· · NFPA 68 Standard on Explosion Protection by Deflagration Venting - 2013 Edition · ·

1.	Service:	Dust Handling - Collection		Project No:	BR-549	Date:	3/12/2014
2.	Client:	Confidential		Equipment:	Building 45 Baghouse		

· · Equipment / System Specifics · ·

3.	Dust:	Paper Dust				
		Metric	**Unit**	**Imperial**	**Unit**	**Reference**
4.	P_{red}:	3.522	bar-g	51.06	psig	*Maximum pressure developed during a vented deflagration*
5.	P_{stat}:	0.250	bar-g	3.63	psig	*Pressure that activates a vent closure*
6.	P_{max}:	8.000	bar-g	116.00	psig	*Maximum pressure developed in a contained deflagration*
7.	V:	25.00	m^3	882.77	cu ft	*Volume of equipment being analyzed*
8.	L/D Ratio:	4.00				*Ratio of height -to- diameter*
9.	K_{st}:	200	bar-m/sec			*Deflagration index of a dust cloud*

8.2.2 - Venting by Means of Low-Inertia Vent Enclosures ..... for Enclosures L/D ≤ 2.0

10.	A_{v0} =	0.3133	m^2	3.37	sq feet	$A_{v0}=1\cdot10^{-4}\cdot(1+1.54\cdot P_{stat}^{4/3})\cdot K_{st}\cdot V^{3/4}\ [(P_{max}/P_{red})-1]^{0.5}$

8.2.3 - Elongated Enclosure Area, L/D > 2 & L/D ≤ 6, ... if L/D ≤ 2.0 Eq. 8.2.2 result is shown

11.	A_{v1} =	0.3133	m^2	3.37	sq feet	$A_{v1}= A_{v0}\cdot[1+0.6\cdot(L/D-2)^{0.75}\cdot\exp(-0.95\cdot P_{red}^2)$

8.2.5 - High Turbulnce Correction, if velocity is > 20-m/sec

12.	Q_{air} =	0.118	m^3/sec	14,998	SCFH	*Air flow rate through the equipment*
13.	L_{equip} =	3.64	meter	11.94	feet	*Equipment overall length in direction of air product flow*
14.	v_{tan_max} =	0.00	m/sec	0.00	feet/sec	*Maximum tangential air velocity in the equipment*
15.	v_{tan} =	0	m/sec	0.00	feet/sec	*Circumferential (tangential) air velocity in the equipment*
16.	v_{axial} =	0.01717608	m/sec	0.06	feet/sec	$V_{axial} = (Q_{air} \cdot L) / V$
17.	A_{v2} =	0.3133	m^2	3.37	sq feet	$A_{v2}=[(1+\max(v_{axial}, v_{tan})-20)/36]\cdot0.7]\cdot A_{v1}$

8.2.6 - Effects of Panel Inertia, if panel mass ≤ 40-kg/m^2

18.	F_{sh} =	1.1				*1.0 for translating panels or 1.1 for hinged panels*			
18.	n =	1	no. vents	M =	12.20	kg/m^2	2.50	lb/sq ft	
19.	M_T =	93.7778	kg/m^2	19.20	lb/ft^2	$M_t=[6.67\cdot(P_{red}^{0.2})\cdot(n^{0.3})\cdot(V/K_{st}^{0.5})]^{1.67}$			
20.	A_{v3} =	0.3133	m^2	3.37	sq feet	$A_{v3}=F_{sh}\cdot[1+(0.0075)\cdot M^{0.6}\cdot K_{st}^{0.5}/(n^{0.3}\cdot V\cdot P_{red}^{0.2})]\cdot A_{v2}$			

8.3.1 - Effects of Partial Volume Correction, ... if X_r can be determined

21.	Π =	0.440196768	P_{red}/P_{max}	X_r =	1.000	fill fraction > Π			
22.	A_{v4} =	0.3133	m^2	3.3726	sq feet	$A_{v4}=A_{v3}\cdot X_r^{-1/3}\cdot(X_r-\Pi/1-\Pi)^{0.5}$			

