Design Definitions

Construction Definition

Walls	Unisnulated Structural Wall with 5” of EPS Sheathing
Roof	Fiberglass Insulated 12” Joists + 4” EPS
Windows	Triple Pane Cardinal 272, Air Filled, Wood Frame
Slab	n/a
Floors	Fiberglass Insulated 10” Joists
Door	R2
Infiltration	ACH50 = 1.5

Location Definition

9,000’ at Powder Mountain

Heating Design Day Definition

Dry Bulb Temperature	-10.0˚F
Wind Speed	25 mph
Set Point	70˚F

Cooling Design Day Definition

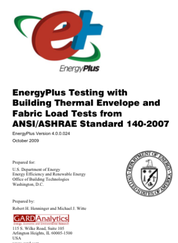
Maximum Dry Bulb Temperature	97.7 ˚F
Coincident Wet Bulb Temperature	63.0 ˚F
Minimum Dry Bulb Temperature	70˚F
Set Point	76˚F

HVAC Loads

Zone	Heating Design Loads (kBtu/hr)
Bedroom 1	1.9
Bedroom 2	1.6
Bedroom 3	1.6
Master Bedroom	2.8
Central Hallway	1.9
Bathroom 3	1.1
Mud Room	2.6
Tech Room	1.0
Bathroom 2	0.4
Bathroom 1	1.0
Kitchen	15.3
Crawlspace	0.0

Total	**31.1**

Calculated using EnergyPluis



1

Engineer: John Easterling
Drawing: John Easterling
Date: 1/18/18

Meehan Cabin HVAC Design
Design Definitions and Loads

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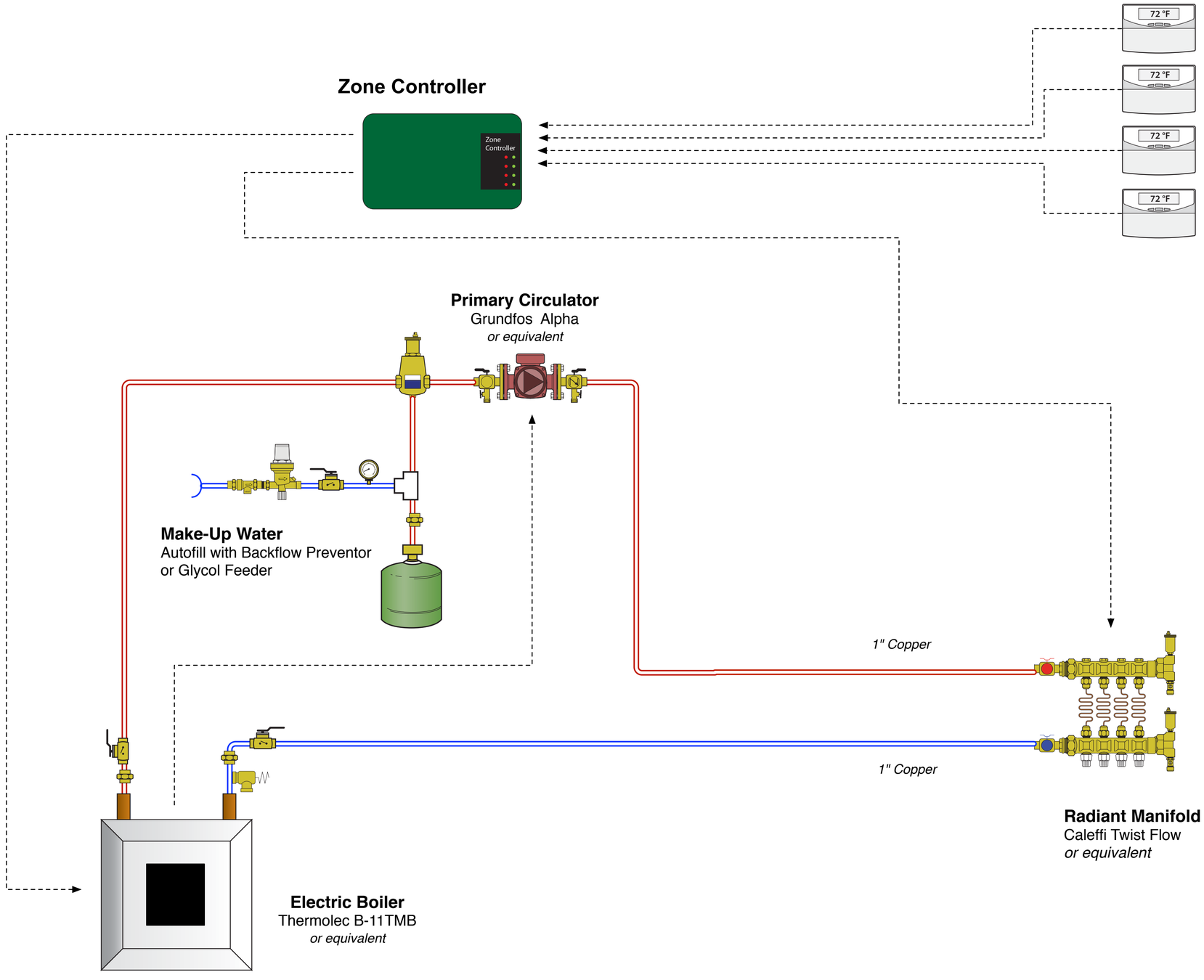

All equipment to be installed per manufacturer's specifications and location lode
Refer to part specific installation manuals for complete wiring

2

Engineer: John Easterling
Drawing: John Easterling
Date: 9/8/17

Meehan Cabin HVAC Design
Hydronic Schematic Electric Boiler

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Condensing Boiler
SlantFin CHS 110
or equivalent

Boiler oversized for DHW production

Zone Controller

Zone Controller

72 °F

72 °F

72 °F

72 °F

Indirect Water Heater
HTP SSU-80
or equivalent

DHW Circulator
Grundfos Alpha
or equivalent

Primary Circulator
Grundfos Alpha
or equivalent

1" Copper

Make-Up Water
Autofill with Backflow Preventor
or Glycol Feeder

Radiant Circulator
Grundfos Alpha
or equivalent

1" Copper

1" Copper

Radiant Manifold
Caleffi Twist Flow
or equivalent

All equipment to be installed per manufacturer's specifications and location lode
Refer to part specific installation manuals for complete wiring

