ADVANCED MANUFACTURING & POWER SYSTEMS INC.
1965 BENNETT DRIVE, DELAND, FL 32724
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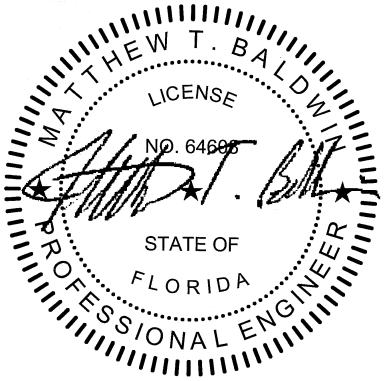
ENGINEERING STRUCTURAL CALCULATIONS
For
Gillette 68" Frame Genset

September 8, 2016

68" Frame Genset Models:

PR-250
SP-250
SP-300
SPJD-300

Designed with reference from: **2014 Florida Building Code 5th Edition with 2016 Supplements**
ASCE 7 - Minimum Design Loads for Buildings and Other Structures
2005 Aluminum Association Design Manual
ANSI/AISC 360-05 Specifications for Structural Steel Buildings



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Project Information

Project Name/Model #	- Gillette 68" Frame Genset
Project Number	-
Project Description	- 180mph Windload Calculations
Project Location	-
Customer	-
Mounting Location	- Ground

Enclosure Materials

Roof Panels	- 0.080 Aluminum Panel - 5052-H34
Wall Panels	- 0.062 Aluminum Panel - 5052-H34

Components

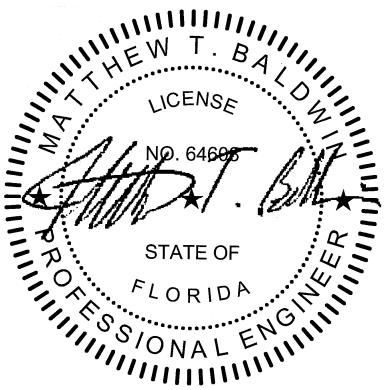
GenSet Manufacturer	- Gillette Generators, Inc.		
GenSet Size and Model	- 68" Frame	Supported by -	Base
Base	- Bent Aluminum Frame		

Fasteners/Hardware

		Bolt Size	Grade/Finish
Panels	-	5/16" - 18	Grade 18-8/SS
Enclosure to Base	-	5/16" - 18	Grade 18-8/SS

Specification Requirements

Wind Speed	-	180	mph (Greater of Design or Site)
Exposure Category	-	D	



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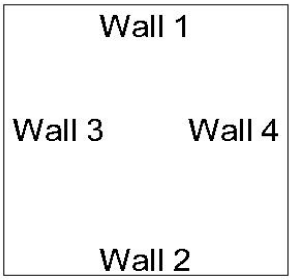
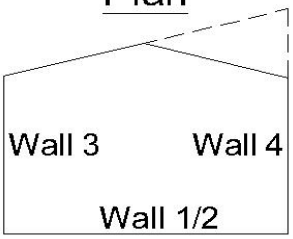
Enclosure Dimensions & Component Weights

Gillette 68" Frame Genset

Roof Style- Flat



Plan



Elevation

Enclosure Dimensions (ft)

Wall	Length (ft)		Height (ft)
1	3	x	3.65
2	3	x	3.65
3	6.84	x	3.65
4	6.84	x	3.65

Base Dimensions

Width (Wall 1/2 Side)	=	36	in
Length (Wall 3/4 Side)	=	68	in
Height	=	4	in

Roof/Eave Information

Roof Pitch Angle - *(θ)*	=	0.0	Degrees
Eave/Roof Height - *h*	=	3.65	

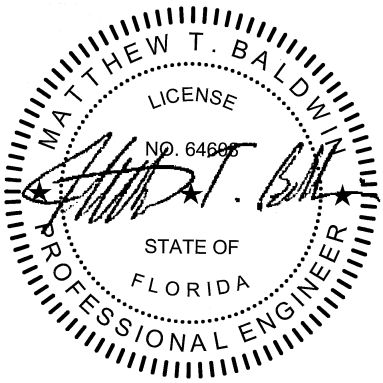
Structure Areas

Walls 1/2 Area -	*(w1)*	=	11.0	ft^2	=	1,577	in^2
Walls 3/4 Area -	*(w3)*	=	25.0	ft^2	=	3,597	in^2
Roof Area -	*(R)*	=	20.5	ft^2	=	2,957	in^2

