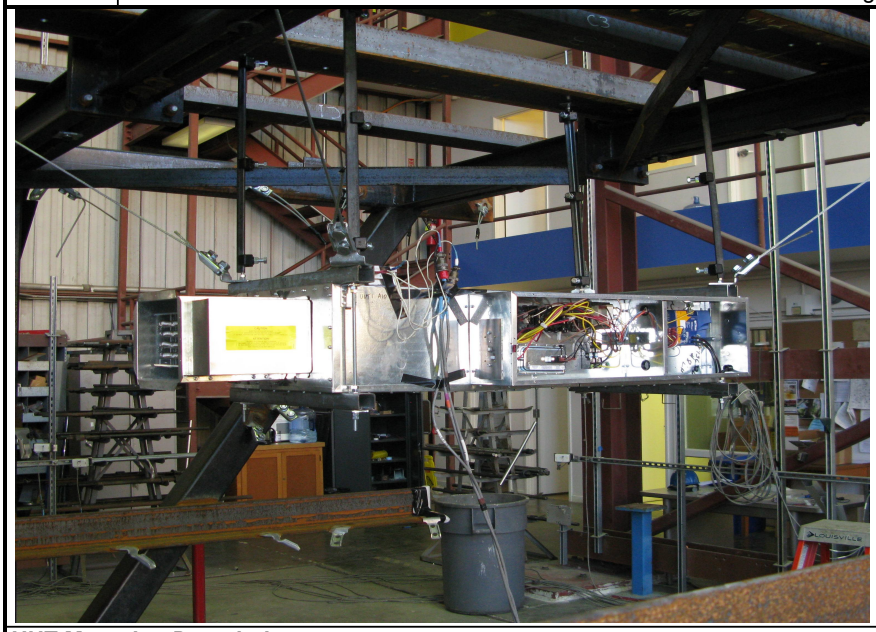
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Standard 1/2" Liner)	48"	21"	10.5"	100 lbs	na	na	na
Electric Heat (4kw, 3 stage)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (5.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-50 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #1b

Manufacturer: Krueger

Model Series: TFS-A Unit A Size 6"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

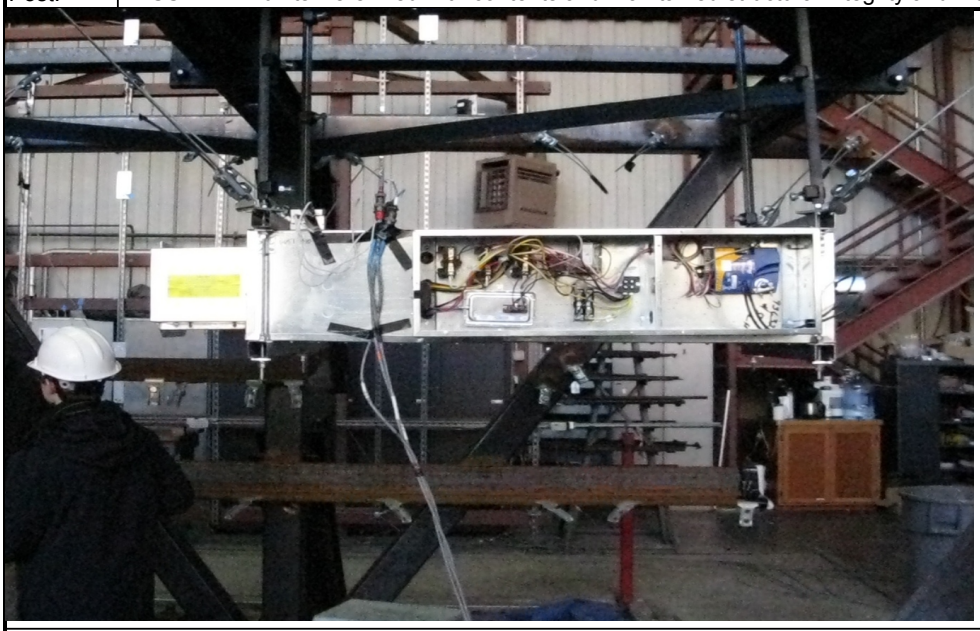
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Standard 1/2" Liner)	48"	21"	10.5"	100 lbs	na	na	na
Electric Heat (4kw, 3 stage)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (5.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #2a

Manufacturer: Krueger

Model Series: TFS Unit B Size 6"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

