```
*****************************************************************************
*  Vibration  Analysis          by HeatAidDesign                            *
*  Date of Running        2017/12/12/14/30/20                               *
*****************************************************************************
```

Title : V***_S***_2014_12_22
Service : Design_Condition_C1

Gas Analysis (Weight Fraction)/(Volume Fraction)

CO2	SO2	N2	H2O	O2	Ar
0.04887	0.00000	0.72942	0.05612	0.15344	0.01215
0.03140	0.00000	0.73630	0.08810	0.13560	0.00860

GAS FLOW 1265800. kg/hr 1003236. Nm3/hr 1.2617 kg/Nm3 351.61 kg/sec

MODULE NUMBER		1	2	3	4	5	6	
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE	
Heating Surface	m2	3425.1	3425.1	19734.5	8222.7	14800.9	11511.8	61120.1
Finned Outside Surface Area	m2/m	0.8353	0.8353	1.6922	1.6922	1.6922	1.6922	
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10	
Tube Min Thickness	mm	2.4000	2.4000	2.4000	2.4000	2.4000	2.4000	
Tube Length	mm	16500.0	16500.0	16500.0	16500.0	16500.0	16500.0	
Tube Material		A213 T22	A213 T22	A178 GrA	A178 GrA	A178 GrA	A178 GrA	
Number of Transverse Tubes		56	56	56	56	56	56	2296
Transverse Spacing	mm	88.900	88.900	88.900	88.900	88.900	88.900	
Number of tubes on w/steam side		2.	2.	12.	1.	9.	1.	
Number of tube passes		2.	2.	1.	5.	1.	7.	
Number of Longitudinal Rows		4.	4.	12.	5.	9.	7.	
Longitudinal Spacing	mm	95.000	95.000	95.000	95.000	95.000	95.000	
Tube Arrang.(1=Stagg,2=lnline)		1.	1.	1.	1.	1.	1.	
Finned Type.(0=No,1=Solid,2=Serr)		2.	2.	2.	2.	2.	2.	
Fin Height	mm	12.7000	12.7000	19.0500	19.0500	19.0500	19.0500	
Fin Thickness	mm	1.2000	1.2000	1.0000	1.0000	1.0000	1.0000	
Fin pitch	mm	5.0787	5.0787	3.7355	3.7355	3.7355	3.7355	
Fin per Meter	ea/m	196.90	196.90	267.70	267.70	267.70	267.70	
Fin per Inch	ea/in	5.00	5.00	6.80	6.80	6.80	6.80	
Fin Material		SUS409	SUS409	C. Steel	C. Steel	C. Steel	C. Steel	
Fin Segment	mm	4.00000	4.00000	4.00000	4.00000	4.00000	4.00000	
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400	
Baffle of Inner Casing	mm	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	

MODULE NUMBER		1	2	3	4	5	6
= Strouhal number for inline bank of tubes by Y.N.Chen =							
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Reynold Number of Gas Side		8357.	8607.	10448.	11882.	13175.	14683.
Effective Diameter	mm	44.10	44.10	48.30	48.30	48.30	48.30
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
SL/Do (Chen Sh)		4.99	4.99	4.99	4.99	4.99	4.99
ST/Do (Chen Sh)		2.33	2.33	2.33	2.33	2.33	2.33
Strouhal Number	-	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Chen Number(for bare)<2000(No Fv)		9156.	9430.	11447.	13018.	14435.	16087.
Chen Number(for Effec. Dia.)		9777.	10070.	12628.	14361.	15924.	17746.

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Tube Material		A213 T22	A213 T22	A178 GrA	A178 GrA	A178 GrA	A178 GrA
Tube Weight of unit meter	kg/m	2.11	2.11	2.11	2.11	2.11	2.11
Fin Weight of unit meter	kg/m	3.31	3.31	5.64	5.64	5.64	5.64
Tube & Fin Weight of 1m	kg/m	5.42	5.42	7.75	7.75	7.75	7.75
Steam/Water Density	kg/m3	22.3181	28.6725	335.3807	864.4528	54.0256	962.7555
Steam/Water Weight of 1m	kg/m	0.0194	0.0250	0.2921	0.7529	0.0471	0.8385
Weight of 1 m tube,Me	kg/m	5.4393	5.4448	8.0446	8.5054	7.7995	8.5910
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
Tube Min Thickness	mm	2.4000	2.4000	2.4000	2.4000	2.4000	2.4000
Support-Support Condition L= 2.500000 m							
Tube Length	mm	2500.0	2500.0	2500.0	2500.0	2500.0	2500.0
Factor Determined by Vib.Mode=1	C	9.87	9.87	9.87	9.87	9.87	9.87
Factor Determined by Vib.Mode=2	C	39.48	39.48	39.48	39.48	39.48	39.48
Factor Determined by Vib.Mode=3	C	88.80	88.80	88.80	88.80	88.80	88.80
Tube Material		A213 T22	A213 T22	A178 GrA	A178 GrA	A178 GrA	A178 GrA

