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Content Based
Chemical Engineering

VENTING of DEFLAGRATIONS of GAS MIXTURES and MISTS
Sizing based on NFPA 68, 2002

BASIS: NFPA 68 Guide for Venting of Deflagrations 2002 Edition

NOTE: Always begin a new case by retrieving the original file. Direct entry of data in cells that originally contain table lookups could cause functions to be lost, or incorrect calculations. I format cells requiring entry colored RED; calculated values are black.

LIMITATIONS: Low Strength Enclosures

- Pred (pressure-reduced) Not to exceed 1.5 psi, or 0.1 bar.
- Low Strength Enclosures cannot have a vent duct.
- Pred (pressure-reduced) should exceed Pstat by 0.35-psi (0.02-bar).
- When the fundamental burning velocity of the gas exceeds 1.3 times that of propane alternate methods of protection should be used.
- When the vent area is restricted to one end of an elongated enclosure the ratio of the length to diameter should be limited to three. Use the effective diameter for cross-sections other than circular or square.

High Strength Enclosures

- Pred (pressure-reduced) > 0.1 bar (1.5-psi)
- Pred (pressure-reduced) ≤ 2 bar (29-psi) and at least 0.05 bar > Pstat
- Kg ≤ 550 bar-m/sec
- Pstat ≤ 0.5 bar (7.5-psi)
- Enclosure Volume ≤ 1000 cubic meter (35314.7 cubic feet)

Explanatory and Warning notes are provided via Excel Comment Boxes and Data Validation (utilizing the "Office Assistar

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Print out using direct EXCEL commands.

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04/17/04

Explosion Venting - Gases & Vapors, Weak Equipment

SERVICE: TESTING
GAS/VAPOR: METHYL ALCOHOL

MAP OF VESSEL:	0.034483	bar	ESSEL SURFACE AREA:	2292.104	meter^2
or:	0.5	psi	or:	24672	sq. ft.
VESSEL MATERIAL:	CARBON STEEL		BURNING VELOCITY:	56	cm/sec

Pred: 0.0344828 bar, or 0.500 psi **···· MAXIMUM ····**
Pstat: 0.0144828 bar, or 0.210 psi **···· MAXIMUM ····**

Selected Pred: 0.0345 bar or 0.500 psi

Selected Pstat: 0.027 bar or 0.392 psi

Fuel Constant, English C = 0.17

The modified Swift-Epstein equation

$$A_V := C \cdot \frac{A_S}{\sqrt{P_{red}}}$$

= **551** **meter²**
= **5932** **feet²**

04/17/04

Explosion Venting - Gases & Vapors, Strong Equipment

SERVICE: ETHANOL TANK - EXPLOSION VENTING REQUIREMENTS
GAS: ETHYL ALCOHOL

MAP (Design Pressure):	1.5	psi, or 0.10-bar	MAP@ yield:	2.500	psi, or 0.17-bar
Yield Stress:	30000	psi, or 2,068.97-bar	MAP@ 2/3 yield:	1.667	psi, or 0.11-bar
Design Stress:	18000	psi, or 1,241.38-bar	P_{max}:	7	bar
Material of Construction:	CARBON STEEL		Deflag. Index-Kg:	78	bar-m/sec
Enclosure Volume:	35310	cu. feet	Enclosure Volume:	999.98	cu. meter
Enclosure L/D Ratio:	3.00	height/diameter	(dP/dt)max:	1131	psi/sec

Selected Pstat: 0.11 bar or 1.566 psig

Selected Pred: 1.5 bar or 21.750 psig

$$A_v = [(0.127 \cdot \log(K_g) - 0.0567) \cdot P_{red}^{-0.582}) + 0.175 \cdot P_{red}^{-0.572} \cdot (P_{stat}-0.1)] \cdot V^{(2/3)}$$

A_v = 14.61 meter^2 or 157.27 ft^2 ..... for Cubic Vessels

- **Elongated Vessel Area, is determined by the equation :** $A_L = A_v + \Delta A_H$