3

Engineer: John Easterling

Drawing: John Easterling

Date: 9/8/17

Meehan Cabin HVAC Design
Hydronic Schematic Propane Boiler

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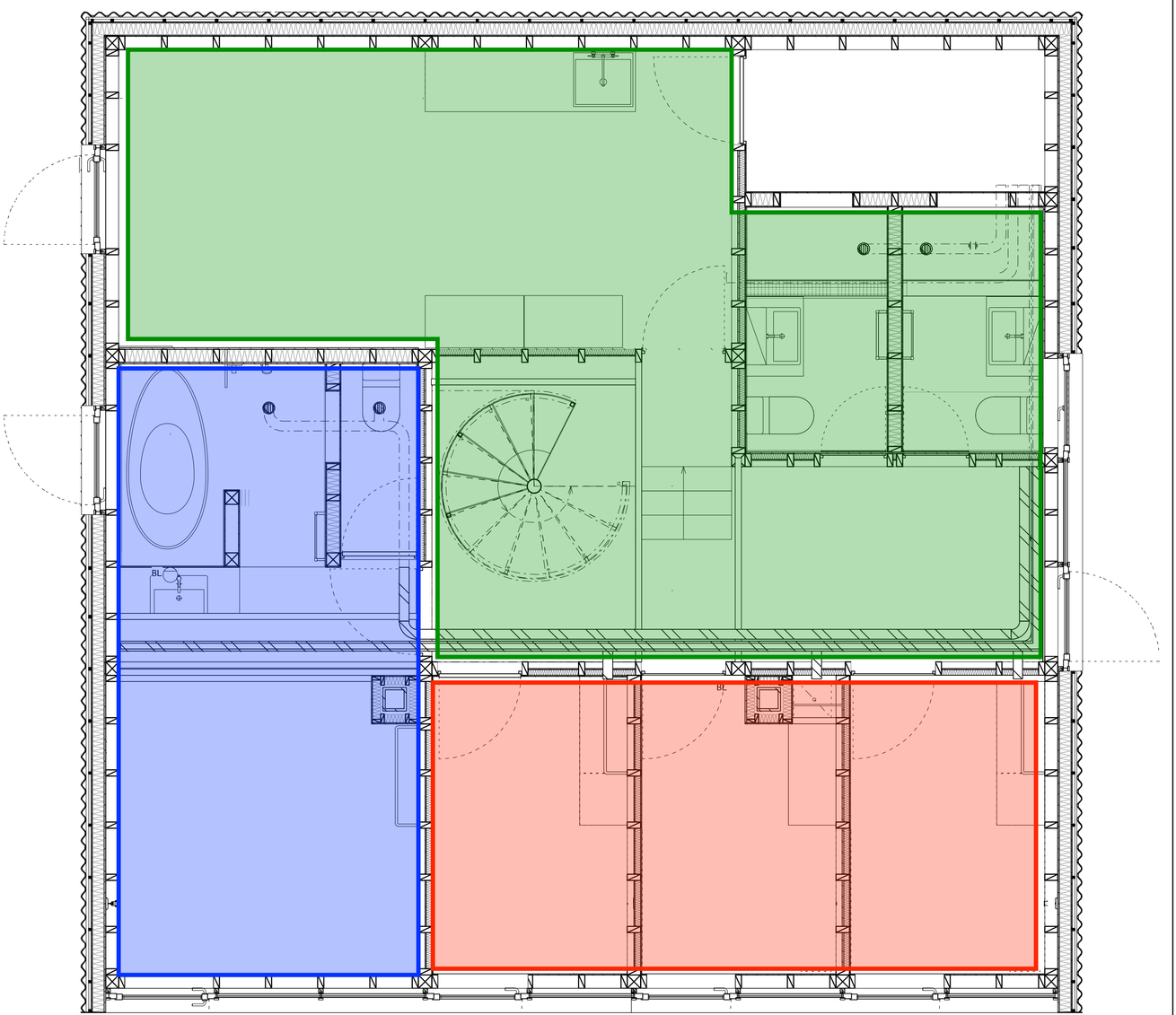
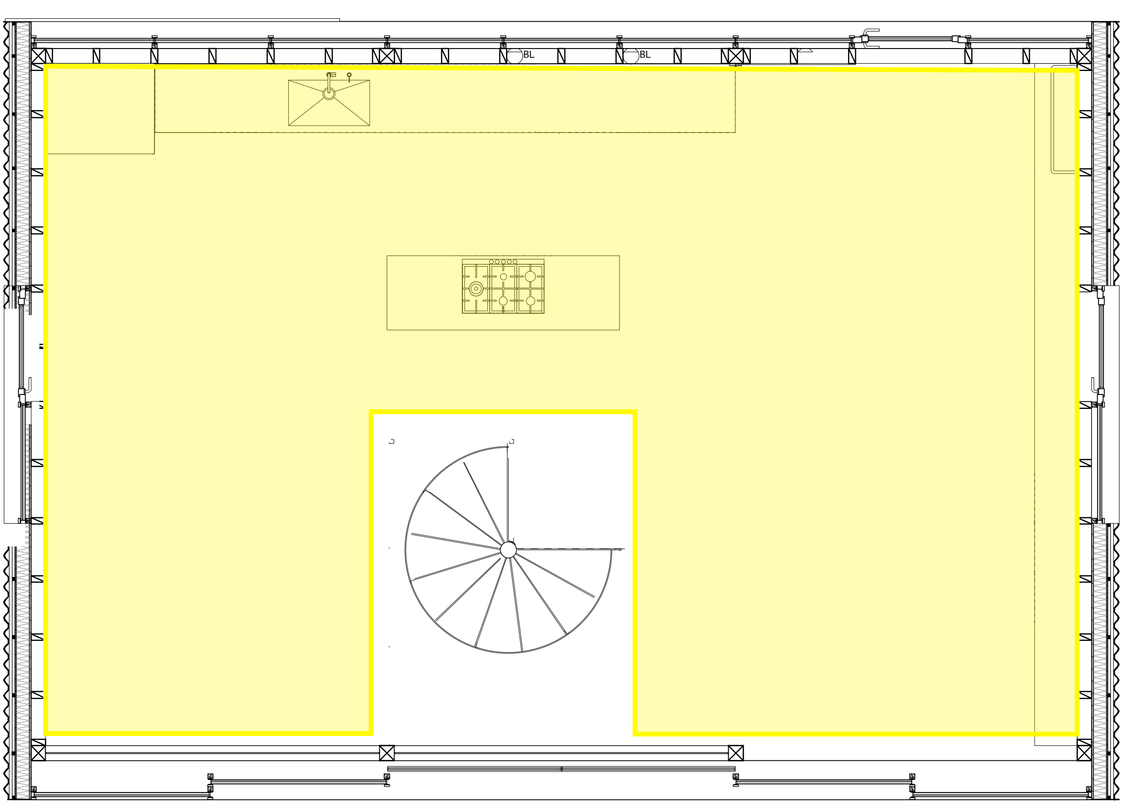
Zone 1: Main Floor

Zone 2: Bedrooms

Zone 3: Master Space

Zone 4: Upper Floor





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Meehan Cabin HVAC Design

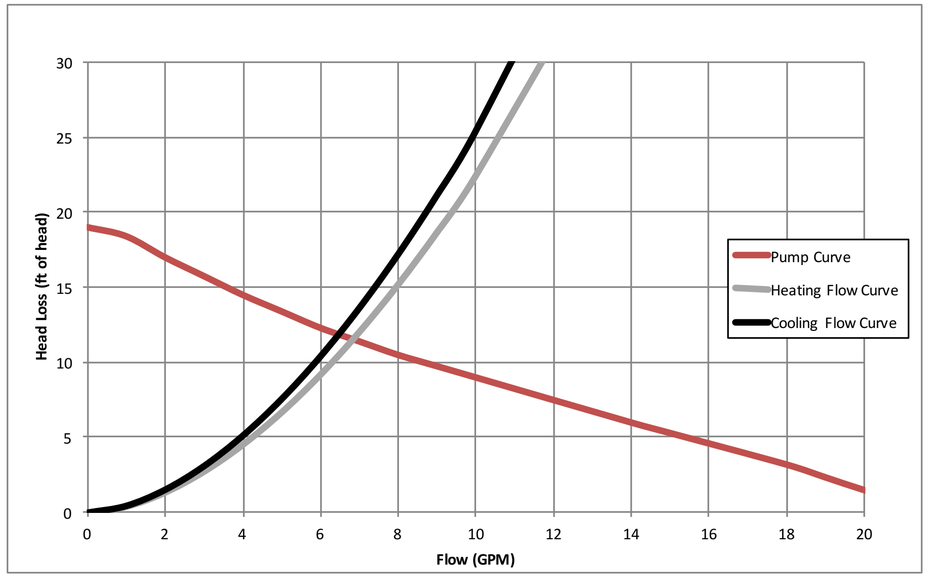
Radiant Zoning

Engineer: John Easterling

Drawing: John Easterling

Date: 1/18/18

	Zone 1	Zone 2	Zone 3	Zone 4
Zoning				
Zone Name	**Main Floor**	**Bedrooms**	**Master Space**	**Upper Floor**
Rooms in Zone	Bathroom 1	Bedroom 2	Master Bedroom	Kitchen
	Bathroom 2	Bedroom 3	Bathroom 3	
	Central Hallway	Bedroom 1		
	Mud Room			
	Tech Room			
Area (ft^2)	592.1	250.5	222.5	703.95
Piping				
Pipe Spaceing (in)	12	12	12	12
Pipe Type	PEX	PEX	PEX	PEX
Pipe Size (in)	0.5	0.5	0.5	0.5
Number of Loops	3	2	2	4
Loop Length (ft)	178	113	100	158
Total Pipe Length (ft)	533	225	200	634
Runouts				
Header Length (ft)	20	40	60	20
Header Type	PEX	PEX	PEX	PEX
Header Size (in)	0.75	0.75	0.75	0.75
Heater Pipe Size Factor	0.14203	0.14203	0.14203	0.14203
Flow Characteristics (Heating)				
Partial Resistance	0.603	0.537	0.537	0.707
Balancing	0.0	0.0	0.0	0.0
Partial Flow (GPM)	1.92	1.71	1.71	2.25
Heating				
Design Heat Load (kBtu/hr)	6.9	5.1	3.8	14.6
Heating Heat Flux (Btu/hr/ft^2)	11.6	20.2	17.1	20.7
Supply Water Temperature (˚F)	91	91	91	91
Temperature Drop (˚F)	14.25	8	7.25	13.5
Heat Transfer Surface Temperature (˚F)	75.9	77.4	77.6	76.1
Heat Transfer Into Space (kBtu/hr)	12.2	6.0	5.4	14.8