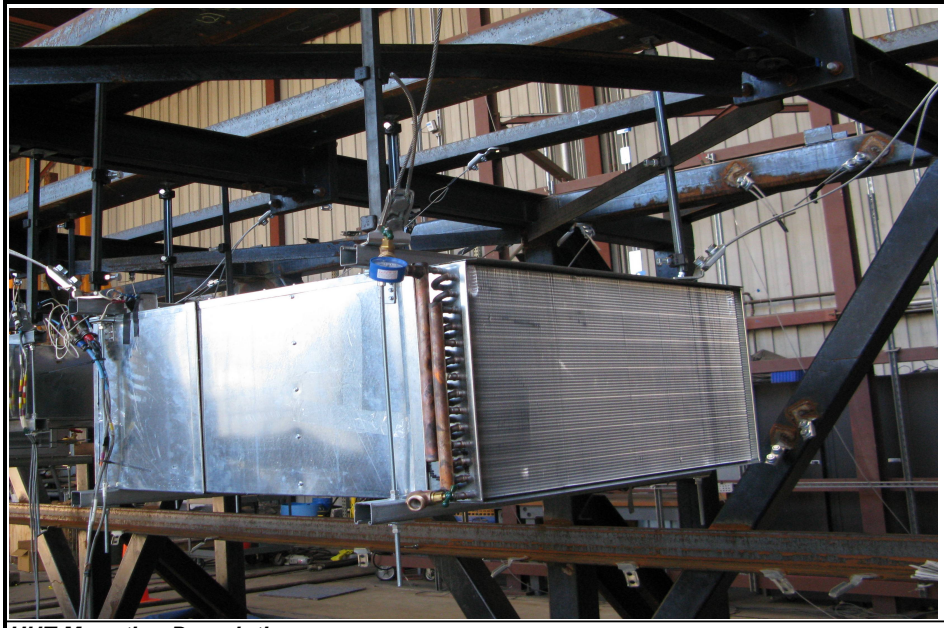
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (1" Liner)	43"	37"	16"	215 lbs	na	na	na
Coil (Hydronic)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (5.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-50 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #2b

Manufacturer: Krueger

Model Series: TFS Unit B Size 6"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (1" Liner)	43"	37"	16"	215 lbs	na	na	na
Coil (Hydronic)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (5.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.

UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #3a

Manufacturer: Krueger

Model Series: TFS Unit B Size 12"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Steriliner Liner)	43"	37"	16"	200 lbs	na	na	na
Electric Heat (4kw, 3 stage)							
Control (Pneumatic)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.

UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-70 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #3b

Manufacturer: Krueger

Model Series: TFS Unit B Size 12"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

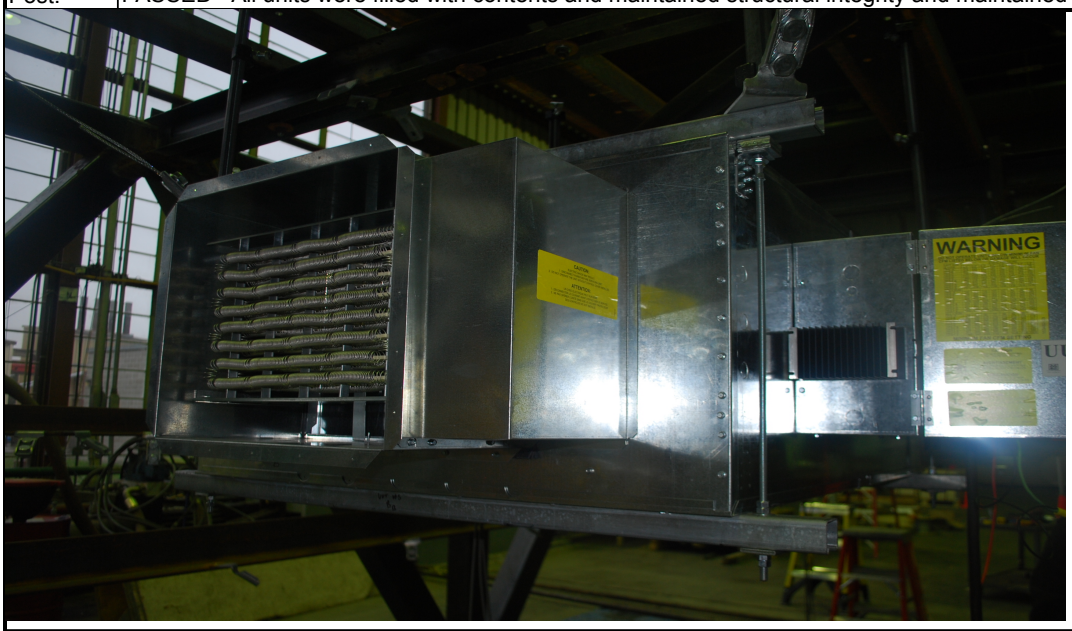
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Steriliner Liner)	43"	37"	16"	200 lbs	na	na	na
Electric Heat (4kw, 3 stage)							
Control (Pneumatic)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #4a

