BR1100

Solar Powered Chemical Injection Pump

The BR1100 Chemical Injection Pump is designed to operate utilizing the power supplied from 12 volt DC batteries which are charged using photovoltaic solar panels. The typical system uses one (1) or two (2) 12VDC, 100 amp-hour deep cycle batteries to store the electric energy produced by the panels for use throughout the day. If two or more batteries are used, they are connected in parallel to remain a 12 VDC system, meaning the positive (+) terminals are connected together, and the negative (-) terminals are connected together.

Deep cycle batteries are designed to be discharged and re-charged thousands of times. The batteries capacity is greatly reduced by cold temperatures. Therefore, it is important to keep the batteries in a warm location if at all possible. Also, the amount the battery is discharged has an effect on the battery life, so proper system sizing is required.
Note: A fully charged battery is a happy battery, it is not as susceptible to temperature affects as a partially or fully discharged battery. A fully charged battery can handle being in temperatures below zero degrees Celsius without any lasting affects outside of a reduced capacity, but a fully discharged battery will freeze in temperatures below zero degrees Celsius, and a frozen battery will normally not take a charge, even when thawed.

A rough guide of Depth of Discharge of the battery can be determined by measuring it voltage. Remember that this is a very rough way to determine depth of discharge and is not very accurate. Here are some typical voltage measurements vs. depth of discharge.

Voltage	State of Charge
12.6+	100%
12.5	90%
12.42	80%
12.32	70%
12.20	60%
12.06	50%
11.9	40%
11.75	30%
11.58	20%
11.31	10%
10.5	0%

To determine the size of the battery system required to operate the pump, follow these steps:

Step 1: Determine the Power System Requirements (Daily Amp Hours) required by the pump (multiply the pump amperage draw by the time on (seconds) per minute by 0.4).

Daily Amp Hours = _____AHr

Step 2: How many Days of Autonomy is the system designed for. Days of Autonomy is the number of days that the batteries will be able to run the system without being charged, or the number of days the system will run without sunlight in a solar charged system (4 min to 14 max).

Days of Autonomy = _____

Step 3: Determine the Amp Hour Storage required. Multiply Daily Amp Hours (Step 1) by Days of Autonomy (Step 2).

Amp Hour Storage = _____AHr

Step 4: Discharge limit for the batteries (between 0.2 – 0.8), an acceptable discharge average is 50% or a discharge limit of 0.5.

Discharge Limit = _____

Step 5: Divide Amp Hour Storage (Step 3) by Discharge Limit (Step 4).

Storage Capacity = _____AHr

Step 6: Select the closest multiplier for the average ambient winter temperature the batteries will experience.

Temperature F	Temperature C	Multiplier
80 F	26.7 C	1.00
70 F	21.2 C	1.04
60 F	15.6 C	1.11
50 F	10.0 C	1.19
40 F	4.4 C	1.3
30 F	-1.1 C	1.4
20 F	-6.7 C	1.59
10 F	-12.2 C	1.81
0 F	-17.8 C	2.12
-10 F	-23.3 C	2.67
-20 F	-28.9 C	3.33

Cold Temperature Multiplier =_____

Step 7: Multiply Storage Capacity (Step 5) by Cold Temperature Multiplier (Step 6) to determine the total battery capacity.

Total Battery Capacity = _____AHr

Step 8: Determine the Amp hour rating for the batteries (typically 100 AHr).

Battery Amp Hour Rating = _____AHr

Step 9: Divide the Total Battery Capacity required (Step 7) by the Battery Amp Hour Rating (Step 8). Round off to the next highest number. This is the number of batteries wired in parallel required.

Number of Battery Cells Required = _____

Step 10: Divide system voltage (typically 12, 24, or 48) by battery voltage (typically 12). This is the number of batteries wired in series needed.

Number of Batteries per Battery Cell = _____

Step 11: Multiply the Number of Battery Cells (Step 9) by the Number of Batteries per Battery Cell (Step 10) to obtain the Total Number of Batteries needed.