Mean Tube Temp	deg C	496.8	402.1	304.8	217.8	149.2	103.0
Youngs Modulus,Value*10^3	MPa	175.32	183.83	184.43	190.93	195.05	197.82
Youngs Modulus,E*10^6	kg/m2	17877.36	18745.30	18806.23	19469.35	19889.06	20171.79
Gravitational Constant,g	m/sec2	9.81	9.81	9.81	9.81	9.81	9.81
Weight of 1 m tube,Me	kg/m	5.4393	5.4448	8.0446	8.5054	7.7995	8.5910
Moment of Inertia,I*10^-9	m4	43.08	43.08	43.08	43.08	43.08	43.08
Natural Freq. of Vib.(mode=1)	Hz	9.37	9.59	7.90	7.82	8.25	7.92
Natural Freq. of Vib.(mode=2)	Hz	37.47	38.35	31.60	31.27	33.00	31.67
Natural Freq. of Vib.(mode=3)	Hz	84.27	86.25	71.07	70.33	74.23	71.23
Fixed - Fixed Condition L= 16.50000	m						
Factor Determined by Vib.Mode=1	C	22.37	22.37	22.37	22.37	22.37	22.37
Factor Determined by Vib.Mode=2	C	61.67	61.67	61.67	61.67	61.67	61.67
Factor Determined by Vib.Mode=3	C	120.90	120.90	120.90	120.90	120.90	120.90
Natural Freq. of Vib.(mode=1)	Hz	0.49	0.50	0.41	0.41	0.43	0.41
Natural Freq. of Vib.(mode=2)	Hz	1.34	1.38	1.13	1.12	1.18	1.14
Natural Freq. of Vib.(mode=3)	Hz	2.63	2.70	2.22	2.20	2.32	2.23
Number of Longitudinal Rows		4.	4.	12.	5.	9.	7.
SL/Do (Chen Sh)		4.99	4.99	4.99	4.99	4.99	4.99
ST/Do (Chen Sh)		2.33	2.33	2.33	2.33	2.33	2.33
Strouhal Number	-	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500
Inlet Vel. of Gas Side.Vi	m/sec	18.94	18.48	18.93	14.67	13.10	10.88
Outlet Vel. of Gas Side.Vo	m/sec	18.48	17.26	14.64	13.10	10.86	9.76
Mean Vel. of Gas Side.Vm	m/sec	18.71	17.87	16.78	13.88	11.98	10.32
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
Effective Diameter	mm	44.10	44.10	48.30	48.30	48.30	48.30
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
Freq. of Vortex.Fv	Hz	122.78	117.28	110.14	91.10	78.63	67.71
Natural Freq. of Vib.(mode=1)	Hz	9.37	9.59	7.90	7.82	8.25	7.92
Ratio of Fv/Fn (mode=1)	-	13.11	12.23	13.94	11.65	9.53	8.55
If Fv/Fn < 0.7 or Fv/Fn > 1.3 => OK							
If Fv/Fn<0.7 or > 1.3 => OK		Yes	Yes	Yes	Yes	Yes	Yes

ASME Section 3 Appendix N-1331.2 Recommended formula
Damping Ratio = 1.00 % Stable Constant(C) = 3.00
Chen proposed the criterion below for the occurrence of fluidelastic instability based on many experimental data.

Stable Constant(C)		3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Natural Freq. of Vib.(mode=1)	Hz	9.37	9.59	7.90	7.82	8.25	7.92
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
Mean Vel. of Gas Side.Vm	m/sec	18.71	17.87	16.78	13.88	11.98	10.32
Non-dimensional flow velocity		52.43	48.93	55.76	46.61	38.12	34.21
Weight of 1 m tube,Me	kg/m	5.4393	5.4448	8.0446	8.5054	7.7995	8.5910
Gas-side fluid density	kg/m3	0.4265	0.4465	0.5209	0.6303	0.7300	0.8481
Damping factor (ratio)		0.0100	0.0100	0.0100	0.0100	0.0100	0.0100
Mass Damping		551.98	527.80	668.41	584.05	462.46	438.47
Mass Damping^0.5		23.49	22.97	25.85	24.17	21.50	20.94
Stable Constant C		2.23	2.13	2.16	1.93	1.77	1.63
If C < Stable Constant(C) => Stable		Yes	Yes	Yes	Yes	Yes	Yes
Critical Velcoity m/sec C= 3.00		25.15	25.17	23.34	21.59	20.28	18.95
If Vcrit > Vi => OK		Yes	Yes	Yes	Yes	Yes	Yes