Manufacturer: Krueger

Model Series: TFS Unit E Size 12"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

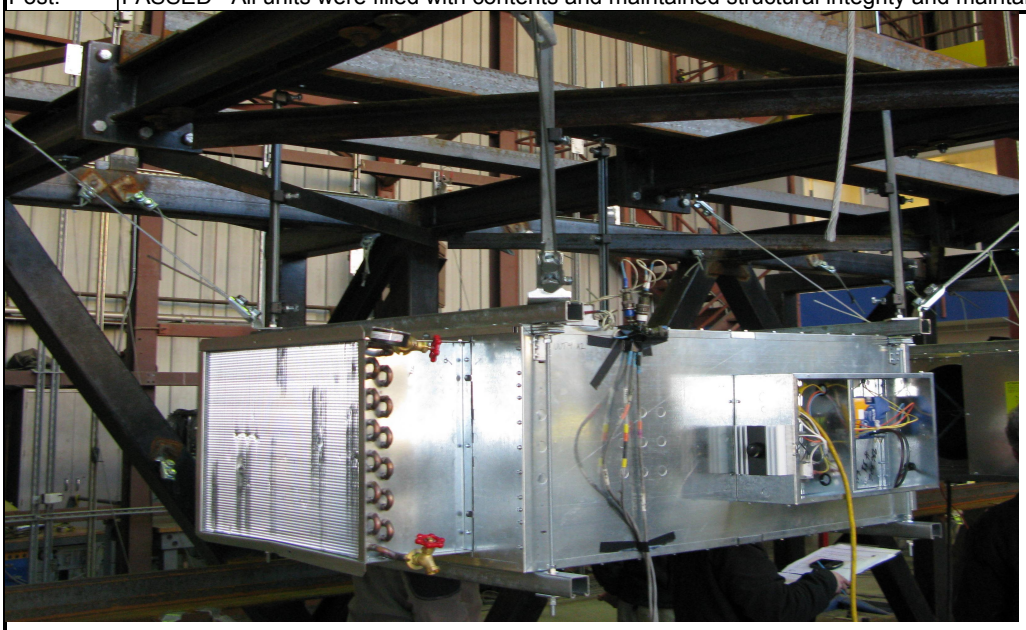
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (EcoShield 1/2" Liner)	47.5"	39"	20"	205 lbs	na	na	na
Coil (Hydronic)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-85 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #4b

Manufacturer: Krueger

Model Series: TFS Unit E Size 12"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

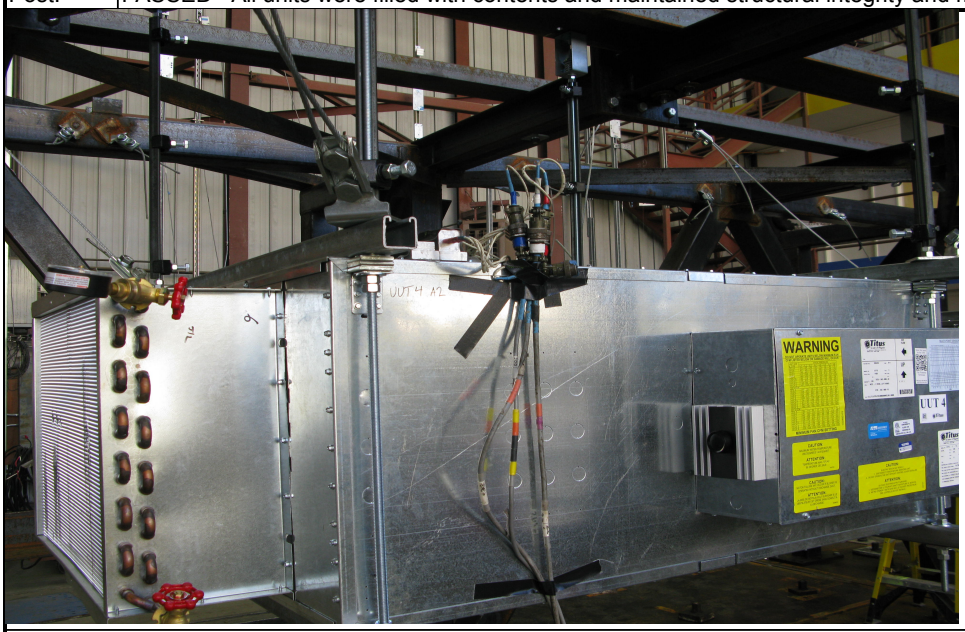
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (EcoShield 1/2" Liner)	47.5"	39"	20"	205 lbs	na	na	na
Coil (Hydronic)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #5a

