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Content Based Chemical Engineering

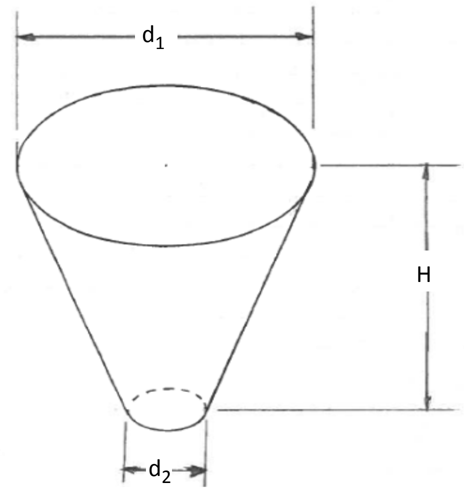
L/D - Cylindrical Hopper

NFPA 68 (2007), A.6.4.3 *Example 1* (2)(b)

SERVICE :

------------------------- **Dimensions** -------------------------

Large Diameter : in. (d_1) m
Small Diameter : in. (d_2) m
Hopper Height : in. (H) m



------------------------- **Volume$_{eff}$** -------------------------

Volume of Hopper (V_{eff}) = $\dfrac{\pi \cdot H \cdot \left[(d_1)^2 + d_1 \cdot d_2 + (d_2)^2 \right]}{12}$

V_{eff} = ft^3 m^3

------------------------- **Area$_{eff}$** -------------------------

Effective Area (A_{eff}) = $\dfrac{V_{eff}}{H}$

A_{eff} = ft^2 m^2

------------------------- **Diameter$_{hydraulic}$** -------------------------

D_{he} = $\dfrac{4 \cdot A_{eff}}{p}$

D_{he} = ft m

--------------- **L/D** ---------------

L/D = $\dfrac{H}{D_{he}}$

L/D =

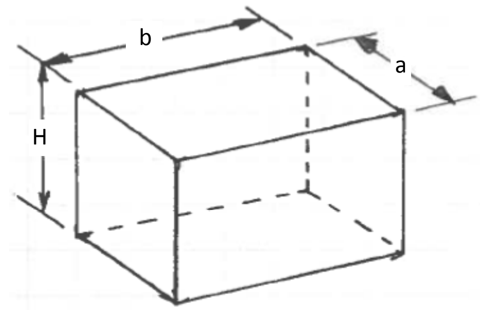
L/D - Rectangular Enclosure

NFPA 68 (2007), A.6.4.3 *Example 3* (2)(a)

SERVICE :

------------------------- **Dimensions** -------------------------

a :		in.	m
b :		in.	m
H :		in.	m



------------------------- **$Volume_{eff}$** -------------------------

$V_{eff} =$ a·b·H

$V_{eff} =$ ft^3 m^3

------------------------- **$Area_{eff}$** -------------------------

$A_{eff} = \frac{V_{eff}}{H}$

$A_{eff} =$ ft^2 m^2

------------------------- **$Diameter_{hydraulic}$** -------------------------

$D_{he} = (A_{eff})^{0.5}$

$D_{he} =$ ft m

-------------- **L/D** --------------

$L/D = \frac{H}{D_{he}}$

L/D =

L/D - Rectangular Hopper

NFPA 68 (2007), A.6.4.3 *Example 3* (2)(b)

SERVICE :

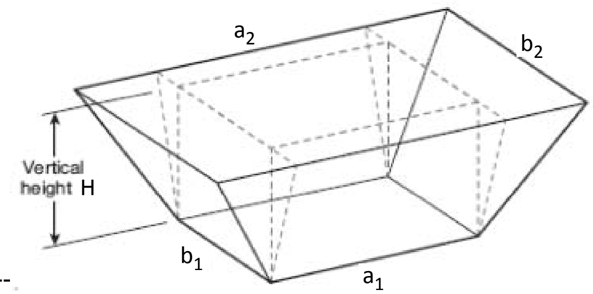
------------------------- **Dimensions** -------------------------

a1 :		in.	m
b1 :		in.	m
a2 :		in.	m
b2 :		in.	m
H :		in.	m

------------------------- **Volume_{eff}** -------------------------

$$V_{eff} = \frac{a_1 \cdot H \cdot (b_2 - b_1)}{2} + \frac{b_1 \cdot H \cdot (a_2 - a_1)}{2} + \frac{H \cdot (a_2 - a_1) \cdot (b_2 - b_1)}{3} + (a_1 \cdot b_1 \cdot h)$$