Glycol Percent	20%	
Average Temperature	90	50
Dynamic Viscosity	0.00096	0.00197
Density (lb/ft^2)	62.93	63.56
Density (lb/gal)	8.41	8.50
Cp (Btu/lb-˚F)	0.97	0.96
alpha	0.0626	0.0746

Equipment 1 Hydraulic Resistance	0	
Equipment 2 Hydraulic Resistance	0	
Equipment 3 Hydraulic Resistance	0	
Equipment 4 Hydraulic Resistance	0	
Pipe Type	Copper	
Pipe Size	1	
Pipe Thickness	0.0625	
Pipe Size Factor	0.0178	
Equivelent Panel Pipe Length (ft)	100	
Panel Hydraulic Resistance	0.111133	0.132538
Manifold Loop Resistance	0.966	
Manifold Resistance	0.01732	
Pump Selection	1. Grundfos Alpha High	

5

Engineer: John Easterling
Drawing: John Easterling
Date: 1/18/18

Meehan Cabin HVAC Design
Radiant Design

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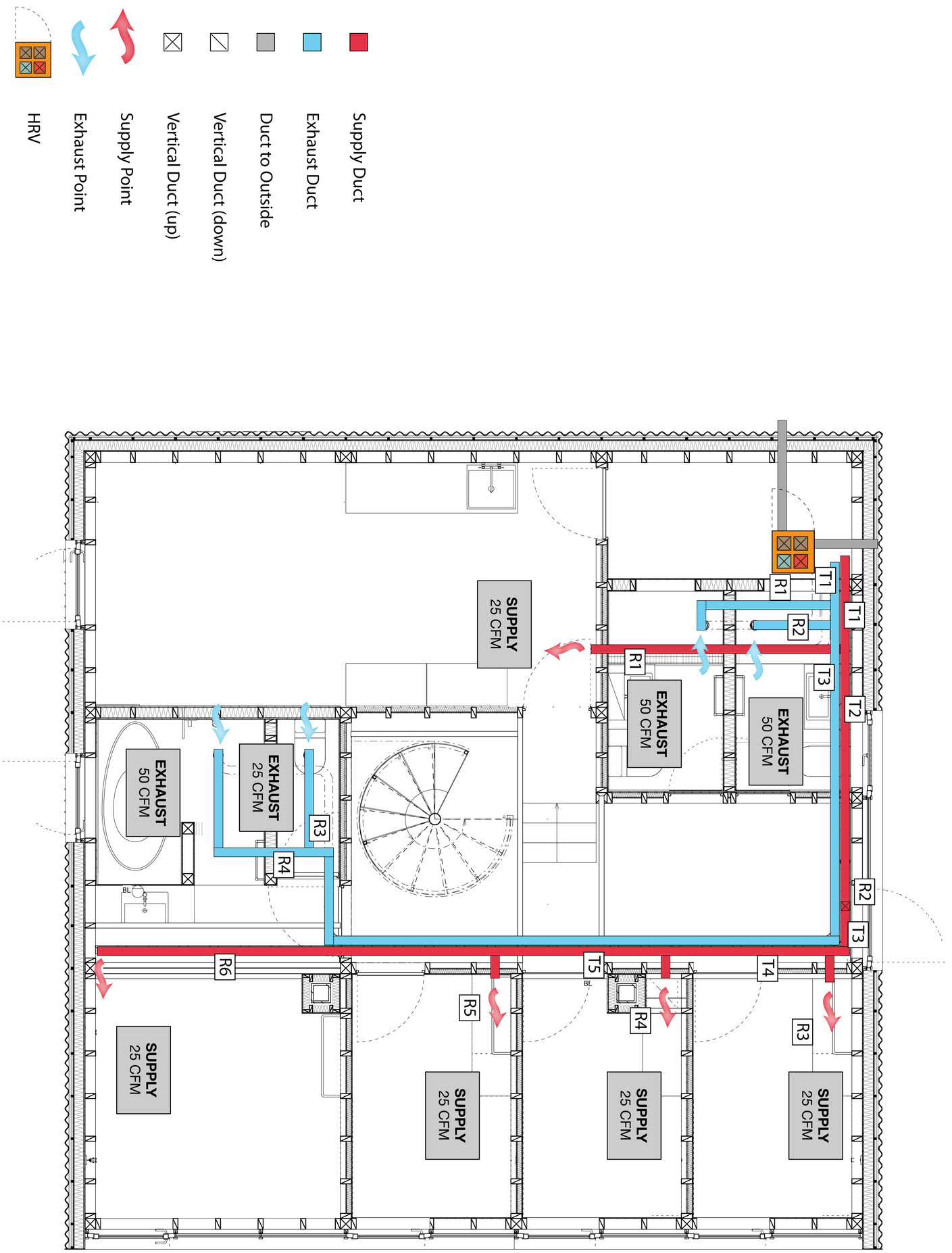

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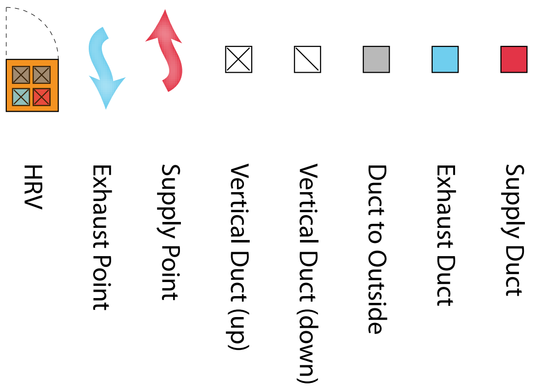
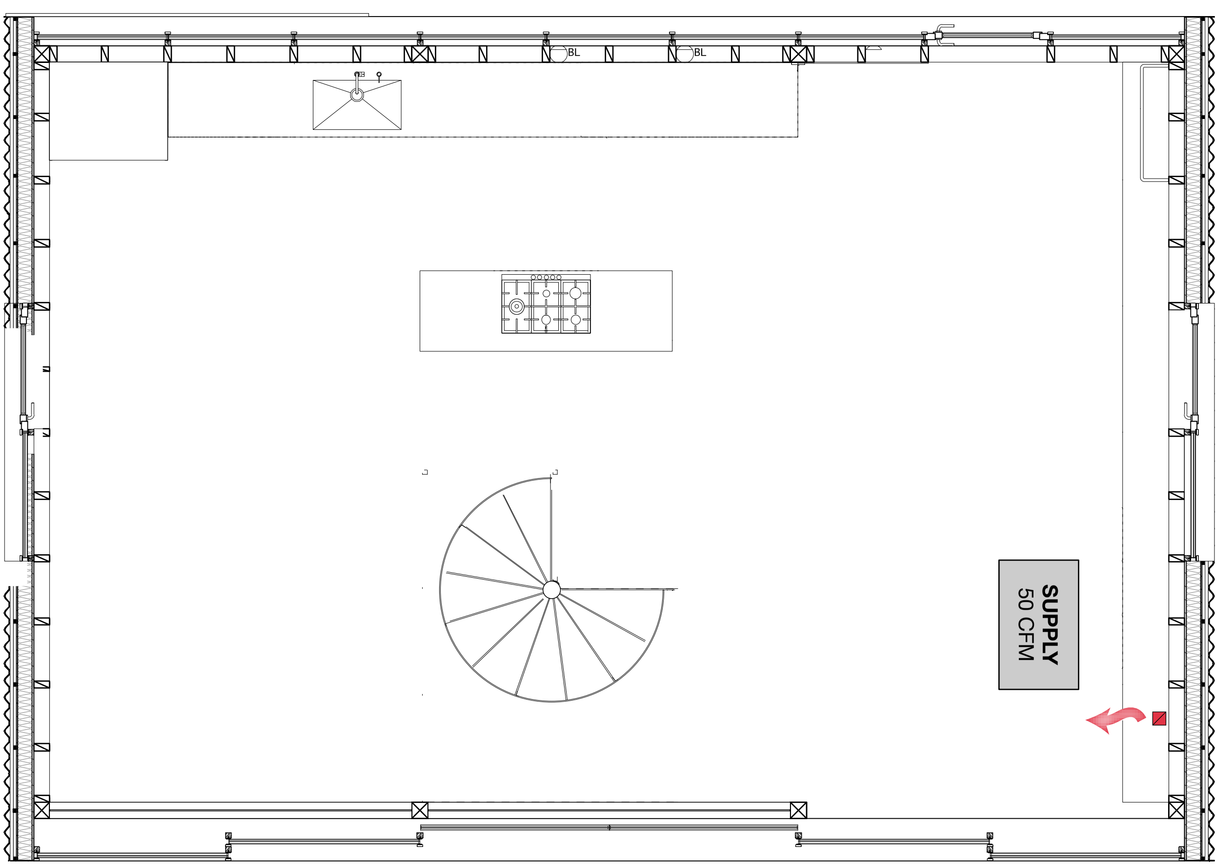
Meehan Cabin HVAC Design