Base Side 1/2	*(T1)*	=	144.0 in2
Base Side 3/4	*(T3)*	=	272.0 in2

Component Weights

Genset	=	0	lbs	(Varies, so will use zero to be conservative/most uplift to resist)
Enclosure	=	150	lbs	(Based on Aluminum to be conserative/most uplift to resist)
Base Frame	=	100	lbs	(Based on Aluminum to be conserative/most uplift to resist)



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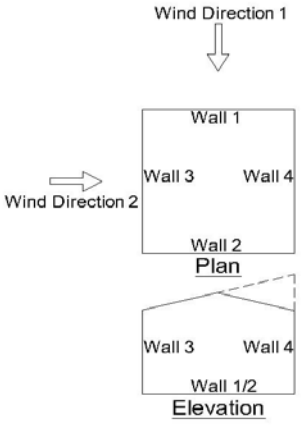
MWFRS Net Pressures

Gillette 68" Frame Genset

Wind

Directional Procedure method from
ASCE 7 are utilized in these calculations.

Enclosure Classification	-	Enclosed	
Exposure Category	-	D	
Basic Wind Speed	(V)	180	mph
Wind Directionality Factors	(K_d)	0.85	
Internal Pressure Coefficients	(GC_{pi})	± 0.18	
Velocity Pressure Exposure Coefficient	(K_z)	1.03	
Roof Mean Height Above Ground Level	(z)	3.98	ft
Velocity Pressure	(q)	72.63	psf



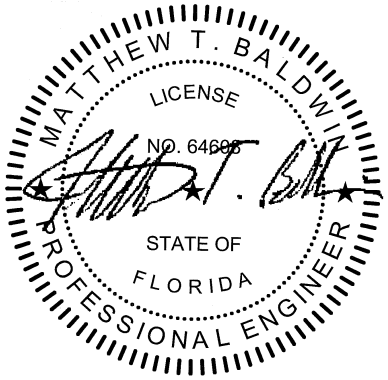
Wind Direction 1

		Enclosure							
		Wall #			Roof				
		1	2	3&4	Parallel to Ridge				
					$(C_p)1$ (Distance From Windward Edge)				$(C_p)2$
		Windward	Leeward	Side	0 to 1.8	1.8 to 3.7	3.7 to 6.8		
Background Response Factor	(Q)	0.98	0.98	0.97	0.98				
Gust Effect Factors	(G)	0.92	0.92	0.91	0.92				
External Pressure Coefficients	(C_p)	0.80	-0.286	-0.70	-0.91	-0.89	-0.51		-0.18
Net Pressures with + (GC_{pi}) - psf	(Net_{p+})	40.1	-32.1	-59.5	-73.5	-72.0	-47.2		-25.0
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	66.3	-5.9	-33.3	-47.4	-45.9	-21.1		1.1

Wind Direction 2

		Enclosure								
		Wall #			Roof - Normal To Ridge					
		3	4	1&2						
					$(C_p)1$ (Distance From Windward Edge)				$(C_p)2$	
		Windward	Leeward	Side	0 to 1.8	> 1.8				
Background Response Factor	(Q)	0.97	0.97	0.98	0.97					
Gust Effect Factors	(G)	0.91	0.91	0.92	0.91					
External Pressure Coefficients	(C_p)	0.80	-0.5	-0.70	-1.04	-0.70			-0.18	
Net Pressures with + (GC_{pi}) - psf	(Net_{p+})	39.9	-46.2	-59.6	-82.0	-59.5			-25.0	
Net Pressures with - (GC_{pi}) - psf	(Net_{p-})	66.1	-20.1	-33.5	-55.8	-33.3			1.1	

Plus and minus signs signify pressures acting toward or away from the surfaces, respectively.