$\Delta A_H = [A_v \cdot Kg \cdot (L/(D-2))^2] / 750$

ΔA_H = 1.5195638 meter^2 or 16.36 ft^2

A_L = 14.61 + 1.52

A_L = 16.13 meter^2 or 173.63 ft^2 ..... for Elongated Vessels

- **Reaction Force resulting from deflagration equals :**

$F_r = \alpha \cdot A_v \cdot P_{red}$

F_r = 652576.38 force, lbf o 2630.0142 kN

VENTING of DUSTS, & HYBRID MIXTURES UTILIZING DUCTS

Service : Mix Tank Vent Duct

Duct Length :	3	meters	Duct Length :	9.84	feet
Pred w/o duct :	0.21	bar	Pred w/o duct :	3.045	psi

- For Vent Ducts with Lengths Less Than 3-meters (10-feet)

$$P'_{red} = 0.779 \cdot (P_{red})^{1.161}$$

=

- For Vent Ducts with Lengths 3-meters to 6-meters (10-feet to 20-feet)

$$P'_{red} = 0.172 \cdot (P_{red})^{1.936}$$

= 0.008 -bar, or 0.122 -psi

MATERIAL	Burning velocity, cm/sec	Reference
1,2-BUTADIENE	68	NFPA-68
1,2-PENTADIENE	61	NFPA-68
1,3-BUTADIENE	64	NFPA-68
1,4-PENTADIENE	55	NFPA-68
1-BUTENE	51	NFPA-68
1-BUTYNE	68	NFPA-68
1-DECENE	44	NFPA-68
1-PENTANE	50	NFPA-68
1-PROPYNE	82	NFPA-68
2,3-PENTADIENE	60	NFPA-68
2-BUTEN-1-YNE (VINYLACETYLENE)	89	NFPA-68
2-BUTYNE	61	NFPA-68
ACETONE	54	NFPA-68
ACETYLENE	166	NFPA-68
ACROLEIN	66	NFPA-68
ACRYLONITRILE	50	NFPA-68
ALLENE (PROPADIENE)	87	NFPA-68
BENZENE	48	NFPA-68
BUTANONE	42	NFPA-68
CARBON DISULFIDE	58	NFPA-68
CARBON MONOXIDE	46	NFPA-68
CYCLOBUTANE	67	NFPA-68
CYCLOHEXANE	46	NFPA-68
CYCLOPENTADIENE	46	NFPA-68
CYCLOPENTANE	44	NFPA-68
CYCLOPENTENE	48	NFPA-68
CYCLOPROPANE	56	NFPA-68
DIETHYL ETHER	47	NFPA-68
DIMETHYL ETHER	54	NFPA-68
ETHANE	47	NFPA-68
ETHENE (ETHYLENE)	80	NFPA-68
ETHYL ACETATE	38	NFPA-68
ETHYLENE OXIDE	108	NFPA-68
ETHYLENIMINE	46	NFPA-68
GASOLINE	40	NFPA-68
HEXADECANE	44	NFPA-68
HYDROGEN	312	NFPA-68
ISOPROPYL ALCOHOL	41	NFPA-68
ISOPROPYLAMINE	31	NFPA-68
JET FUEL, JP-1	40	NFPA-68
JET FUEL, JP-1	41	NFPA-68
METHANE	40	NFPA-68
METHYL ALCOHOL	56	NFPA-68
n-BUTANE	45	NFPA-68
n-DECANE	43	NFPA-68
n-HEPTANE	46	NFPA-68
n-HEXANE	46	NFPA-68
n-PENTANE	46	NFPA-68
PROPANE	46	NFPA-68
PROPENE	52	NFPA-68
PROPIONALDEHYDE	58	NFPA-68
PROPYLENE OXIDE	82	NFPA-68
SPIROPENTANE	71	NFPA-68
TETRAHYDROPYRAN	48	NFPA-68
TETRALIN	39	NFPA-68
TOLUENE	41	NFPA-68