Main Floor HRV Ducts

Engineer: John Easterling
Drawing: John Easterling
Date: 1/18/18





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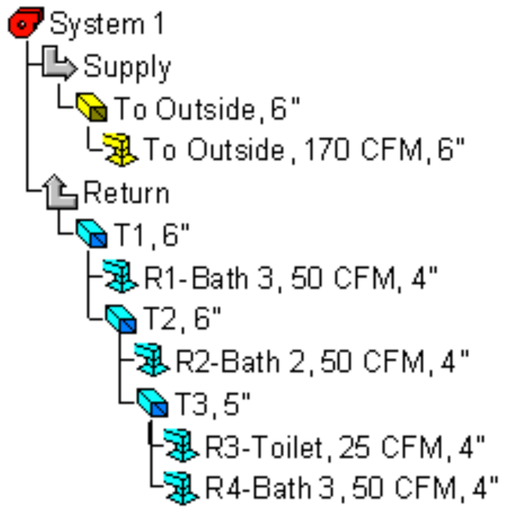
Meehan Cabin HVAC Design

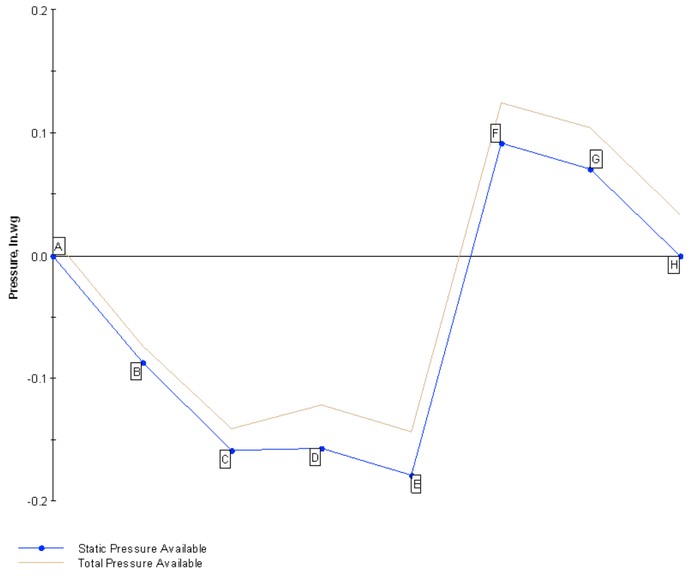
Upper Floor HRV Ducts

Engineer: John Easterling
Drawing: John Easterling
Date: 1/18/18

EXHAUST DUCTS

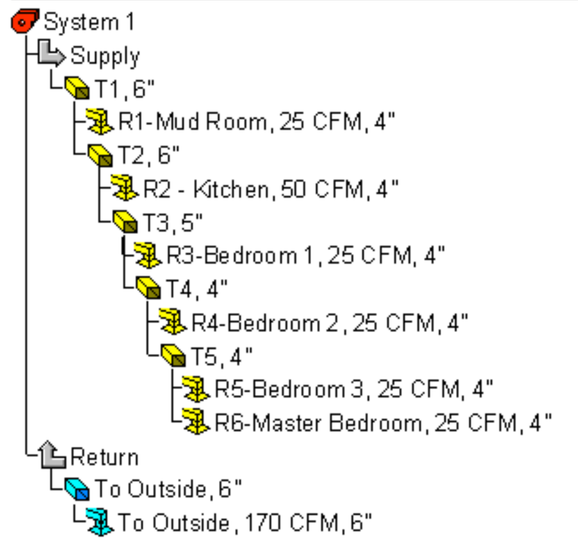


Pressure Changes Through Route with Highest Static Pressure Loss

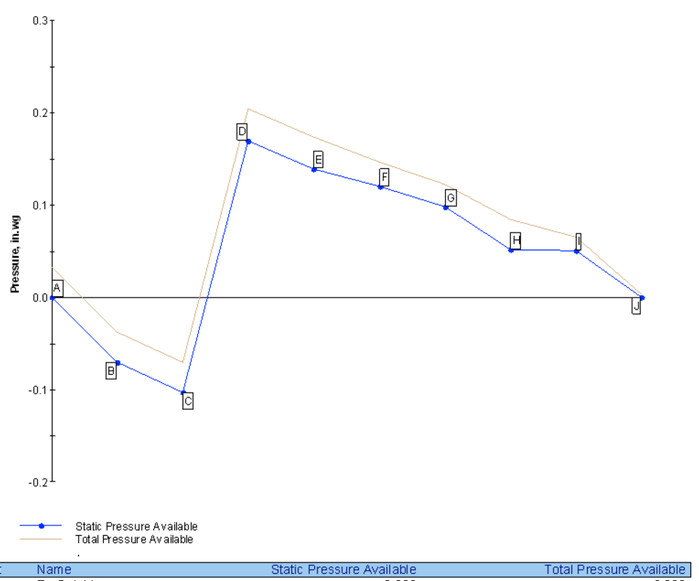


Point	Name	Static Pressure Available	Total Pressure Available
A	R4-Bath 3	0.000	0.014
B	T3	-0.087	-0.074
C	T2	-0.159	-0.141
D	T1	-0.157	-0.122
E	[Fan Entrance]	-0.179	-0.144
F	[Fan Exit]	0.091	0.124
G	To Outside	0.071	0.104
H	To Outside	0.000	0.033

SUPPLY DUCTS



Pressure Changes Through Route with Highest Static Pressure Loss



Point	Name	Static Pressure Available	Total Pressure Available
A	To Outside	0.000	0.033
B	To Outside	-0.071	-0.038
C	[Fan Entrance]	-0.103	-0.070
D	[Fan Exit]	0.169	0.204
E	T1	0.139	0.174
F	T2	0.120	0.146
G	T3	0.098	0.122
H	T4	0.051	0.084
I	T5	0.051	0.065
J	R5-Bedroom 3	0.000	0.004

8

Engineer: John Easterling

Drawing: John Easterling

Date: 1/18/18

Meehan Cabin HVAC Design

HRV Duct Design

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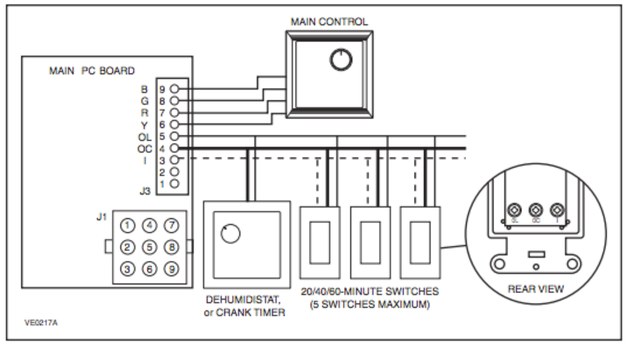
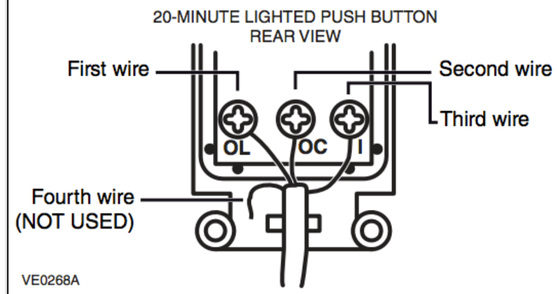
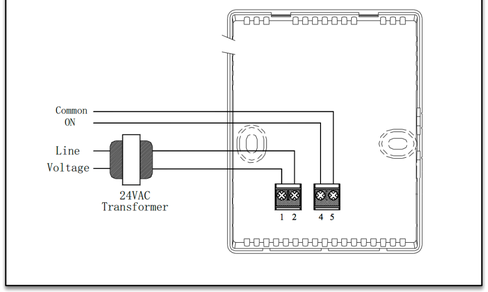
HRV Wiring Detail



