

Flow Calculation for Sonic Nozzle

revised 04/16/10

$m = 0.53257 \cdot C \cdot p \cdot A / \sqrt{T}$ (Marks Handbook, Seventh Edition, p. 4-61) - coefficient corrected

where:

Assume:

- m mass flow rate, lb/sec
- p inlet pressure lb/ft², absolute
- A throat area, ft²
- T inlet temperature, deg R
- C discharge coefficient
- 0.99 discharge coefficient for trial calculation
- 14.7 psi atmospheric pressure
- 100 psig inlet pressure
- 0.3465 in. diameter of throat
- 0.0752 lbm mass of one standard cubic foot of air
- 68 degrees F inlet temperature
- 0.044 lbm/hr-ft (mu) - 60 deg F
- Re = G * d / mu
- G = m / A, lb/ft²sec
- C = 1 - 4.47 / sqrt(Re)

SAMPLE CALCULATION

Throat Area: 0.0006548 ft² mass velocity: 377.16 lbm/sec-ft²
 Re: 891029
 Inlet pressure: 16,517 lb/ft² 1 / sqrt(Re): 0.0011
 Absolute temperature: 528 degrees R C: 0.9953
 mass flow: 0.2470 lb/sec or 197.05 scfm 0.3465

SONIC NOZZLE FLOW												
Model 3200												
Flow shown in scfm referenced to air at 20 deg C.												
One standard cubic foot weighs 0.0752 lb.												
Inlet Conditions												
p (psig)	t (deg F) =	40	45	50	55	60	65	70	75	80	85	90
10	43.8	43.6	43.4	43.2	43.0	42.8	42.6	42.4	42.2	42.0	41.8	
15	52.7	52.5	52.2	52.0	51.7	51.5	51.2	51.0	50.7	50.5	50.3	
20	61.6	61.3	61.0	60.7	60.4	60.2	59.9	59.6	59.3	59.0	58.8	
25	70.6	70.2	69.9	69.5	69.2	68.9	68.5	68.2	67.9	67.6	67.3	
30	79.5	79.1	78.7	78.3	77.9	77.6	77.2	76.8	76.5	76.1	75.8	
35	88.4	88.0	87.5	87.1	86.7	86.3	85.9	85.5	85.1	84.7	84.3	
40	97.3	96.9	96.4	95.9	95.5	95.0	94.6	94.1	93.7	93.2	92.8	
45	106.3	105.8	105.2	104.7	104.2	103.7	103.2	102.7	102.3	101.8	101.3	
50	115.2	114.6	114.1	113.5	113.0	112.4	111.9	111.4	110.9	110.3	109.8	
55	124.1	123.5	122.9	122.3	121.7	121.1	120.6	120.0	119.5	118.9	118.4	
60	133.1	132.4	131.8	131.1	130.5	129.9	129.3	128.6	128.1	127.5	126.9	
65	142.0	141.3	140.6	139.9	139.2	138.6	137.9	137.3	136.6	136.0	135.4	
70	150.9	150.2	149.5	148.7	148.0	147.3	146.6	145.9	145.2	144.6	143.9	
75	159.9	159.1	158.3	157.5	156.8	156.0	155.3	154.6	153.8	153.1	152.4	
80	168.8	168.0	167.2	166.3	165.5	164.7	164.0	163.2	162.4	161.7	161.0	
85	177.8	176.9	176.0	175.1	174.3	173.5	172.6	171.8	171.0	170.3	169.5	
90	186.7	185.8	184.8	183.9	183.1	182.2	181.3	180.5	179.6	178.8	178.0	
95	195.6	194.7	193.7	192.8	191.8	190.9	190.0	189.1	188.2	187.4	186.5	
100	204.6	203.5	202.5	201.6	200.6	199.6	198.7	197.8	196.8	195.9	195.0	
105	213.5	212.4	211.4	210.4	209.4	208.4	207.4	206.4	205.4	204.5	203.6	
110	222.4	221.3	220.2	219.2	218.1	217.1	216.1	215.0	214.0	213.1	212.1	
115	231.4	230.2	229.1	228.0	226.9	225.8	224.7	223.7	222.6	221.6	220.6	
120	240.3	239.1	238.0	236.8	235.7	234.5	233.4	232.3	231.2	230.2	229.1	
125	249.3	248.0	246.8	245.6	244.4	243.3	242.1	241.0	239.9	238.7	237.7	
130	258.2	256.9	255.7	254.4	253.2	252.0	250.8	249.6	248.5	247.3	246.2	
135	267.1	265.8	264.5	263.2	262.0	260.7	259.5	258.3	257.1	255.9	254.7	
140	276.1	274.7	273.4	272.0	270.7	269.4	268.2	266.9	265.7	264.4	263.2	
145	285.0	283.6	282.2	280.8	279.5	278.2	276.8	275.5	274.3	273.0	271.8	
150	294.0	292.5	291.1	289.7	288.3	286.9	285.5	284.2	282.9	281.6	280.3	
155	302.9	301.4	299.9	298.5	297.0	295.6	294.2	292.8	291.5	290.1	288.8	
160	311.9	310.3	308.8	307.3	305.8	304.3	302.9	301.5	300.1	298.7	297.3	
165	320.8	319.2	317.6	316.1	314.6	313.1	311.6	310.1	308.7	307.3	305.9	
170	329.7	328.1	326.5	324.9	323.3	321.8	320.3	318.8	317.3	315.8	314.4	
175	338.7	337.0	335.3	333.7	332.1	330.5	329.0	327.4	325.9	324.4	322.9	
180	347.6	345.9	344.2	342.5	340.9	339.2	337.6	336.1	334.5	333.0	331.4	
185	356.6	354.8	353.1	351.3	349.6	348.0	346.3	344.7	343.1	341.5	340.0	
190	365.5	363.7	361.9	360.1	358.4	356.7	355.0	353.4	351.7	350.1	348.5	
195	374.5	372.6	370.8	369.0	367.2	365.4	363.7	362.0	360.3	358.7	357.0	
200	383.4	381.5	379.6	377.8	376.0	374.2	372.4	370.6	368.9	367.2	365.6	

CAUTION: NOZZLE MUST BE USED WITH MUFFLER.

CDI Meters, Inc.
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