8.4.1 - Effects of Initially Elevated Pressure

23.	$P_{initial}$ =	0	bar-g	0.00	psig	$P_{effective}$ =	0	bar-g	
24.	P^E_{max} =	8.00	bar-g	$\Pi_{effective}$ =	0.440196768	bar-g			
25.	A_{vep} =	10.17369092	m^2	109.51	sq feet	$A_{vep}=A_{v1}\cdot[1+1.54\cdot(P_{stat}-P_{initial}/1+P_{effective})^{4/3}]\cdot(1/\Pi_{effective}-1)^{0.5}/[1+1.54\cdot P_{stat}^{4/3})\cdot(P_{max}/P_{red}-1)^{0.5}$			

8.5.1 - Effects of Vent Ducts

26.	L_{duct} =	12.00	meter	39.37	feet	ε =	0.26	effective roughness, mm	
27.	D_h =	1.5	meter	4.92	feet	f_D =	0.0133	$f_D=[1/(1.14-2\log_{10}(\varepsilon/D_h))]^2$	
28.	K_{inlet} :	1.5	K_{exit} :	0.75	E_1 =	0.85	$E_1=(A_{vf} \cdot L_{duct})/V$		
29.	$K_{ells + add'l K}$:	2.4	ΣK =	4.757	E_2 =	6.37	$E_2=(10^4\ A_{vf})/(1+1.54\ P_{stat}^{4/3})\ K_{st}\ V^{3/4}$		
30.	$f_D\cdot L/D_h$ =	0.107	assum A_{vent} =	1.77	$meter^2$	19.05	sq feet	%error =	0.00%
31.	A_{vf} =	1.7700	m^2	19.0523	sq feet	$A_{vf}=A_{v4}\cdot(1+1.18\cdot E_1^{0.8}\cdot E_2^{0.4})\cdot(K/K_o)^{0.5}$			

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6.3.5.2 - Enclosure Support Criteria $F_r = a \cdot DLF \cdot A_v \cdot P_{red}$

3.	Dust:	Paper Dust				
		Metric	**Unit**	**Imperial**	**Unit**	**Reference**
4.	a:	100		1.00		*Units Conversion*
5.	DLF:	1.2	X_m/X_s			*Maximum dynamic deflection/static deflection*
6.	A_v =	1.00	sq meter	1550.00	sq in	*Vent Area*
7.	P_{red}:	3.522	bar-g	51.06	psig	*Maximum pressure developed during a vented deflagration*
8.	F_r:	422.59	kN	95002.93	lbf	*Maximum reaction force resulting from combustion venting*

6.3.5.5 - Reaction Force Duration $t_f = b \cdot (P_{max}/P_{red})^{0.5} \cdot (V/A_v)$

		Metric	**Unit**	**Imperial**	**Unit**	**Reference**
9.	b:	0.0043		0.0013		*Units Conversion*
10.	P_{max}:	8.00	bar-g	116.00	psig	*Maximum pressure developed in an unvented explosion*
11.	P_{red}:	1.00	bar-g	14.50	psig	*Maximum pressure developed during venting*
12.	V:	24.00	cubic meter	348.00	cubic ft	*Enclosure volume*
13.	A_v =	3.00	sq meter	32.29	sq ft	*Vent Area*
14.	t_f:	0.097	seconds			*Duration of Pressure Pulse After Vent Opening*

6.3.5.6 - Enclosure Support Criteria $I = 0.52 \cdot F_r \cdot t_f$

		Metric	**Unit**	**Imperial**	**Unit**	**Reference**
15.	F_r:	423.0	kN	95095.69	lbf	*Maximum reaction force resulting from combustion venting*
16.	t_f:	0.100	seconds			*Duration of Pressure Pulse After Vent Opening*
17.	I:	22.00	kN-s	4944.98	lbf-s	*Total impulse experienced by supporting structure*