Manufacturer: Krueger

Model Series: TFS Unit E Size 16"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

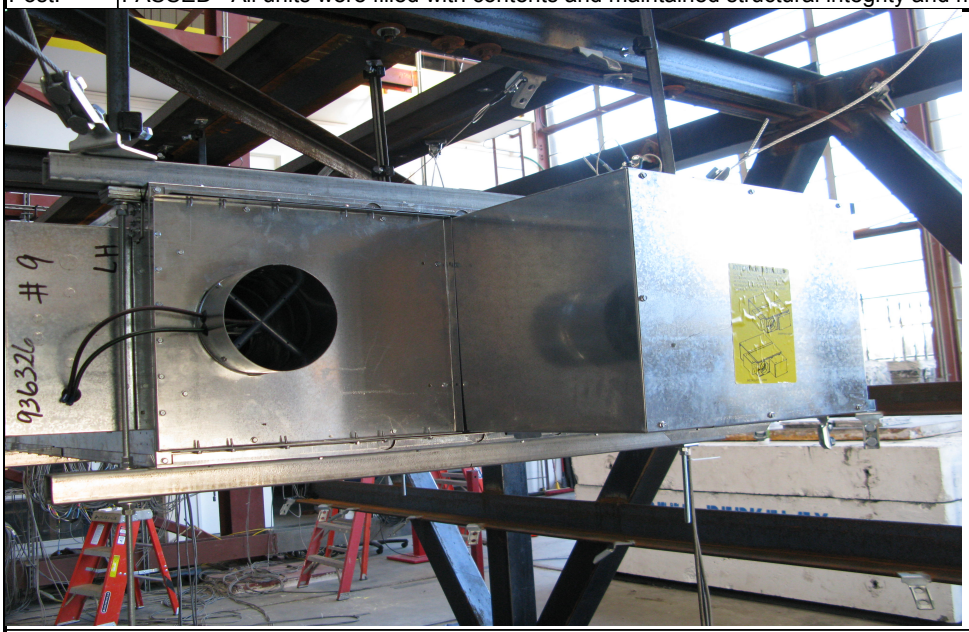
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (EcoShield 1/2" Liner)	46.75"	39"	20"	235 lbs	na	na	na
Electric Heat (11kw, 1 stage)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-85 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #5b

Manufacturer: Krueger

Model Series: TFS Unit E Size 16"