V_{eff} = ft^3 m^3



------------------------- **Area_{eff}** -------------------------

$$A_{eff} = \frac{V_{eff}}{H}$$

A_{eff} = ft^2 m^2

------------------------- **$\text{Diameter}_{hydraulic}$** -------------------------

$$D_{he} = (A_{eff})^{0.5}$$

D_{he} = ft m

--------------- **L/D** ---------------

$$L/D = \frac{H}{D_{he}}$$

L/D =

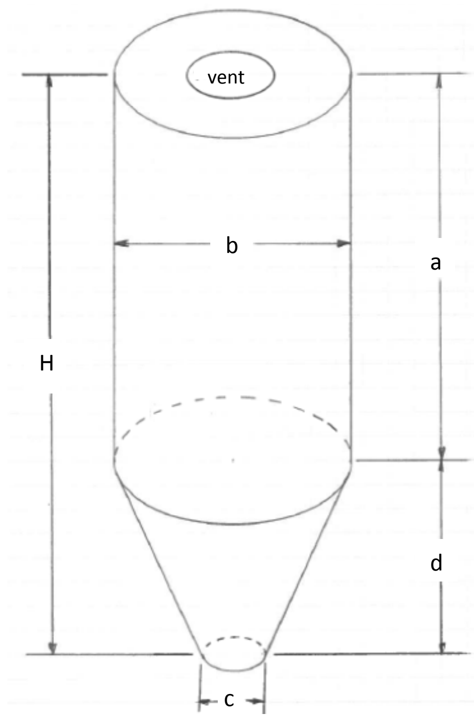
L/D - Cylindrical Vessel with Hopper and Top Vent

NFPA 68 (2007), Figure A.6.4.3(a)

SERVICE :

------------------------- **Dimensions** -------------------------

Cylinder Height :	in. (a)	m
Large Diameter :	in. (b)	m
Small Diameter :	in. (c)	m
Hopper Height :	in. (d)	m
Total Height :	in. (H)	m



------------------------- **Volume$_{eff}$** -------------------------

Volume of Cylinder (V_1) = $\frac{\pi \cdot b^2}{4} \cdot a$

V_1 = ft^3 m^3

Volume of Hopper (V_2) = $\frac{\pi \cdot d \cdot \left(b^2 + b \cdot c + c^2\right)}{12}$

V_2 = ft^3 m^3

V_{eff} = $V_1 + V_2$

V_{eff} = ft^3 m^3

------------------------- **Area$_{eff}$** -------------------------

Effective Area (A_{eff}) = $\frac{V_{eff}}{H}$

A_{eff} = ft^2 m^2

------------------------- **Diameter$_{hydraulic}$** -------------------------

D_{he} = $\frac{4 \cdot A_{eff}}{p}$

D_{he} = ft m

--------------- **L/D** ---------------

L/D = $\frac{H}{D_{he}}$

L/D =

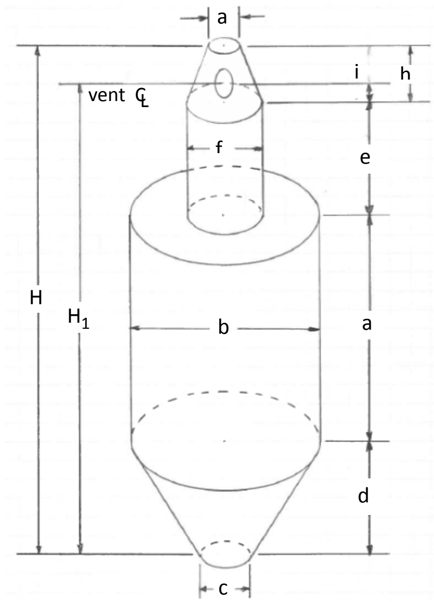
L/D - Cylindrical Vessel with Hopper and Extended Top Vent

NFPA 68 (2007), Figure A.6.4.3(a) modified

SERVICE :