Total Number of Batteries Required = _____

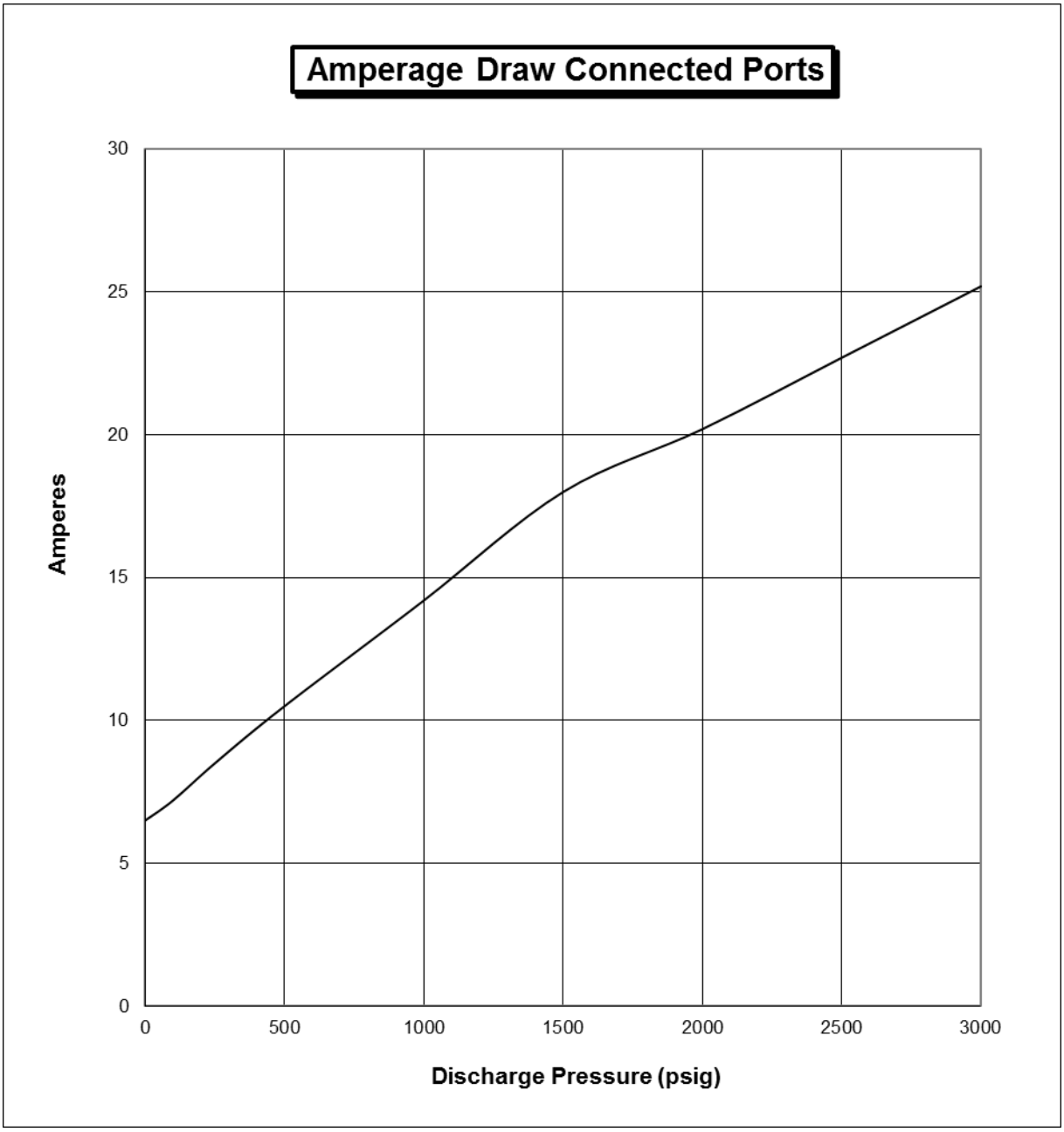

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Table 1 - Determine Required Duty Cycle from Required Pressure and Volume