C is a fitting constant that is a function of the stiffness ofthe system, and the pitch-to-diameter ratio of the tube array.
The Connors criterion provides a suitable stability map with adistinct boundary between stable and unstable flow. However, a look into the literature shows a large scatter around the suggested stability boundary fixed by the ASME boiler code at C=3

ASME Section 3 Appendix N-1331.2 Recommended formula
Damping Ratio = 0.50 % Stable Constant(C) = 2.40
Chen proposed the criterion below for the occurrence of fluidelastic instability based on many experimental data.

Stable Constant(C)		2.4000	2.4000	2.4000	2.4000	2.4000	2.4000
Natural Freq. of Vib.(mode=1)	Hz	9.37	9.59	7.90	7.82	8.25	7.92
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
Mean Vel. of Gas Side.Vm	m/sec	18.71	17.87	16.78	13.88	11.98	10.32
Non-dimensional flow velocity		52.43	48.93	55.76	46.61	38.12	34.21
Weight of 1 m tube,Me	kg/m	5.4393	5.4448	8.0446	8.5054	7.7995	8.5910
Gas-side fluid density	kg/m3	0.4265	0.4465	0.5209	0.6303	0.7300	0.8481
Damping factor (ratio)		0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Mass Damping		275.99	263.90	334.21	292.02	231.23	219.23
Mass Damping^0.5		16.61	16.25	18.28	17.09	15.21	14.81
Stable Constant C		3.16	3.01	3.05	2.73	2.51	2.31
If C < Stable Constant(C) => Stable		No	No	No	No	No	Yes
Critical Velcoity m/sec C= 2.40		14.23	14.24	13.21	12.21	11.47	10.72
If Vcrit > Vi => OK		No	No	No	No	No	Yes

ASME Section 3 Appendix N-1331.2 Recommended formula

Damping Ratio = 0.50 % Stable Constant(C) = 6.49

Chen proposed the criterion below for the occurrence of fluidelastic instability based on many experimental data.

Stable Constant(C)		6.4900	6.4900	6.4900	6.4900	6.4900	6.4900
Natural Freq. of Vib.(mode=1)	Hz	9.37	9.59	7.90	7.82	8.25	7.92
Tube Diameter	mm	38.10	38.10	38.10	38.10	38.10	38.10
Mean Vel. of Gas Side.Vm	m/sec	18.71	17.87	16.78	13.88	11.98	10.32
Non-dimensional flow velocity		52.43	48.93	55.76	46.61	38.12	34.21
Weight of 1 m tube,Me	kg/m	5.4393	5.4448	8.0446	8.5054	7.7995	8.5910
Gas-side fluid density	kg/m3	0.4265	0.4465	0.5209	0.6303	0.7300	0.8481
Damping factor (ratio)		0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Mass Damping		275.99	263.90	334.21	292.02	231.23	219.23
Mass Damping^0.5		16.61	16.25	18.28	17.09	15.21	14.81
Stable Constant C		3.16	3.01	3.05	2.73	2.51	2.31
If C < Stable Constant(C) => Stable		Yes	Yes	Yes	Yes	Yes	Yes
Critical Velcoity m/sec C= 6.49		38.48	38.51	35.71	33.03	31.02	28.99
If Vcrit > Vi => OK		Yes	Yes	Yes	Yes	Yes	Yes

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = Without baffle ; N = 1							
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	55.32	54.69	52.95	46.87	44.39	40.57
Acoustic Frequency(mode=2)	Hz	110.65	109.38	105.90	93.75	88.79	81.15
Acoustic Frequency(mode=3)	Hz	165.97	164.06	158.85	140.62	133.18	121.72
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		No	No	No	No	No	No
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	54.69	52.95	46.87	44.39	40.57	38.50
Acoustic Frequency(mode=2)	Hz	109.38	105.90	93.75	88.79	81.15	76.99
Acoustic Frequency(mode=3)	Hz	164.06	158.85	140.62	133.18	121.72	115.49
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		No	No	No	No	No	No

