

# DRIVER/OPERATOR CHEAT SHEET

<b>Friction Loss (FL) = C (Q<sup>2</sup>) L</b> <b>PDP = NP + [FL + AL ± EP]</b>	<b>AL = Appliance Loss</b> 10 psi - Wye/Siamese 15 psi - Deck Gun 25 psi - Portable Monitor 25 psi - Stand Pipe 75 psi - Aerial Ladder (Do not add elevation)	<b>EP = Elevation Pressure</b> +5 psi - every floor (excluding 1 <sup>st</sup> ) - 5 psi - Below 1 <sup>st</sup> floor (basements, etc.) +5 psi - every 10' of elevation -5 psi - every 10' drop of elevation
Friction loss { NP = Nozzle Pressure 100 psi - Combination 80 psi - Smooth Bore (master) 50 psi - Smooth Bore (handheld)	* AL applies at 350gpm+	
<b>L = Length of line (±by 100)</b>	↻ Rules of Thumb ↻ 👉 150' of 1½" or 1¾" hose, pump at 135 psi 👉 200' of 1½" or 1¾" hose, pump at 150 psi 👉 2½" line - drop '0', minus 10 = FL per 100' 👉 Supplying other engines:....Start at 50 psi 👉 Supply sprinkler systems at 100psi in volume 👉 Assume 250 gpm for unspecified fog nozzles 👉 Assume 200gpm for " smooth bore handlines	↻ Calculation Considerations ↻ Wye - Add GPMs from both nozzles * For two equal lines, calculate for only one. Siamese - Divide nozzle GPM by 2 - Never exceed PDP of 250 psi - Intake (residual pressure) should never drop below 20 psi - Begin calcs at nozzle and work back - Like lines can be calculated once
<b>C = Coefficient of hose</b> 1" - 150      2½" - 2 1½" - 24      3" - .8 1¾" - 10      5" - .08  <b>Q = Quantity (±by 100) a.k.a. GPM</b> 👉 Fog Nozzle - 250gpm - 100psi 👉 1" Smooth tip - 100gpm - 50psi		

↻ Field Hydraulics ↻			
2½" Handline (smooth bore)			
Tip	GPM	Actual FL / 100'	Field #'s
¾"	150	5 PSI	5
1"	200	8 PSI	10
1½"	250	13 PSI	15
1¾"	300	21 PSI	20
2½" Master Streams (smooth bore)			
TIP	GPM	Actual FL / 100'	Field #'s
1¾"	400	32 PSI	30
1¾"	500	50 PSI	40
1½"	600	72 PSI	50
1½"	700	98 PSI	60
1¾"	800	128 PSI	70
1¾"	900	162 PSI	80
2"	1000	200 PSI	100

1.25 <sup>2</sup> = 1.56
1.5 <sup>2</sup> = 2.25
1.75 <sup>2</sup> = 3.06
2.5 <sup>2</sup> = 6.25
3.5 <sup>2</sup> = 12.25

GPM from Hydrants	
Red:	0 - 499
Orange:	500 - 999
Green:	1000 - 1499
Blue:	1500 +

Square roots for Nozzle Pressure	
50 PSI	7.07
80 PSI	8.94
100 PSI	10

↻ Firefighter Math ↻			
L Frequently Squared #'s J			
Measures of a circle: Circumference ○ Radius ⊙ Diameter ⊙ Area ●			
π (pi)			= 3.14
Area			= πr <sup>2</sup>
Circumference			= 2πr
Cylindrical Volume			= d <sup>2</sup> 6h
Cubic Volume			= w•l•h
Gallons per cubic foot			= 7.48
Gallons Per Minute	....for Nozzle Pressure		= 29.7 (d2•vNP)
Gallons Per Minute	....for Hydrant Pressure		= 29.7 [C(d2•vFP)]

↻ GPM Generalizations ↻	
👉 If the GPM for a handline is unknown, assume the following: <ul style="list-style-type: none"> <li>• 1½" hoseline – 100 gpm</li> <li>• 1¾" hoseline – 150 gpm</li> <li>• 2½" hoseline – 250 gpm</li> </ul>	👉 Typical GPM for lines: <ul style="list-style-type: none"> <li>Small fire stream.....40 GPM or less</li> <li>1¾' hand line .....100 gpm to 210 gpm</li> <li>2½" hand line..... up to 325 gpm</li> <li>Master streams..... 350 gpm or greater</li> </ul>

- 👉 Use **Volume** mode when:
- 2 or more 2½" or larger hose lines are used
  - Pumping at 70% or more of pump capacity
  - Only applies to dual stage pumps (i.e. E31)
- 👉 Be sure to set relief valve appropriately

<b>Drafting</b> <ol style="list-style-type: none"> <li>1. Ensure drains/valves are airtight</li> <li>2. Throttle RPM's to 1000-1200</li> <li>3. Close tank to pump</li> <li>4. Switch to volume mode (31 only)</li> </ol>	<ol style="list-style-type: none"> <li>5. Pull prime 15-45 seconds     ➤ Adequate intake pressure?</li> <li>6. Flow line to maintain lift</li> <li>7. Set relief valve for desired PDP</li> </ol>
<b>Suction Percentage Drop = [(Static – Residual) • 100] / Static</b> 0-10% drop allows 3 times amount of water being delivered 11-15% drop allows 2 times amount of water being delivered 16-25% drop allows 1 times amount of water being delivered	

FL chart	1½" Hose					1¾" Hose					2½" Hose					5" Hose		
GPM→	20	30	60	95	125	30	60	95	125	150	150	200	250	325	500	1000	1250	1500
↓LGTH																		
100'	1	2	9	22	37	1	4	9	16	23	5	8	13	21	50	8	13	18
200'	2	4	17	43	75	2	7	18	31	45	9	16	25	42	100	16	25	36
300'	3	6	26	64	112	3	11	27	47	68	14	24	38	63	150	24	37.5	54
400'	4	9	35	87	150	4	14	36	62	90	18	32	50	84	200	32	50	72
500'	5	11	43	108	187	5	18	45	78	113	23	40	63	106	40	63	90	
600'	6	13	52	130	5	22	54	94	135	27	48	75	127	48	75	108		
700'	7	15	60	152	6	25	63	109	158	32	56	88	148	56	87.5			
800'	8	17	69			7	29	72	125	180	36	64	100	169	64	100		
900'	9	19	78			8	32	81	140		41	72	113	72	* Never exceed 250 psiPDP			
1000'	10	22	86			* based on coefficient of 10					45	80	125	80				

<b>E-31 (U-113)</b> 2009 Hi-tech Spartan Allison transmission Dual stage (pump in pressure or volume) 1500 gpm @ 150psi 750 gal tank	<b>E-29 (U-111)</b> 1994 Pierce Saber Allison transmission Waterous pump Single stage (mid-ship) 1500 gpm @ 150psi 750 gal tank	<b>E-231 (U-201)</b> 2001 International w/ master build up Waterous aux pump Single stage 750gpm @ 150psi 500 gal tank	<b>Water tender (U-601)</b> 1994 International Waterous aux pump Single stage 750gpm @ 150psi 3000 gal tank <i>actually 2888 gal</i>	<b>Brush (U-301 &amp; 302)</b> Ford 550 Hale – aux pump 400 gal tank 140 gpm @ 125 psi **Air unit: 5000 psi in storage	<b>Notes:</b> <small>Copyright © 2008 Firestorm</small>
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