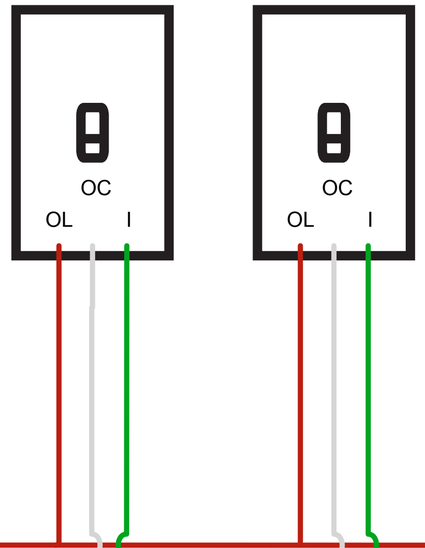
Push Button Wiring Detail



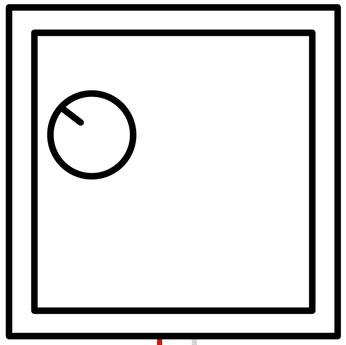
CO2 Switch Wiring Detail



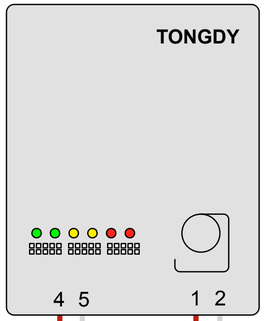
20-Minute Lighted
Push Button



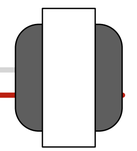
Dehumidistat
(Optional)



CO2 Switch
(Optional)

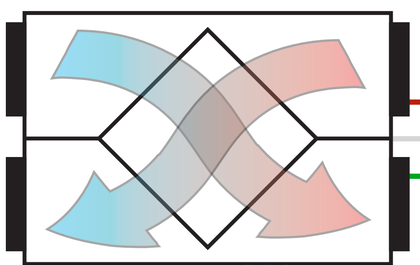


24 VAC
Transformer

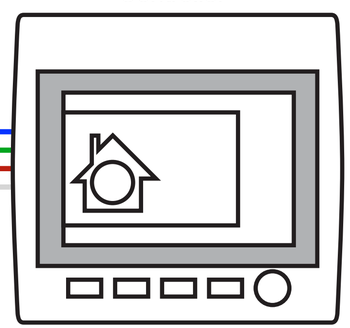


18-2

18-2



X-Touch Wall
Controller



9

Engineer: John Easterling

Drawing: John Easterling

Date: 5/5/17

Meehan Cabin HVAC Design

Wiring Layout

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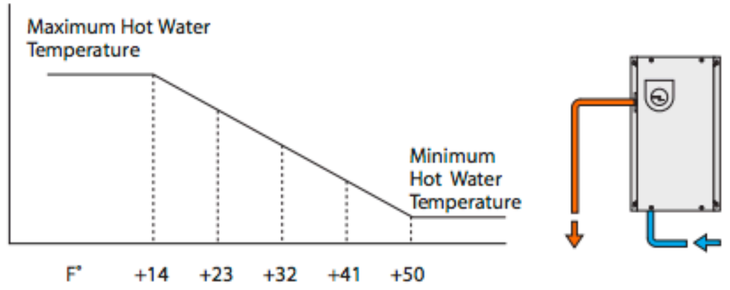
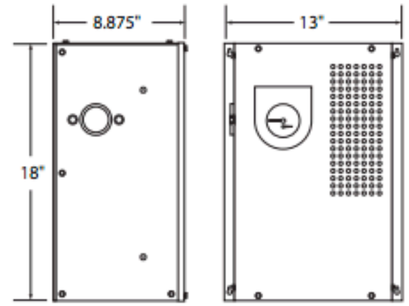
THERMOLEC

TMB BOILER

Outdoor Sensor and Supply Water Temperature Reset

The outdoor reset control proportionally varies the hot water temperature when the outdoor temperature is between +14˚F and +50˚F. The result is improved comfort and energy savings on mild days.





Limited Warranty

10 years on elements and tank, 2 years on all other components.

Water Temperature controlled by Electronic Aquastat											
Set-point		10	9	8	7	6	5	4	3	2	1
Maximum temperature	°C	88	81	75	67	58	50	45	42	39	36
	°F	190	178	167	153	137	122	113	107	102	97
Minimum temperature	°C	48	48	48	45	40	38	34	31	29	28
	°F	118	118	118	113	104	100	93	88	84	82

Thermolec TMB Boiler Specifications @ 240v 1ph				
	B-3TMB	B-6TMB	B-9TMB	B-11TMB
kW	3	6	9	11
BTU/H	10,236	20,472	30,708	37,532
Total Amps	12.5	25	37.5	45.8
Breaker Amps	1 @ 20A	1 @ 40A	1 @ 50A	1 @ 60A
Unit Weight	21 lbs.	23 lbs.	25 lbs.	27 lbs.

10

Engineer: John Easterling
Drawing: John Easterling
Date: 10/8/14

Meehan Cabin HVAC Design
Boiler Specs

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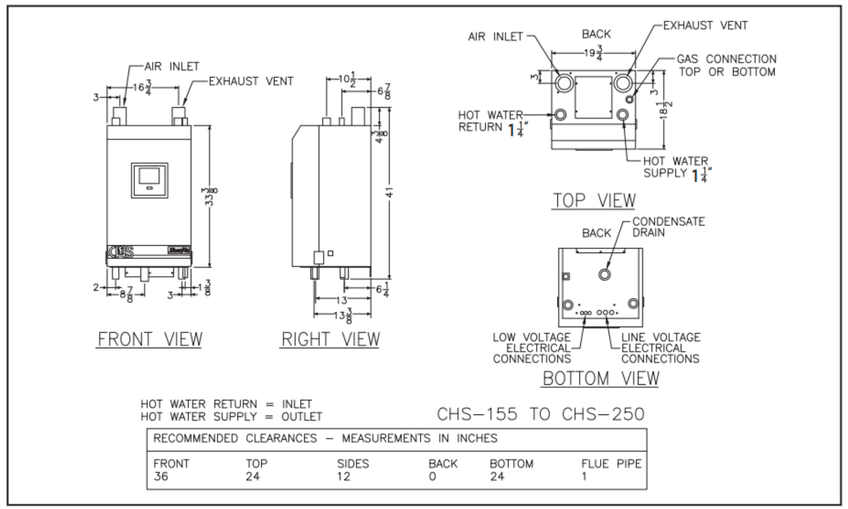
Slant/Fin Series Gas Boiler

Condensing **H**igh Efficiency **S**tainless Steel

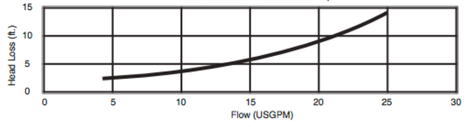
Look for our Hydronic Explorer app on iTunes and Google Play! (Works on iPad, iPhone & Android devices)



HOT WATER RETURN = INLET
HOT WATER SUPPLY = OUTLET

CHS–155 TO CHS–250

RECOMMENDED CLEARANCES – MEASUREMENTS IN INCHES					
FRONT	TOP	SIDES	BACK	BOTTOM	FLUE PIPE
36	24	12	0	24	1



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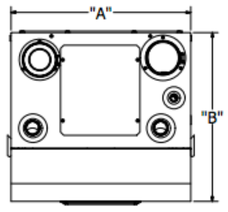
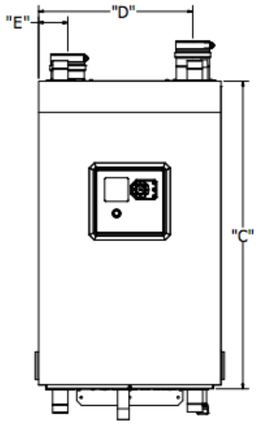