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

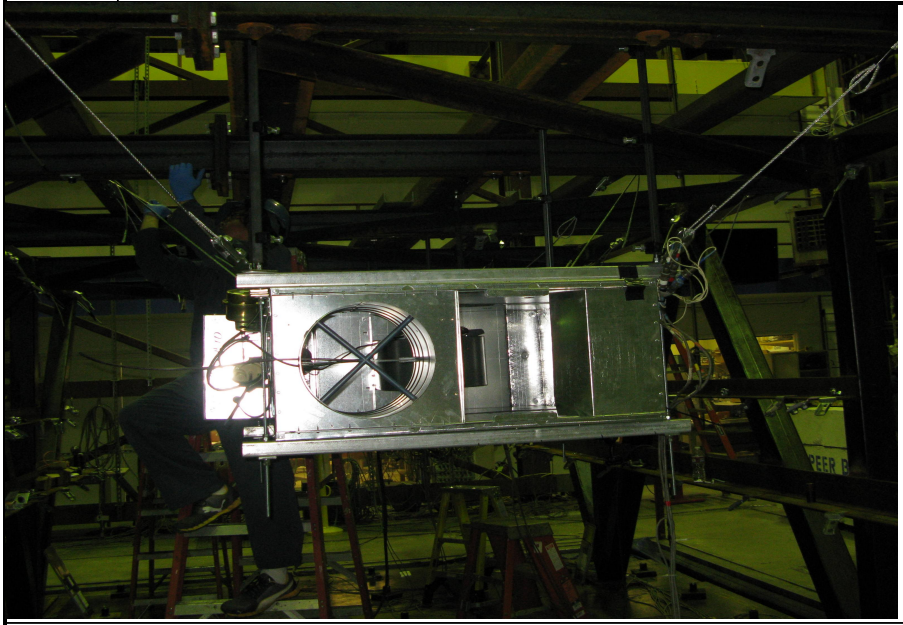
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (EcoShield 1/2" Liner)	46.75"	39"	20"	235 lbs	na	na	na
Electric Heat (11kw, 1 stage)							
Control (Digital)							
Disconnect (Non Fusable, 3 Pole)							
Fuses (KLK, Fast Acting, Line Fuse)							
Contactors (Magnetic)							
Transformer (AirCore Class 2)							
Relays (SPST)							
Airflow Switch (Electro Pneumatic)							
Damper (11.875" dia, Galv Carbon Steel)							
Fan Speed Control (Adjustable SCR)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #6a

Manufacturer: Krueger

Model Series: LMHS Size 8" (Clone of Titus ESV)

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

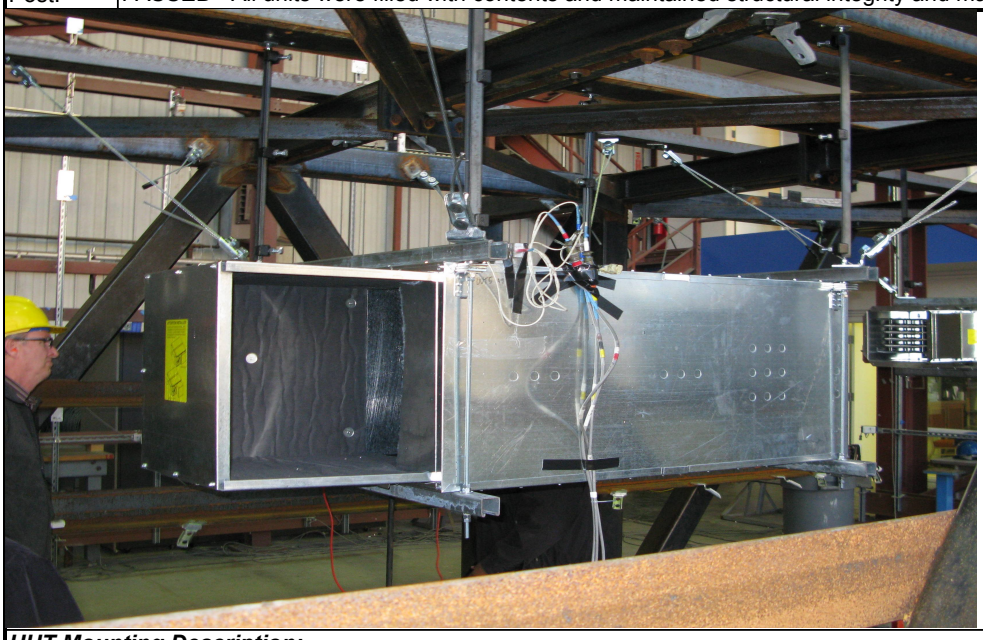
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Standard 1/2" Liner)	39.5"	12"	10"	70 lbs	na	na	na
Coil (Hydronic)							
Electric Heat (7kw, 1 stage)							
Control (Pneumatic)							
Transformer (Air Core Class 2)							
Airflow Switch (Electro Pneumatic)							
Damper (7.875" dia Galv Carbon Steel)							
Inlet Sensor							
Sound Attenuator (Integral)							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-20 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #6b

Manufacturer: Krueger

Model Series: LMHS Size 8" (Clone of Titus ESV)