------------------------ Dimensions ------------------------

Cylinder Height :	in. (a)	m
Large Diameter :	in. (b)	m
Small Diameter :	in. (c)	m
Hopper Height :	in. (d)	m
Vent Cylinder Height :	in. (e)	m
Vent Large Diamter :	in. (f)	m
Vent Small Diameter :	in. (g)	m
Vent Cone Height :	in. (h)	m
EV Centerline Height :	in. (i)	m
Total Height :	in. (H)	m
Total Flame Height :	in. (H_1)	m



------------------------ Volume_{eff} ------------------------

Volume of Cylinder (V_1) = $\frac{\pi \cdot b^2}{4} \cdot a$

V_1 = ft^3 m^3

Volume of Hopper (V_2) = $\frac{\pi \cdot d \cdot \left(b^2 + b \cdot c + c^2\right)}{12}$

V_2 = ft^3 m^3

Volume of Vent Cylinder (V_3) = $\frac{\pi \cdot f^2}{4} \cdot e$

V_3 = ft^3 m^3

Volume of Vent Hopper (V_4) = $\frac{\pi \cdot h \cdot \left(f^2 + f \cdot g + g^2\right)}{12}$

V_4 = ft^3 m^3

V_{eff} = $V_1 + V_2 + V_3 + V_4$

V_{eff} = ft^3 m^3

------------------------ Area_{eff} ------------------------

Effective Area (A_{eff}) = $\frac{V_{eff}}{H}$

A_{eff} = ft^2 m^2

------------------------ $\text{Diameter}_{hydraulic}$ ------------------------

D_{he} = $\frac{4 \cdot A_{eff}}{p}$

D_{he} = ft m

--------------- L/D ---------------

L/D = $\frac{H_1}{D_{he}}$

L/D =

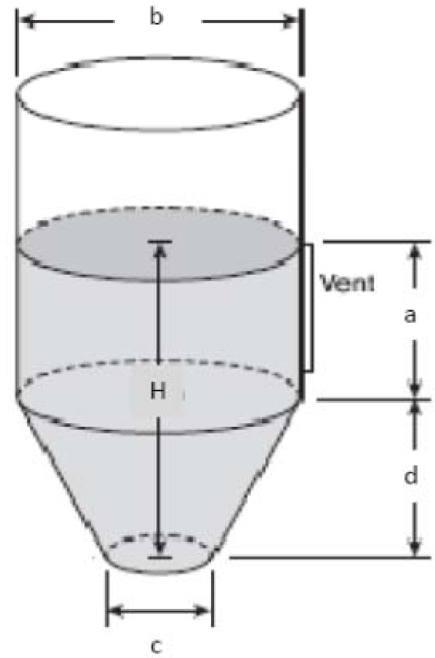
L/D - Cylindrical Vessel with Hopper and Side Vent

NFPA 68 (2007), Figure A.6.4.3(b)

SERVICE :

------------------------ **Dimensions** ------------------------

Bottom Cyl. to Top Vent :	in. (a)	m
Large Diameter :	in. (b)	m
Small Diameter :	in. (c)	m
Hopper Height :	in. (d)	m
Total Flame Height :	in. (H)	m



------------------------ **Volume$_{eff}$** ------------------------

Volume of Cylinder (V_1) = $\frac{\pi \cdot b^2}{4} \cdot a$

V_1 = ft^3 m^3

Volume of Hopper (V_2) = $\frac{\pi \cdot d \cdot \left(b^2 + b \cdot c + c^2\right)}{12}$

V_2 = ft^3 m^3

V_{eff} = $V_1 + V_2$

V_{eff} = ft^3 m^3

------------------------ **Area$_{eff}$** ------------------------

Effective Area (A_{eff}) = $\frac{V_{eff}}{H}$

A_{eff} = ft^2 m^2

------------------------ **Diameter$_{hydraulic}$** ------------------------

D_{he} = $\frac{4 \cdot A_{eff}}{p}$

D_{he} = ft m

-------------- **L/D** --------------

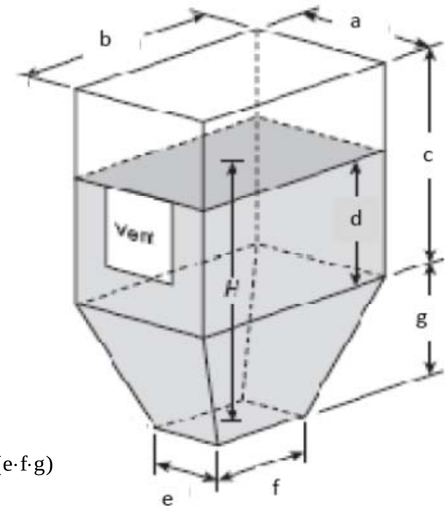
L/D = $\frac{H}{D_{he}}$

L/D =

L/D - Rectangular Enclosure with Hopper and Side Vent

NFPA 68 (2007), Figure A.6.4.3(c)