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Structural Calculations - Roof

Gillette 68" Frame Genset

Critical Loads & Pressures

Wind Pressures

Downforce	1.146	psf	=	0.01 psi
Uplift	-81.99	psf	=	-0.57 psi

Section Properties

0.080 Aluminum Panel - 5052-H34

Modulus of Elasticity	(E)	=	1.02E+04 ksi
Safety Factor	(n_u)	=	1.95
Safety Factor	(n_y)	=	1.65
Coefficient	(k_t)	=	1.00
Tensile Ultimate Strength	(F_{tu})	=	34 ksi
Tensile Yield Strength	(F_{ty})	=	26 ksi
Compressive Yield Strength	(F_{cy})	=	24 ksi
Shear Ultimate Strength	(F_{su})	=	20 ksi

Entire Roof Uplift Calculations

Roof Area

Area of Roof Subjected to Uplift (R) = 2,957 in^2

Roof Uplift Calculated Forces

Wind Load Uplift Force (w_{ru}) = -1,683 lbs

Total Roof Design Uplift (W_{ru}) = -1,683 lbs

Mounting Hardware - Roof Frame to Wall Panels

Screws Along Length - 1 Side	=	5	5/16" - 18	- Grade 18-8/SS
Screws Along Width - 1 Side	=	2	5/16" - 18	- Grade 18-8/SS
Total Mounting Screws	=	14	5/16" - 18	- Grade 18-8/SS

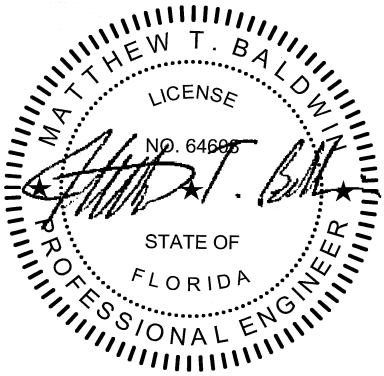
Entire Roof Uplift Design Calculations

Grade 18-8/SS	=	150,000	psi
5/16" Bolt Nominal Diameter	=	0.255	in
5/16" Bolt Effective Area	=	0.051	in^2
5/16" Bolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.875	in
Wall Panel Tensile Ult. Strength	=	34	ksi
Wall Panel Tensile Yield Strength	=	26	ksi
Safety Factor	=	3	
Wall Panel Nominal Thickness	=	0.062	in
Maximum Tensile Strength	=	439.2	lbs
Maximum Shear/Bearing Strength	=	408.6	lbs
Max. Shear Load per Screw	=	408.6	lbs

Max. Total Screws Shear Strength (P_{ts}) = 5,720 lbs

Conclusion

(W_{ru}) 1,683 lbs < (P_{ts}) 5,720 lbs **OK**



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Roof Panel Uplift Calculations

Roof Panel Critical Member Dimensions

Critical Panel Length (L_p) = 68 in
Critical Panel Width (W_p) = 36 in

Roof Panel Uplift Calculated Forces

Distributed Loads

Wind Load Uplift Force (w_{pu}) = 1,393.9 lbs

Mounting Hardware - Roof Panel to Roof Frame

Screws Along Length - 1 Side =	7	5/16" - 18	- Grade 18-8/SS
Screws Along Width - 1 Side =	3	5/16" - 18	- Grade 18-8/SS

Roof Panel Uplift Design Calculations

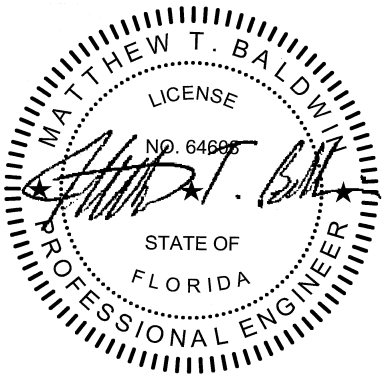
Grade 18-8 Ultimate Strength	=	150,000	psi
5/16 Bolt Nominal Diameter	=	0.255	in
5/16 Bolt Effective Area	=	0.051	in^2
5/16 SBolt Threads per Inch	=	18	
Washer Nominal Diameter	=	0.875	in
Roof Panel Tensile Ult. Strength	=	34	ksi
Roof Panel Tensile Yield Strength	=	26	ksi
Safety Factor	=	3	
Roof Panel Nominal Thickness	=	0.080	in

		Roof Frame		
Maximum Tensile Strength	=	439.2	lbs	(Accounts for screw pull-over strength)
Maximum Shear/Bearing Strength	=	408.6	lbs	
Max. Tensile Load per Screw	=	408.6	lbs	

Max. Total Screws Tensile Strength (P_{ts}) = 8,171 lbs

Conclusion

(w_{pu}) 1,394 lbs < (P_{ts}) 8,171 lbs **OK**



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Structural Calculations - Walls/Columns

Gillette 68" Frame Genset

Critical Wind Load Pressures and Roof Forces

Walls 1 & 2

Maximum Pressures Acting:

Toward	66.3	psf	=	0.4602	psi
Away	-59.6	psf	=	-0.4140	psi

Walls 3 & 4

Maximum Pressures Acting:

Toward	66.1	psf	=	0.4589	psi
Away	-59.5	psf	=	-0.4129	psi

Critical Wall Panel Dimensions

Critical/Maximum Panel Width		=	33.5	in
Critical/Maximum Panel Height		=	42.0	in

Section Properties

0.062 Aluminum Panel - 5052-H34

Cross Sectional Area	(A)	=	2.21	in^2
Moment of Inertia - x	(I_x)	=	0.05	in^4
Section Modulus - x	(S_x)	=	0.81	in^3
Radius of Gyration - x	(r_x)	=	0.15	in
Modulus of Elasticity	(E)	=	1.02E+04	ksi
Safety Factor	(n_u)	=	1.95	
Factor of Safety	(n_y)	=	1.65	
Coefficient - Tension Member	(k_t)	=	1.0	
Tensile Ultimate Strength	(F_{tu})	=	34	ksi
Tensile Yield Strength	(F_{ty})	=	26	ksi
Shear Ultimate Strength	(F_{su})	=	20	ksi
Compressive Yield Strength	(F_{cy})	=	23	ksi

Critical Wall Panel Calculated Forces

Maximum Wind Pressure on Walls

Maximum + Wind Pressure	=	0.4602	psi
Maximum - Wind Pressure	=	-0.4140	psi

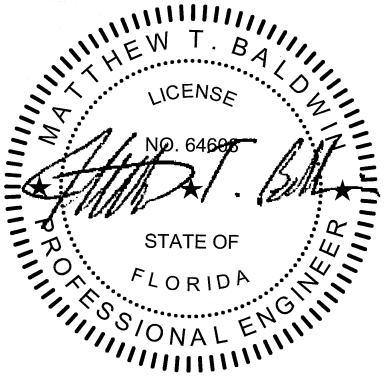
Plus and minus signs signify pressures acting toward or away from the surfaces, respectively.

Wind Shear Distributed Loads on Critical Panel

Maximum + Wind Shear	=	15.4	lbs/in
Maximum - Wind Shear	=	-13.9	lbs/in

Total Wind Shear on Critical Panel

Total Panel Design Shear	(V_{ww})	=	647.5	lbs



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Critical Panel Roof Load (Roof to Wall)

Axial Roof Load (W_{wr}) = 0.0 lbs

Mounting Hardware - Wall Panel to Wall Panel

To be conservative, the 'wall to roof' and 'wall to floor' connections are negleted.

Bolts Along Length - 1 Side = 3 5/16" - 18 - Grade 18-8/SS

Total Mounting Screws = 6 5/16" - 18 - Grade 18-8/SS

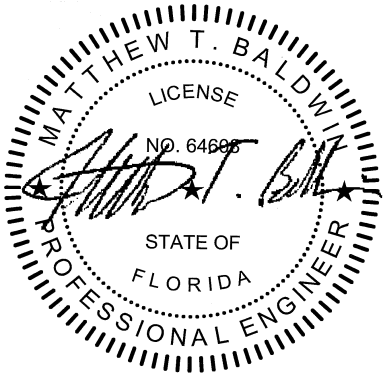
Wall Panel Design Calculations

Mounting Hardware - Shear and Tension

Grade 18-8/SS	=	150,000	psi
Grade 18-8/SS Shear Strength	=	30,000	psi (Includes Reduction Factor)
Grade 18-8/SS Tensile Strength	=	57,000	psi (Includes Reduction Factor)
5/16" Bolt Effective Area	=	0.0510	in^2
Shear Strength per Bolt	=	1,530	lbs
Tensile Strength per Bolt	=	2,907	lbs
Total Bolts Shear Strength (R_{vb})	=	9,180	lbs
Total Bolts Tensile Strength (R_{tb})	=	17,442	lbs

Conclusion

(V_{ww}) 647 lbs < (R_{vb}) 9,180 lbs **OK**



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Structural Calculations - Enclosure to Base

Gillette 68" Frame Genset

Critical Pressures & Loads

To determine maximum moment forces, pressures are algebraically combined relative to toward or away forces (+ & -) and each wind direction.