TOP



FRONT

Boiler Dimensions

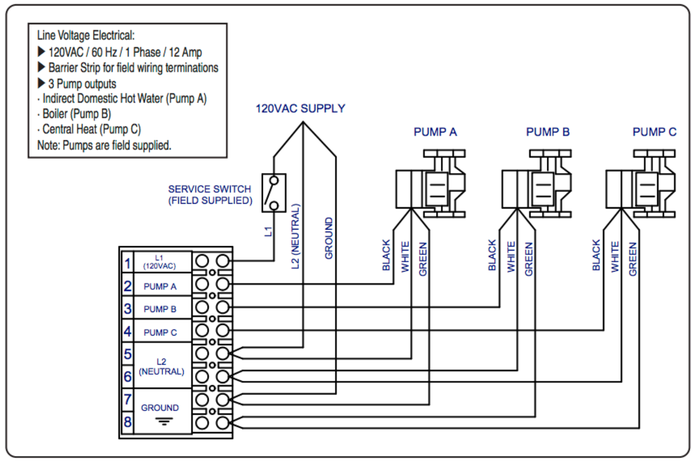
MODEL	"A"	"B"	"C"	"D"	"E"
CHS-85	19 3/4	14 1/2	33 3/8	16 7/8	3 5/8
CHS-110					
CHS-155	19 3/4	18 1/2	33 3/8	16 3/4	3
CHS-175					
CHS-200					
CHS-250					
CHS-300	25	20	36 3/8	22 1/2	3 7/8
CHS-399					

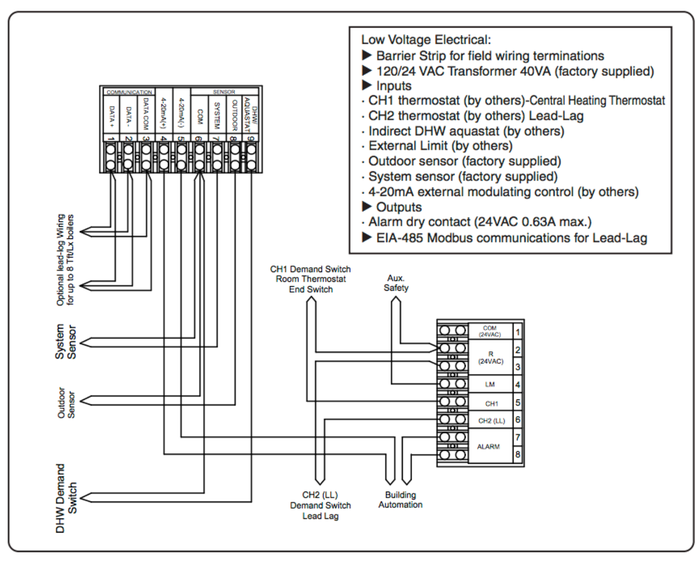
Boiler Ratings

Model	C.S.A. Max Input NG/LP (MBH)	C.S.A. Min Input NG/LP (MBH)	D.O.E. Capacity (MBH)	Net AHRI (MBH)	A.F.U.E. %	Vent Diameter (Inches)	Max Vent Length NG/LP (Ft)	Approx. Water Content (Gal.)	Supply & Return Piping Male NPT (Inches)	Gas Connection Male NPT (Inches)
CHS-85	85/88	17/17.6	78	68	95.0	2" or 3	150**	3.2	1	1/2
CHS-110	108/113	21.6/22.6	99	86	95.0	2" or 3	150**	3.2	1	1/2
CHS-155	155	31	144	125	95.0	3	100	4.9	1 1/4	1/2
CHS-175	175	31	163	141	95.0	3	100	4.9	1 1/4	1/2
CHS-200	200	31	185	160	95.0	3	100	4.9	1 1/4	1/2
CHS-250	250	31	230	199	95.0	3	100	4.9	1 1/4	1/2
CHS-300	299	79.8	278	239	94.0	4	100	6.4	1 1/2	3/4
CHS-399	399	79.8	380†	330	95.4*	4	100	6.4	1 1/2	3/4

**Max length of 150' for 3" venting only, 100' for 2" vent † Gross output * CHS399 efficiency is Thermal Efficiency • Reducer required

Simplified Wiring Diagrams





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Meehan Cabin HVAC Design

Gas Boiler Specs

Engineer: John Easterling

Drawing: John Easterling

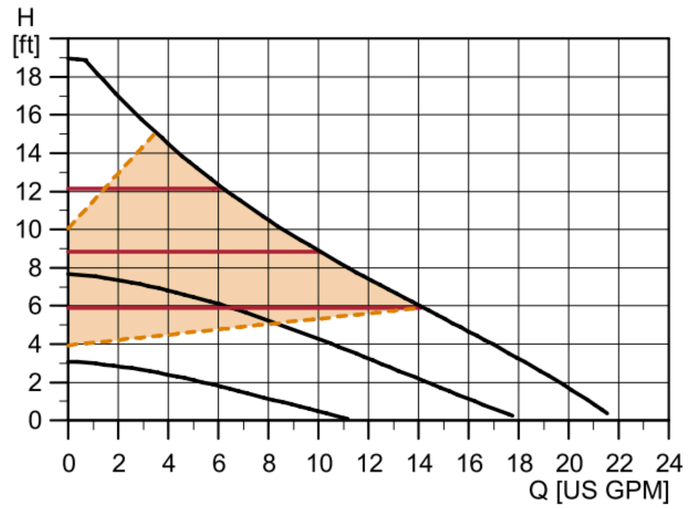
Date: 9/19/15

GRUNDFOS
ALPHA 15-55 F

Technical Data:

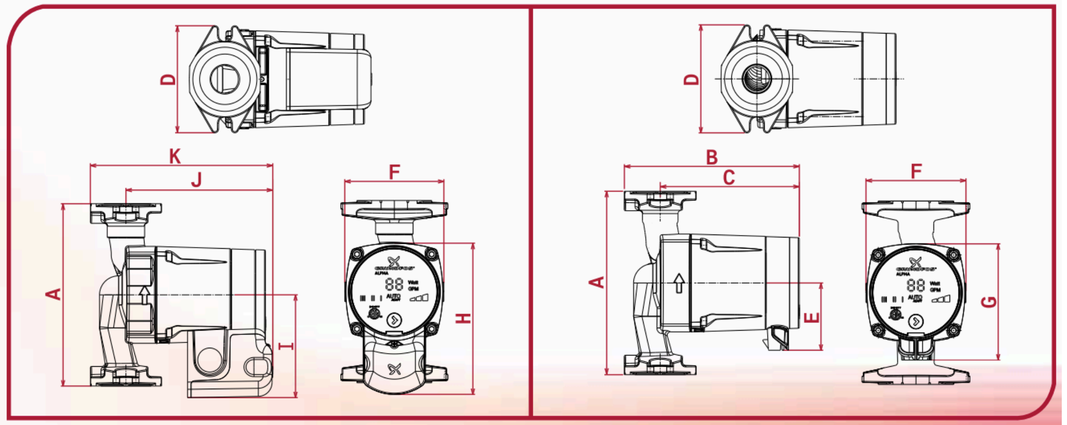
Flow Range:	0 to 21 GPM
Head Range:	0 to 19 Feet
Motor:	1X115V
Min. Fluid Temperature:	36°F (2°C)
Max. Fluid Temperature:	230°F (110°C)
Max. Working Pressure:	150 PSI
Watts:	5-45W
Amps:	0.65A

Performance Curve:



- **Orange:** AUTO*ADAPT*™ Range
- **Red:** 3 Constant Pressure Settings
- **Black:** 3 Fixed Speed Settings

Dimensional Drawing:



A	B	C	D	E	F	G	H	I	J	K
6-1/2	6-3/16	4-15/16	3-13/16	2-3/8	3-7/16	4-1/8	5-3/8	6-11/16	5-1/4	6-1/2

12

Engineer: John Easterling
Drawing: John Easterling
Date: 5/5/17

Meehan Cabin HVAC Design
Radiant Circulator Specs

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BROAN

HRV160 ECM

Part no. HRV160TE

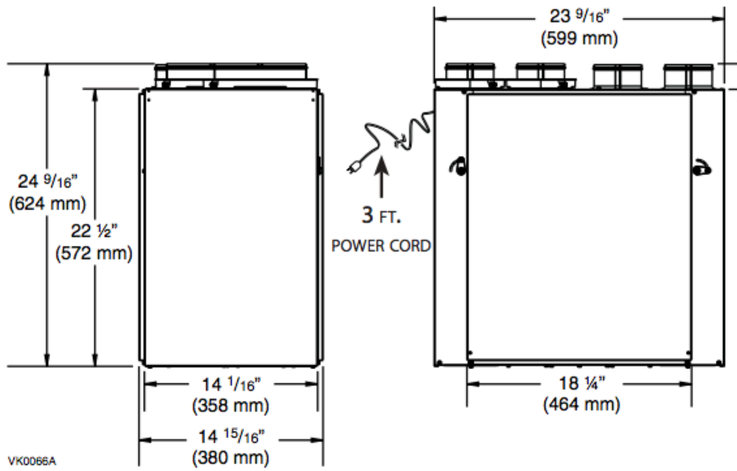
85 to 157 CFM*
65 to 157 CFM*
55 to 125 CFM* **(Factory Set)**
* Maximum speed at 0.4 in. w.g.