SERVICE :



Dimensions

a :	in.	m
b :	in.	m
c :	in.	m
d :	in.	m
e :	in.	m
f :	in.	m
g :	in.	m
H :	in.	m

Volume$_{eff}$

$V_1 = a \cdot b \cdot d$

$V_1 =$ ft^3 m^3

$$V_2 = \frac{f \cdot g \cdot (a - e)}{2} + \frac{e \cdot g \cdot (b - f)}{2} + \frac{g \cdot (a - e) \cdot (b - f)}{3} + (e \cdot f \cdot g)$$

$V_2 =$ ft^3 m^3

$V_{eff} = V_1 + V_2$

$V_{eff} =$ ft^3 m^3

Area$_{eff}$

$$A_{eff} = \frac{V_{eff}}{H}$$

$A_{eff} =$ ft^2 m^2

Diameter$_{hydraulic}$

$D_{he} = (A_{eff})^{0.5}$

$D_{he} =$ ft m

L/D

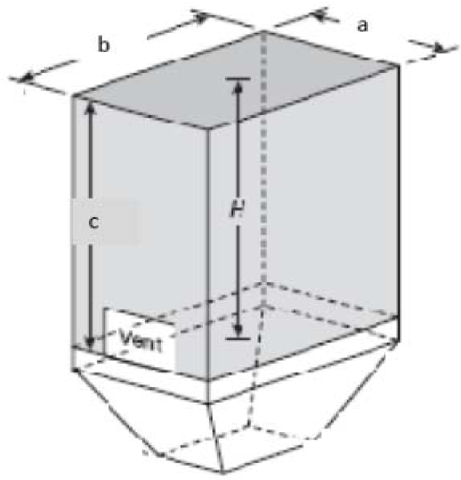
$$L/D = \frac{H}{D_{he}}$$

L/D =

L/D - Rectangular Enclosure with Hopper and Side Vent Close to Hopper

NFPA 68 (2007), Figure A.6.4.3(d)

SERVICE :



Dimensions

a :		in.	m
b :		in.	m
c :		in.	m
H :		in.	m

Volume$_{eff}$

$V_{eff} = a \cdot b \cdot c$

$V_{eff} =$ ft^3 m^3

Area$_{eff}$

$A_{eff} = \frac{V_{eff}}{H}$

$A_{eff} =$ ft^2 m^2

Diameter$_{hydraulic}$

$D_{he} = (A_{eff})^{0.5}$

$D_{he} =$ ft m

L/D

$L/D = \frac{H}{D_{he}}$

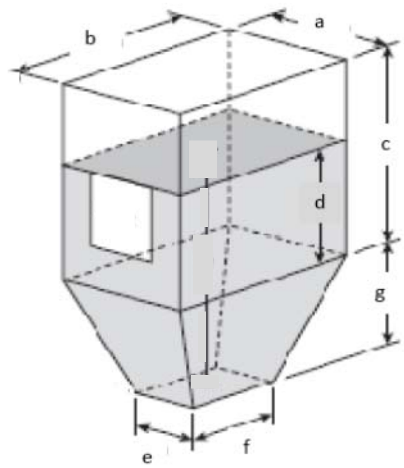
L/D =

10/04/11

L/D - Rectangular Enclosure with Hopper and Two Vents on Opposite Sides

NFPA 68 (2007), Figure A.6.4.3(f)

SERVICE :