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

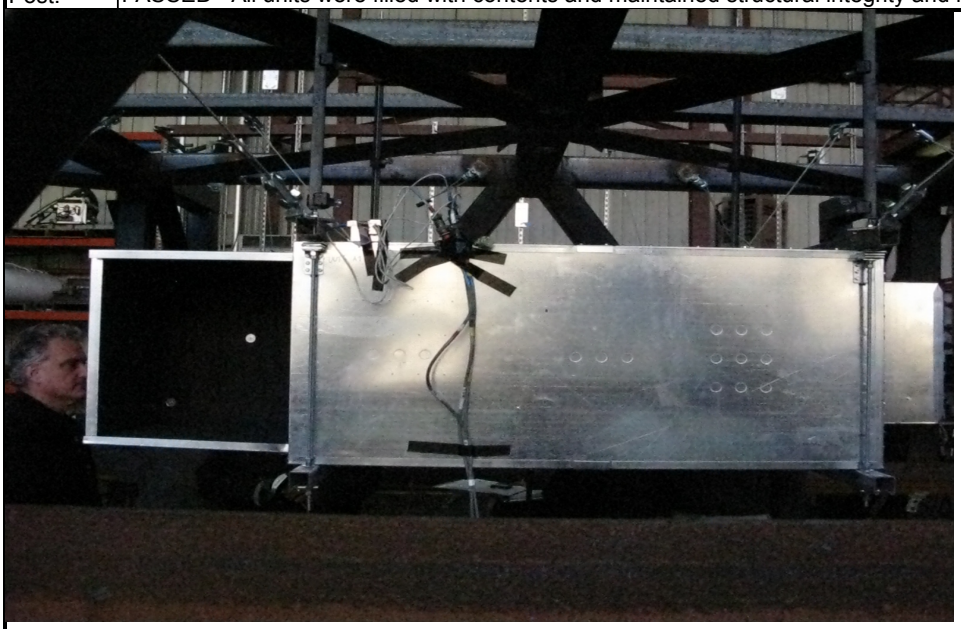
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Standard 1/2" Liner)	39.5"	12"	10"	70 lbs	na	na	na
Coil (Hydronic)							
Electric Heat (7kw, 1 stage)							
Control (Pneumatic)							
Transformer (Air Core Class 2)							
Airflow Switch (Electro Pneumatic)							
Damper (7.875" dia Galv Carbon Steel)							
Inlet Sensor							
Sound Attenuator (Integral)							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #7a

Manufacturer: Krueger

Model Series: LMHS Size 24"x16" (Clone of Titus ESV)

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

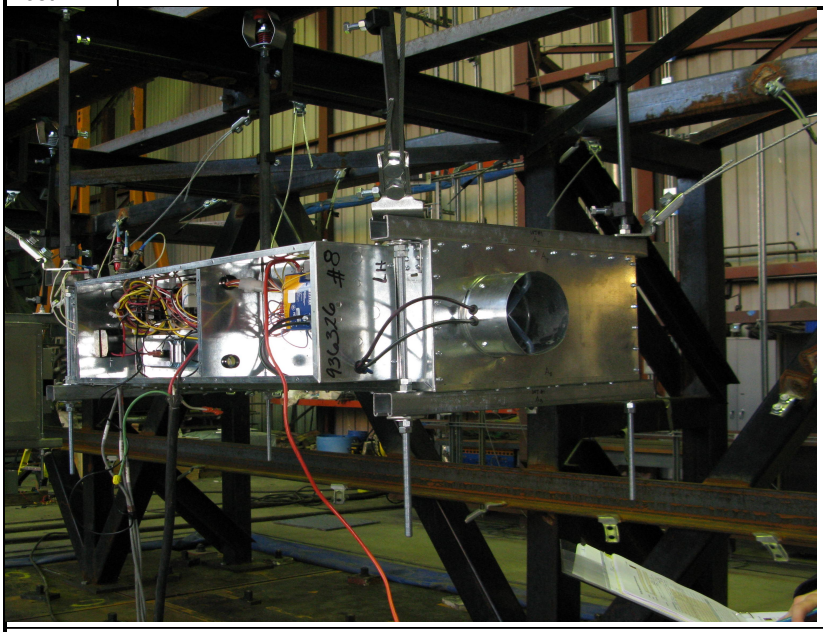
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Sterilwall Liner)	39.5"	38"	18"	245 lbs	na	na	na
Coil (Hydronic)							
Electric Heat (35kw, 3 stage)							
Control (Digital)							
Transformer (Air Core Class 2)							
Airflow Switch (Electro Pneumatic)							
Damper (16"H x 24"W, Aluminum)							
Sound Attenuator (Integral)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Vibration Isolated Suspended unit on (4) 1/2" ASTM-A307 rods [30" Long], with VMC HRSA-1B-35 Vibration Isolator Hangers, (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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UUT #7b