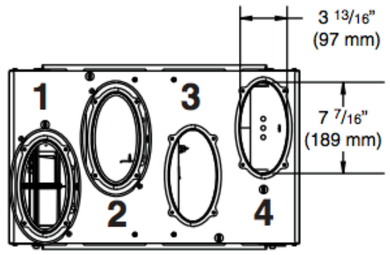
40 to 125 CFM*
40 to 80 CFM*

Energy Performance

Supply Temperature	Net Air Flow			Power consumed watts	Sensible recovery efficiency SRE	Apparent Sensible Recovery Efficiency ASRE	Apparent sensible effectiveness	Latent recovery/ moisture transfer
°F	L/s	CFM	m^3/h					
Heating								
32	23	49	83	22	76	80	83	0
32	30	64	109	25	75	78	81	0
32	39	82	139	32	73	76	78	0
32	55	117	199	50	68	71	72	0
-13	30	64	109	40	64	67	82	0

Dimensions: HRV160 ECM



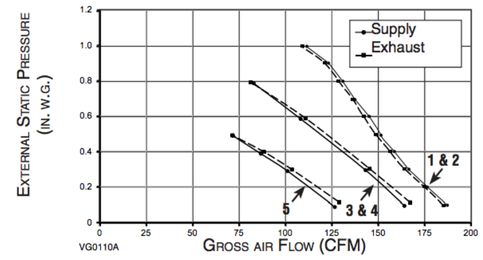


NOTE: Every port fits 6" round duct.

1: Exhaust air to outdoor port
2: Fresh air from outdoor port
3: Exhaust air from building port
4: Fresh air to building port

NOTE: All units ports were created to be connected to ducts having a minimum of 6" diameter, but if need be, they can be connected to bigger sized ducts by using an appropriate transition (e.g.: 6" diameter to 7" diameter transition).

Fan curves according to speed



Speed Range **1:** 85 to 157CFM*
Speed Range **2:** 65 to 157CFM*
Speed Range **3:** 55 to 125CFM* **(Factory Set)**
Speed Range **4:** 40 to 125CFM*
Speed Range **5:** 40 to 80CFM*

*Maximum speed at 0.4 in. w.g.

Specifications

- Model: HRV160 ECM
- Part Number: HRV160TE
- Total Assembled Weight (including polypropylene core): 52.4 lb.
- Oval shaped ports; fit 6" round ducts
- Drains: 1/2" fittings with 10 ft PVC drain
- Core Filters: 2 washable Merv 9 filters, 9.2" x 14.25" x 0.38"
- Insulation: Expanded polystyrene
- Mounting: Suspension by chains and springs
- Supply and Exhaust Blower Motors: 2 ECM motors
  - Protection type: Thermally protected
  - Insulation class: B
- Speed Control on Unit:
  - Low speed and high speed
  - Other modes available with VT8W or VT7W main control
- Heat Recovery Core:
  - Heat Exchange Surface Area: 110 $ft.^2$
  - Type: Crossflow
  - Material: Polypropylene
- Housing: Pre-painted steel
- Unit Electrical Characteristics:

Volts	Frequency	Ampere	Watts
120	60 Hz	1.3	98

Ventilation Performance

External Static Pressure		Net Supply Air Flow		Gross Air Flow			
				Supply		Exhaust	
Pa	in. w.g.	L/s	CFM	L/s	CFM	L/s	CFM
25	0.1	88	186	88	187	87	185
50	0.2	83	176	83	176	83	175
75	0.3	78	165	78	166	77	164
100	0.4	74	157	74	158	74	156
125	0.5	71	150	71	151	70	149
150	0.6	68	144	68	145	67	142
175	0.7	64	137	65	137	64	136
200	0.8	61	130	62	131	61	128
225	0.9	58	123	58	123	57	122
250	1.0	54	115	55	116	54	114

13

Engineer: John Easterling
Drawing: John Easterling
Date: 5/5/17

Meehan Cabin HVAC Design
HRV Specs

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HTP

Advanced Heating & Hot Water Systems

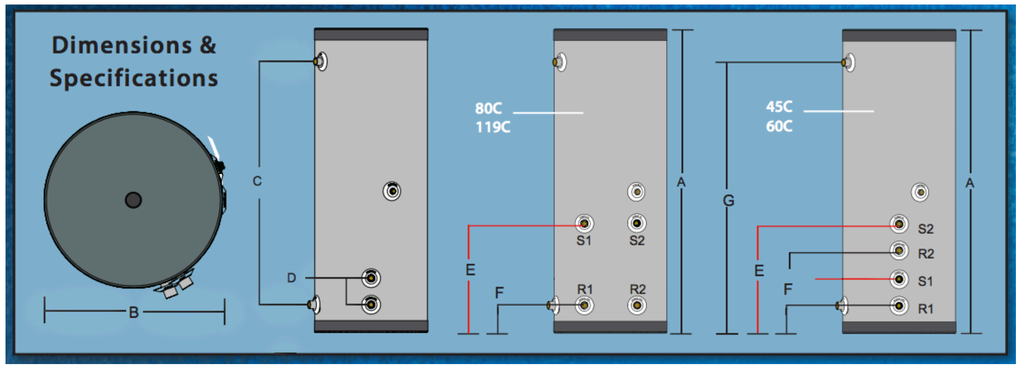
SUPERstor ULTRA Stainless Steel

C. Reduced Boiler Input Sizing Guide

NOTE: IT IS NOT RECOMMENDED TO REDUCE BOILER INPUT WHEN USING DOUBLE WALL TANKS.

MODEL		GROSS OUTPUT (x 1,000 BTU/HR)														
		40	60	84	100	120	140	160	180	200	220	240	260	280	300	320
SSU-20	A	73	112	168				-								
	B	53	81	121				-								
SSU-30	A	83	125	160	212			-								
	B	60	90	115	154			-								
SSU-30LB	A	84	128	166	234			-								
	B	60	92	120	169			-								
SSU-45	A	94	138	180	210	266	292		-							
	B	68	99	130	152	193	212		-							
SSU-60	A	-			221	244	251	309	370				-			
	B	-			160	176	181	206	266				-			
SSU-80	A	-			297	305	314	367	424	489	503					-
	B	-			216	223	230	269	311	359	370					-
SSU-119	A	-					333	384	444	457	470	543	627	645		
	B	-					216	251	290	335	345	399	460	474		