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = With one baffle ; N = 2							
If a baffle or plate is used to divide the duct width into two regions							
the acosutic frequency is doubled as the wavelength or width is halved.							
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	110.65	109.38	105.90	93.75	88.79	81.15
Acoustic Frequency(mode=2)	Hz	221.30	218.75	211.79	187.50	177.58	162.29
Acoustic Frequency(mode=3)	Hz	331.95	328.13	317.69	281.25	266.37	243.44
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		No	No	No	No	No	Yes
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	109.38	105.90	93.75	88.79	81.15	76.99
Acoustic Frequency(mode=2)	Hz	218.75	211.79	187.50	177.58	162.29	153.98
Acoustic Frequency(mode=3)	Hz	328.13	317.69	281.25	266.37	243.44	230.98
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		No	No	No	No	No	Yes

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = with 2 baffle ; N =		3					
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	165.97	164.06	158.85	140.62	133.18	121.72
Acoustic Frequency(mode=2)	Hz	331.95	328.13	317.69	281.25	266.37	243.44
Acoustic Frequency(mode=3)	Hz	497.92	492.19	476.54	421.87	399.55	365.16
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	164.06	158.85	140.62	133.18	121.72	115.49
Acoustic Frequency(mode=2)	Hz	328.13	317.69	281.25	266.37	243.44	230.98
Acoustic Frequency(mode=3)	Hz	492.19	476.54	421.87	399.55	365.16	346.46
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes

This project shall be subject to this condition.

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = with 3 baffle ; N =		4					
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	221.30	218.75	211.79	187.50	177.58	162.29
Acoustic Frequency(mode=2)	Hz	442.60	437.51	423.59	375.00	355.16	324.58
Acoustic Frequency(mode=3)	Hz	663.89	656.26	635.38	562.50	532.74	486.88
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	218.75	211.79	187.50	177.58	162.29	153.98
Acoustic Frequency(mode=2)	Hz	437.51	423.59	375.00	355.16	324.58	307.97
Acoustic Frequency(mode=3)	Hz	656.26	635.38	562.50	532.74	486.88	461.95
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = with 4 baffle ; N =		5					
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	276.62	273.44	264.74	234.37	221.97	202.86
Acoustic Frequency(mode=2)	Hz	553.25	546.88	529.49	468.75	443.95	405.73
Acoustic Frequency(mode=3)	Hz	829.87	820.32	794.23	703.12	665.92	608.59
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4

Result_file

Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	273.44	264.74	234.37	221.97	202.86	192.48
Acoustic Frequency(mode=2)	Hz	546.88	529.49	468.75	443.95	405.73	384.96
Acoustic Frequency(mode=3)	Hz	820.32	794.23	703.12	665.92	608.59	577.44
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes

MODULE NUMBER		1	2	3	4	5	6
GAS SIDE		HP_SH2	HP_SH1	HP_EVAP	HP_ECON	Int_Deaer	LTE
Design Condition = with 5 baffle ; N = 6							
Inlet Condition of Bundle							
INLET TEMPERATURE	deg C	545.0	525.2	472.6	304.6	242.9	155.3
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3448	1.3466	1.3513	1.3670	1.3728	1.3811
Velocity of Sound (Gas)	m/sec	568.74	562.19	544.31	481.87	456.38	417.09
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	331.95	328.13	317.69	281.25	266.37	243.44
Acoustic Frequency(mode=2)	Hz	663.89	656.26	635.38	562.50	532.74	486.88
Acoustic Frequency(mode=3)	Hz	995.84	984.39	953.08	843.75	799.11	730.31
Freq. of Vortex(in).Fv	Hz	124.28	121.28	124.22	96.24	85.96	71.37
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes
Outlet Condition of Bundle							
OUTLET TEMPERATURE	deg C	525.2	472.6	304.6	242.9	155.3	111.4
Molecular Mass of Gas	kg/mol	0.02828	0.02828	0.02828	0.02828	0.02828	0.02828
Universal Gas Constant	J/mol-K	8.31400	8.31400	8.31400	8.31400	8.31400	8.31400
Adiabatic Constant		1.3466	1.3513	1.3670	1.3728	1.3811	1.3852
Velocity of Sound (Gas)	m/sec	562.19	544.31	481.87	456.38	417.09	395.74
Width of HRSG	m	5.1400	5.1400	5.1400	5.1400	5.1400	5.1400
Acoustic Frequency(mode=1) Fa	Hz	328.13	317.69	281.25	266.37	243.44	230.98
Acoustic Frequency(mode=2)	Hz	656.26	635.38	562.50	532.74	486.88	461.95
Acoustic Frequency(mode=3)	Hz	984.39	953.08	843.75	799.11	730.31	692.93
Freq. of Vortex(out).Fv	Hz	121.28	113.28	96.06	85.96	71.30	64.05
If Fa > Fv x 1.2 => OK		Yes	Yes	Yes	Yes	Yes	Yes

Since the Design_Condition_C1
case is most critical case on tube vibartion analysis.
This case is only shown on this calculation sheet.