Manufacturer: Krueger

Model Series: LMHS Size 24"x16" (Clone of Titus ESV)

Cabinet Construction Summary:

Base:	20 Gauge galvanized carbon steel
Walls:	20 Gauge galvanized carbon steel
Roof:	20 Gauge galvanized carbon steel

Component Summary:

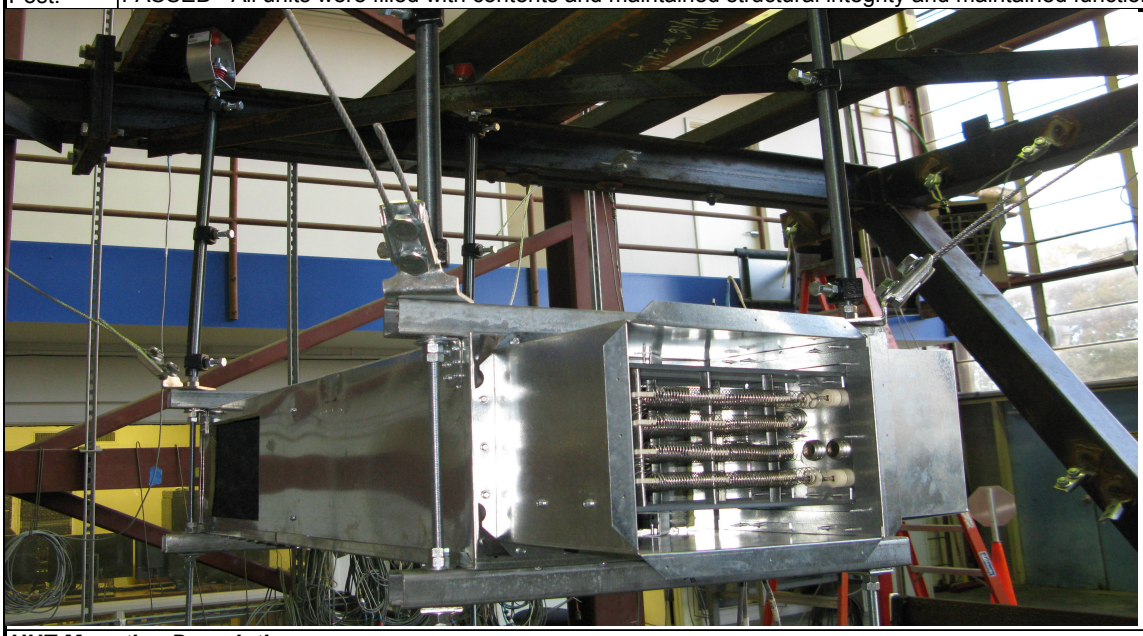
Item	Dimensions				Lowest Natural Frequency		
	Length	Width	Height	Weight	F-B	S-S	V
Cabinet (Sterilwall Liner)	39.5"	38"	18"	245 lbs	na	na	na
Coil (Hydronic)							
Electric Heat (35kw, 3 stage)							
Control (Digital)							
Transformer (Air Core Class 2)							
Airflow Switch (Electro Pneumatic)							
Damper (16"H x 24"W, Aluminum)							
Sound Attenuator (Integral)							
Inlet Sensor							
Control Enclosure (NEMA 1)							

Seismic Test Parameters:

Qualification Method	Sds(g)	z/h	Ip	Aflx-H(g)	Arig-H(g)	Aflx-V(g)	Arig-V(g)
ICC-ES AC156	2.00	1.0	1.5	3.20	2.40	1.33	0.53

Pre/Post Shake Functionality Test Results:

Pre:	PASSED
Post:	PASSED - All units were filled with contents and maintained structural integrity and maintained functionality.



UUT Mounting Description:

Rigidly Suspended unit on (4) 3/8" ASTM-A307 rods [30" Long], with (4) SB-250 (1/4") Seismic Cable Kits [at 45 Degrees] and (3 per rod) SRBC-1 Rod Stiffening Clamps. SB-250's are attached to structure using 5/8" hardware. SRBC-1s are fastened to L1x1x1/4 ASTM-A36 angle [30" Long].

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