Volume	Pressure PSI																	
L/day	0		100		250		500		1000		1500		2000		2500		3000	
	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle	On time (s/min)	Duty cycle
1	0.035	0.06	0.042	0.07	0.045	0.08	0.058	0.10	0.085	0.14	0.1	0.17	0.145	0.24	0.175	0.29	0.22	0.37
2	0.052	0.09	0.066	0.11	0.075	0.13	0.097	0.16	0.15	0.25	0.2	0.33	0.27	0.45	0.33	0.55	0.42	0.70
3	0.073	0.12	0.09	0.15	0.102	0.17	0.14	0.23	0.23	0.38	0.31	0.52	0.4	0.67	0.5	0.83	0.62	1.03
4	0.094	0.16	0.115	0.19	0.138	0.23	0.19	0.32	0.32	0.53	0.425	0.71	0.54	0.90	0.67	1.12	0.8	1.33
5	0.12	0.20	0.14	0.23	0.177	0.30	0.25	0.42	0.4	0.67	0.53	0.88	0.68	1.13	0.84	1.40	1.02	1.70
6	0.15	0.25	0.175	0.29	0.23	0.38	0.315	0.53	0.49	0.82	0.64	1.07	0.8	1.33	0.98	1.63	1.3	2.17
7	0.18	0.30	0.21	0.35	0.28	0.47	0.38	0.63	0.58	0.97	0.75	1.25	0.95	1.58	1.17	1.95	1.4	2.33
8	0.217	0.36	0.25	0.42	0.33	0.55	0.44	0.73	0.66	1.10	0.85	1.42	1.08	1.80	1.33	2.22	1.6	2.67
9	0.265	0.44	0.31	0.52	0.38	0.63	0.52	0.87	0.75	1.25	0.96	1.60	1.19	1.98	1.48	2.47	1.77	2.95
10	0.306	0.51	0.36	0.60	0.44	0.73	0.57	0.95	0.83	1.38	1.06	1.77	1.32	2.20	1.7	2.83	1.95	3.25
15	0.543	0.91	0.63	1.05	0.75	1.25	0.9	1.50	1.28	2.13	1.65	2.75	2	3.33	2.5	4.17	2.95	4.92
20	0.82	1.37	0.9	1.50	1.03	1.72	1.26	2.10	1.7	2.83	2.12	3.53	2.69	4.48	3.37	5.62	3.96	6.60
25	1.07	1.78	1.19	1.98	1.3	2.17	1.6	2.67	2.15	3.58	2.67	4.45	3.38	5.63	4.22	7.03	4.92	8.20
30	1.37	2.28	1.45	2.42	1.63	2.72	1.9	3.17	2.58	4.30	3.21	5.35	4.07	6.78	5.06	8.43	5.95	9.92
35	1.615	2.69	1.7	2.83	1.9	3.17	2.3	3.83	3.02	5.03	3.77	6.28	4.76	7.93	5.9	9.83	6.94	11.57
40	1.875	3.13	1.97	3.28	2.2	3.67	2.6	4.33	3.45	5.75	4.32	7.20	5.45	9.08	6.81	11.35	8.05	13.42
45	2.13	3.55	2.25	3.75	2.5	4.17	2.95	4.92	3.88	6.47	4.86	8.10	6.14	10.23	7.58	12.63	9	15.00
50	2.4	4.00	2.53	4.22	2.8	4.67	3.28	5.47	4.32	7.20	5.29	8.82	6.83	11.38	8.47	14.12	10.17	16.95
60	2.94	4.90	3.1	5.17	3.4	5.67	3.95	6.58	5.2	8.67	6.42	10.70	8.16	13.60	10.17	16.95	12.05	20.08
70	3.5	5.83	3.65	6.08	3.97	6.62	4.65	7.75	6.1	10.17	7.47	12.45	9.53	15.88	11.93	19.88	14.14	23.57
80	4	6.67	4.2	7.00	4.57	7.62	5.3	8.83	6.94	11.57	8.54	14.23	11	18.33	13.62	22.70	16.14	26.90
90	4.55	7.58	4.75	7.92	5.17	8.62	5.96	9.93	7.82	13.03	9.59	15.98	12.26	20.43	15.21	25.35	18.24	30.40
100	5.1	8.50	5.3	8.83	5.76	9.60	6.65	11.08	8.69	14.48	10.69	17.82	13.69	22.82	17.16	28.60	20.36	33.93
120	6.2	10.33	6.4	10.67	6.96	11.60	7.98	13.30	10.5	17.50	12.63	21.05	16.29	27.15	20.36	33.93	24.43	40.72
140	7.2	12.00	7.5	12.50	8.16	13.60	9.35	15.58	12.2	20.33	14.83	24.72	19.17	31.95	23.86	39.77	28.73	47.88
160	8.3	13.83	8.6	14.33	9.35	15.58	10.95	18.25	13.95	23.25	17.16	28.60	21.93	36.55	27.42	45.70	32.47	54.12
180	9.35	15.58	9.7	16.17	10.9	18.17	12.55	20.92	15.75	26.25	19.27	32.12	24.69	41.15	30.43	50.72	36.55	60.92
200	10.4	17.33	11.25	18.75	11.75	19.58	13.9	23.17	17.5	29.17	21.55	35.92	27.55	45.92	34.09	56.82	41.06	68.43
300	15.7	26.17	16.27	27.12	17.7	29.50	20.25	33.75	26.3	43.83	32.12	53.53	41.23	68.72	51.37	85.62		
400	21	35.00	21.8	36.33	23.3	38.83	26.6	44.33	35.05	58.42	43.17	71.95	55.35	92.25				
500	26.3	43.83	27.3	45.50	29.5	49.17	33.9	56.50	43.9	73.17	53.91	89.85						
600	31.6	52.67	32.7	54.50	35.6	59.33	40.7	67.83	51.4	85.67								
800	42.2	70.33	43.65	72.75	47.55	79.25	54.36	90.60										
1000	52.8	88.00	54.6	91.00	58.75	97.92												