Table 3 - Describes Cold Start First Hour Ratings (A and B) and Boiler Size



Model	A Dimensions Ht	B Diameter	C Domestic Connections	D Boiler Connections	E Floor to Boiler Supply		F Floor to Boiler Return		G Floor to Domestic Out	Capacity	Heat Exchanger Surface	Shipping Weight
SSU-20	27"	19 1/4"	3/4"	1" NPT	S1- 9 3/4"		R1- 5 1/4"		22"	20	15 SQ FT	51 LBS
SSU-30	39 1/2"	19 1/4"	3/4"	1" NPT	S1- 9 3/4"		R1- 5 1/4"		34"	30	15 SQ FT	62 LBS
SSU-30LB	28 1/2"	23 1/4"	3/4"	1" NPT	S1- 9 3/4"		R1- 5 1/4"		22"	30	15 SQ FT	71 LBS
SSU-45	52 1/2"	19 1/4"	3/4"	1" NPT	S1- 9 3/4"		R1- 5 1/4"		46"	45	20 SQ FT	72 LBS
SSU-60	52 1/2"	23 1/4"	1"	1" NPT	S1- 9 3/4"		R1- 5 1/4"		46"	60	20 SQ FT	109 LBS
SSU-80	72"	23 1/4"	1 1/2"	1" NPT	S1- 29"		R1- 6"		64 3/4"	80	34 SQ FT	143 LBS
SSU-119	74"	27"	1 1/2"	1" NPT	S1- 30 1/4"		R1- 7 1/4"		66"	119	34 SQ FT	212 LBS
SSU-45C	42	23 1/4"	3/4"	1" NPT	S1- 9 3/4"	S2- 18 3/4"	R1- 5 1/4"	R2-14"	35"	45	40 SQ FT	106 LBS
SSU-60C	52 1/2"	23 1/4"	1"	1" NPT	S1- 9 3/4"	S2- 18 3/4"	R1- 5 1/4"	R2-14"	46"	60	40 SQ FT	126 LBS
SSU-80C	72"	23 1/4"	1 1/2"	1" NPT	S1- 29"	S2- 29"	R1- 6"	R2- 6"	64 3/4"	80	68 SQ FT	175 LBS
SSU-119C	74"	27"	1 1/2"	1" NPT	S1- 30 1/4"	S2- 30 1/4"	R1- 7 1/4"	R2- 7 1/4"	66"	119	68 SQ FT	242 LBS

SINGLE WALL

MODEL	180 DEG F BOILER WATER FIRST HOUR RATING		CIRCULATOR GPM	PRESSURE DROP (FEET)
	140 DEG F	115 DEG F		
SSU-20	121 GPH	168 GPH	8	6.0
SSU-30	154 GPH	212 GPH	8	6.0
SSU-30LB	169 GPH	234 GPH	8	6.0
SSU-45	212 GPH	292 GPH	10	7.9
SSU-60	266 GPH	370 GPH	10	7.9
SSU-80	330 GPH	440 GPH	12	9.1
SSU-119	423 GPH	564 GPH	14	11.3

14

Engineer: John Easterling

Drawing: John Easterling

Date: 5/5/17

Meehan Cabin HVAC Design

DHW Tank Specs

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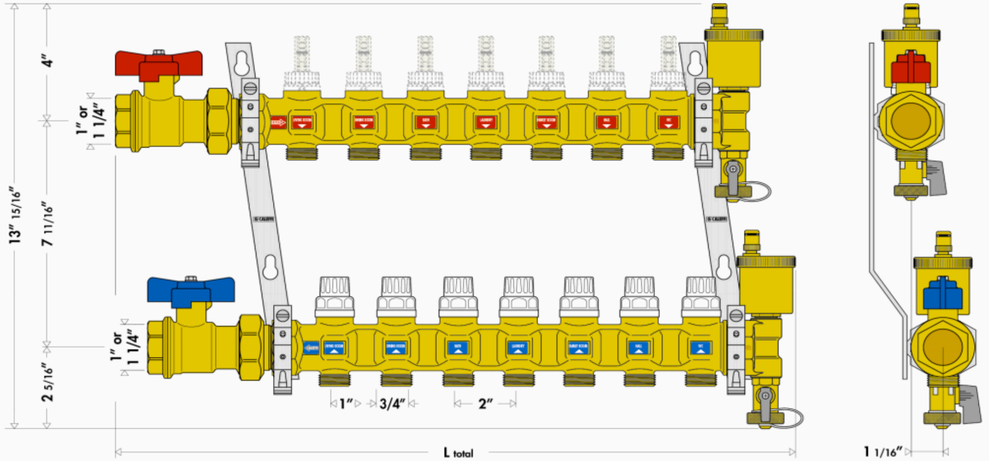


Code (1")	6686C5S1A	6686D5S1A	6686E5S1A	6686F5S1A	6686G5S1A	6686H5S1A	6686I5S1A	6686L5S1A	6686M5S1A	6686N5S1A	6686O5S1A
Code (1 1/4")	6687C5S1A	6687D5S1A	6687E5S1A	6687F5S1A	6687G5S1A	6687H5S1A	6687I5S1A	6687L5S1A	6687M5S1A	6687N5S1A	6687O5S1A
No. outlets	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Total length	15 3/16"	17 1/8"	19"	21"	23"	25	28 1/8"	30 1/8"	32 1/16"	34 1/16"	36"

Performance:

Medium:	water, glycol solutions
Max. percentage glycol	50%
Max. working pressure	150 psi (10 bar)
Max. end fitting discharge pressure:	35 psi (2.5 bar)
Working temperature range:	32 to 180°F (0 to 80°C)
Max. peak temperature:	200°F (93°C)
Flow meter scale:	1/4 to 2 GPM
Accuracy:	±15%
Loop Cv:	1.23 (combined supply & return ports)
Main connections:	1", 1-1/4" F
Connection center distance:	7-11/16" (195 mm)
Outlets:	3/4" M (18 mm)
Outlet center distance:	2" (50 mm)

Thermo-electric actuators

6561

Thermo-electric actuator.
For series 663 and 668S1 manifolds.
Normally closed.

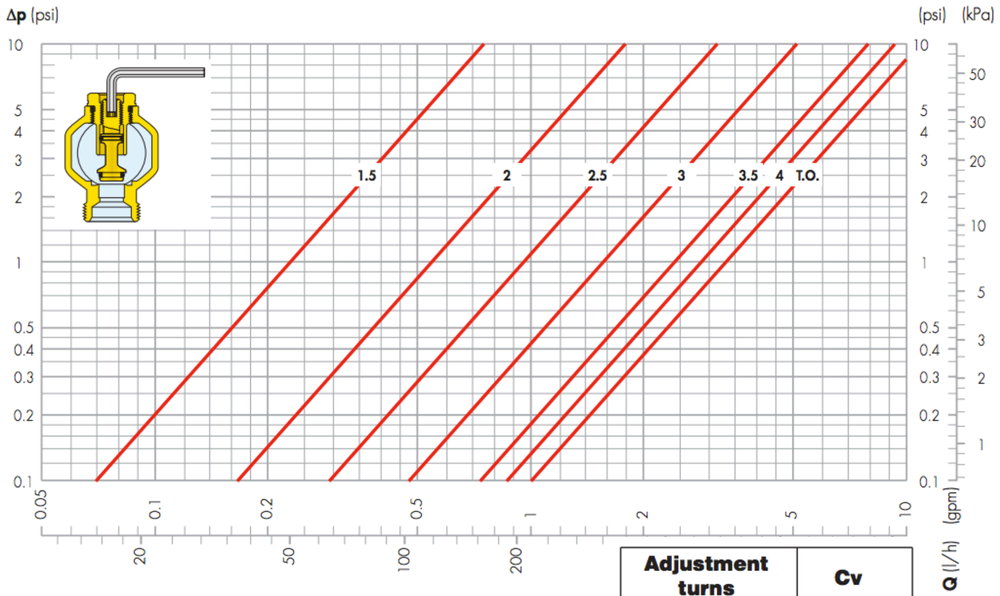
CE

Code	Voltage (V)
656104	24
656114 **With auxiliary microswitch**	24

Technical specification

- Materials: - protection shell	self-extinguishing polycarbonate
- color	white version with micro: grey
- Normally closed	
- Electric supply:	24 V (ac)
- Starting current:	800 mA
- Working current:	24 V (ac) - 140 mA
- Power consumption:	3 W
- Auxiliary microswitch contacts rating:	5 A
- Protection class:	IP 44 (in vertical position)
- Double insulation construction:	CE
- Max. ambient temperature:	122°F (50°C)
- Operating time:	opening and closing from 120 s to 180 s
- Length of supply cable:	31 1/2" (0.8 m)

Hydronic characteristics of supply manifold for 663 series only



Adjustment turns	Cv
1.5	0.25
2	0.55
2.5	1.0
3	1.7
3.5	2.5
4	3.0
Totally Open (T.O.)	3.2

Cv = flow in gal/min for a pressure loss of 1 psi

15

Engineer: John Easterling
Drawing: John Easterling
Date: 6/26/13

Meehan Cabin HVAC Design
Radiant Manifold Specs

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