Wind Direction 1

Net Pressures with + Internal Pressure *(+Gcpi)*

Walls 1 & 2	-	72.2	psf =	0.5014	psi
Wall 3 or 4	-	59.5	psf =	0.4129	psi
Roof Uplift	-	73.5	psf =	0.5107	psi

Net Pressures with - Internal Pressure *(-Gcpi)*

Walls 1 & 2	-	72.2	psf =	0.5014	psi
Wall 3 or 4	-	33.3	psf =	0.2313	psi
Roof Uplift	-	47.4	psf =	0.3291	psi

Wind Direction 2

Net Pressures with + Internal Pressure *(+Gcpi)*

Walls 3 & 4	-	86.1	psf =	0.5982	psi
Wall 1 or 2	-	59.6	psf =	0.4140	psi
Roof Uplift	-	82.0	psf =	0.5694	psi

Net Pressures with - Internal Pressure *(-Gcpi)*

Walls 3 & 4	-	86.1	psf =	0.5982	psi
Wall 1 or 2	-	33.5	psf =	0.2324	psi
Roof Uplift	-	55.8	psf =	0.3878	psi

Enclosure Critical Dimensions & Weights

Total Enclosure Weight		(W_t)	=	150	lbs	(Includes all components)
Walls 1/2 Area	-	*(w1)*	=	1576.8	in^2	
Walls 3/4 Area	-	*(w3)*	=	3597.1	in^2	
Roof Area	-	*(R)*	=	2956.5	in^2	

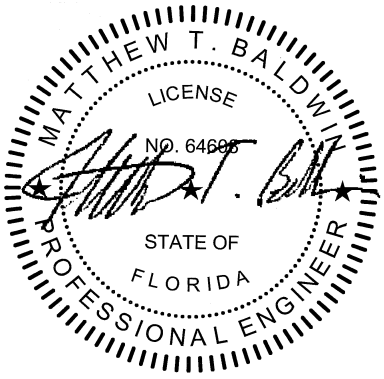
Enclosure Calculated Forces

Maximum Wind Load Forces on Walls

Wind Direction 1

Net Forces with + Internal Pressure *(+Gcpi)*

Walls 1/2	-	=	791	lbs
Wall 3 or 4	-	=	1,485	lbs
Roof Uplift	-	=	1,510	lbs



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Net Forces with - Internal Pressure*(-Gcpi)*

Walls 1/2	-	=	791	lbs
Wall 3 or 4	-	=	832	lbs
Roof Uplift	-	=	973	lbs

Wind Direction 2

Net Forces with + Internal Pressure*(+Gcpi)*

Walls 3/4	-	=	2,152	lbs
Wall 1 or 2	-	=	653	lbs
Roof Uplift	-	=	1,683	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Walls 3/4	-	=	2,152	lbs
Wall 1 or 2	-	=	366	lbs
Roof Uplift	-	=	1,147	lbs

Enclosure Overturn Forces

(Postive forces act upward, negative forces act downward)

Wind Direction 1

Net Forces with + Internal Pressure*(+Gcpi)*

Overturn on Walls 1/2	=	816	lbs
Overturn on Walls 3/4	=	1,508	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Overturn on Walls 1/2	=	547	lbs
Overturn on Walls 3/4	=	843	lbs

Wind Direction 2

Net Forces with + Internal Pressure*(+Gcpi)*

Overturn on Walls 3/4	=	2,001	lbs
Overturn on Walls 1/2	=	941	lbs

Net Forces with - Internal Pressure*(-Gcpi)*

Overturn on Walls 3/4	=	1,732	lbs
Overturn on Walls 1/2	=	521	lbs

Design Overturn Force (O_E) = 2,001 lbs Acting On Wall 3/4

Mounting Hardware - Enclosure to Base/Tank or Pad

To be conservative, half the bolt connections along the adjacent walls are neglected.

No. of Bolt Connections Along Wall 3/4 = 5 5/16" - 18 - Grade 18-8/SS

Enclosure Overturn Design Calculations

Grade 18-8 Ultimate Strength	=	150,000	psi
Grade 18-8 Shear Strength	=	30,000	psi (Includes Reduction Factor)
5/16" Bolt Effective Area	=	0.051	in^2
Shear Strength per Bolt	=	1,530	lbs

Total Bolts Shear Strength (R_{vb}) = 7,650 lbs

Conclusion

(O_E) 2,001 lbs < (R_v) 7,650 lbs **OK**

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