------------------------- Dimensions -------------------------

a :	in.	m
b :	in.	m
c :	in.	m
d :	in.	m
e :	in.	m
f :	in.	m
g :	in.	m
H :	in.	m

------------------------- $\text{Volume}_{\text{eff}}$ -------------------------

$V_1 = a \cdot b \cdot d$

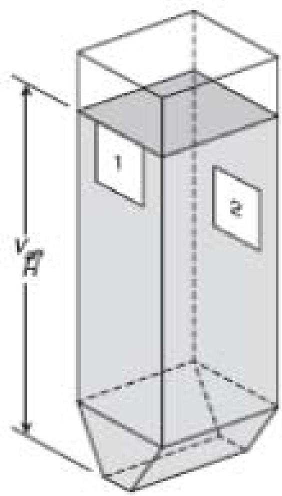
$V_1 =$ ft^3 m^3

$$V_2 = \frac{f \cdot g \cdot (a - e)}{2} + \frac{e \cdot g \cdot (b - f)}{2} + \frac{g \cdot (a - e) \cdot (b - f)}{3} + (e \cdot f \cdot g)$$

$V_2 =$ ft^3 m^3

$V_{eff} = V_1 + V_2$

$V_{eff} =$ ft^3 m^3



------------------------- Area_{eff} -------------------------

$$A_{eff} = \frac{V_{eff}}{H}$$

$A_{eff} =$ ft^2 m^2

------------------------- $\text{Diameter}_{\text{hydraulic}}$ -------------------------

$D_{he} = (A_{eff})^{0.5}$

$D_{he} =$ ft m

-------------- L/D --------------

$$L/D = \frac{H}{D_{he}}$$

L/D =

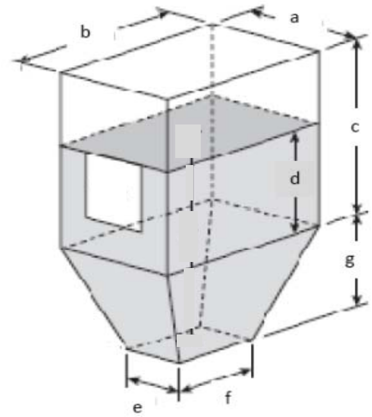
L/D - Rectangular Enclosure w/Hopper and 2 Vents on Same Sides of Enclosure

NFPA 68 (2007), Figure A.6.4.3(g)

SERVICE :

Dimensions

a :		in.	m
b :		in.	m
c :		in.	m
d :		in.	m
e :		in.	m
f :		in.	m
g :		in.	m
H_1 :		in.	m
H_2 :		in.	m



Volume$_{eff}$

$V_1 = a \cdot b \cdot d$

$V_1 =$ ft^3 m^3

$$V_2 = \frac{f \cdot g \cdot (a - e)}{2} + \frac{e \cdot g \cdot (b - f)}{2} + \frac{g \cdot (a - e) \cdot (b - f)}{3} + (e \cdot f \cdot g)$$

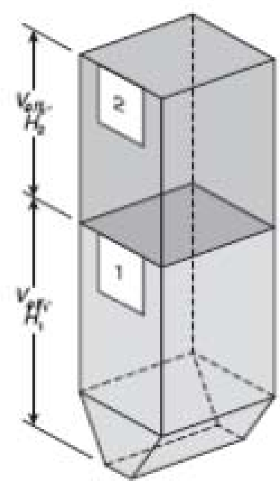
$V_2 =$ ft^3 m^3

$V_{eff_1} = V_1 + V_2$

$V_{eff_1} =$ ft^3 m^3

$V_{eff_2} = a \cdot b \cdot H_2$

$V_{eff_2} =$ ft^3 m^3



Area$_{eff}$

$$A_{eff} = \frac{V_{eff}}{H}$$

$A_{eff_1} =$ ft^2 m^2

$A_{eff_2} =$ ft^2 m^2

Diameter$_{hydraulic}$

$D_{he} = (A_{eff})^{0.5}$

$D_{he_1} =$ ft m

$D_{he_2} =$ ft m

L/D

$$L/D = \frac{H}{D_{he}}$$

$L/D_1 =$

$L/D_2 =$

Length to Diameter Ratio

BASIS : This program is for calculating the length to diameter ratio for use in determining explosion venting requirements.

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 and/or incorrect calculations. Cells that require data entry are colored **RED**; calculated values are black.

REFERENCES :

1) *NFPA 68 (2007), Section A.6.4*

<>-<>-<>-<>-<> ProcSafety September 2011, by Mark Roote <>-<>-<>-<>-<>

procsafety@rooteshome.com