

Worksheet for Sizing Engine Cranking Batteries  
X/H - Type FNC Batteries

Information Required to Size Batteries for Engine Cranking:

Date:

Customer Reference:

- |   |       |
|---|-------|
| 1 Engine Make                                 | _____ |
| 2 Engine Model                                | _____ |
| 3 Engine Displacement (cubic inches / liters) | _____ |
| 4 Starting System Voltage                     | _____ |
| 5 Number of cells                             | _____ |
| 6 Number of Starters (1 or 2)                 | _____ |
| 7 Number of Starts                            | _____ |
| 8 Duration of each Crank                      | _____ |
| 9 Minimum Battery Temperature                 | _____ |
| 10 Engine Oil Temperature (min)               | _____ |
| 11 Engine Oil Viscosity                       | _____ |

To convert cubic inches to liters, divide the number by a factor of 61.02

**Standards:**

**NFPA 20 Standard for Centrifugal Fire Pumps**

Each engine must have 2 separate batteries, sized at 40 deg F (4.5 degC) with a 6 minute start cycle totalling 180 seconds of crank time.

**NFPA 99 Standard for Health Care Facilities**

Battery temperature for sizing is 50 deg F (10 degC), but oil temperature is required over 70 degF (21 degC). Total cranking time is 60 seconds.

**Sample Specification:**

The engine starting battery supplied shall be an alkaline nickel cadmium battery utilizing fiber matrix plate technology, designed for high rate discharge performance and electrically sized to perform the specified starting cycle for a period of at least 25 years. It is to have minimum internal resistance, welded construction, and be at least 80% efficient on recharge.

The battery must be designed for float / standby service without excessive maintenance such as electrolyte replacement, while being capable of 2,500 or more full discharges with less than 20% loss of capacity.

Cells must be individual, translucent containers to facilitate ease of observation of the electrolyte level and serviceability, with the electrolyte level minimum clearly marked on the cell. All inter cell connectors and inter-row connector cables must be sized for the maximum current draw of the engine to assure minimal voltage drop during the cranking cycle.

The battery shall have the power and life characteristics of the FNC TYPE X, or be an approved equal.



**ENGINE STARTING BATTERY SELECTION GUIDE & WORKSHEET**

- Step 1** Find the Cubic Inch Displacement of the Engine

Determine the Starting Voltage of the Engine (12VDC, 24VDC, 32VDC)
- Step 2** Convert Engine Cubic Inch Displacement to Starting Amperes (standard conditions)  Table A
- Step 3** Determine the Lowest Battery Operating Temperature (Temp F)X  Table B
- Step 4** Determine the Oil Viscosity Weight and Temperature During Starting (Oil F)X  Table C
- Step 5** Determine the Total Cranking Time (minus rest periods) (Crank Time F)X  Table D
- Step 6** Multiply Factors X Starting Amps (Operating Temp, Oil Wt & Temp, Crank Time)
- Step 7 For dual starting motors (start current X 1.10) enter 1.10
- Step 7** Select Cell Type and Quantity based on Step 6 \_\_\_\_\_ Table E
- Step 8** Select Rack Type and Model \_\_\_\_\_ Table F

Standard Starting Conditions:

- 30 seconds total crank time
- 70 deg F Battery temperature
- Multi weight oil at 70 deg F
- 0.65 vpc engine breakaway voltage
- 0.85 vpc engine rolling voltage

Enter a factor F of 1.0 when a multiplier is not required

Some engine controls require higher breakaway voltages (e.g., 1.00 vpc). Please consult Hoppecke for sizing

**TABLE A** Cubic Inch Displacement vs Amperes

Displacement	Amperes	Amperes
Cubic Inche	12 volt	24 volt
50	135	67
100	200	100
150	255	128
200	322	161
250	380	190
300	422	211
350	465	233
400	516	258
450	548	274
500	587	294
550	631	316
600	674	337
650	702	351
700	729	365
750	772	386
800	814	407
850	858	429
900	901	452
950	947	474
1000	993	497

Displacement	Amperes	Amperes
Cubic Inche	24 volt	32 volt
1100	525	405
1200	553	425
1300	583	449
1400	613	471
1500	638	492
1600	662	509
1700	691	532
1800	719	553
1900	747	575
2000	775	596
2250	831	640
2500	886	682
2750	940	724
3000	994	765
3250	1065	820
3500	1135	873
3750	1186	913
4000	1237	952
4250	1299	1000
4500	1361	1047

Displacement	Amperes	Amperes
Cubic Inche	24 volt	32 volt
4750	1417	1091
5000	1472	1132
5250	1523	1172
5500	1577	1215
5750	1668	1284
6000	1681	1293
6250	1750	1347
6500	1772	1365
6750	1823	1403
7000	1863	1433
7250	1900	1462
7500	1951	1502
7750	2015	1550
8000	2038	1568
8250	2063	1587
8500	2122	1634
8750	2188	1684
9000	2205	1696
9500	2288	1762
10000	2370	1823



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**TABLE B**

Battery Temperature			
deg F	deg C	H cell factor	X cell factor
70	21	1.00	1.00
60	16	1.01	1.00
50	10	1.02	1.00
40	4	1.03	1.00
32	0	1.06	1.00
20	-7	1.14	1.02
10	-12	1.25	1.07
0	-18	1.62	1.43
-10	-23	2.00	1.67
-15	-26	2.22	1.85
-20	-29	3.40	2.22

**TABLE C**

Oil (SAE) at Temperature*			
40W	30W	20W	10W
1.08	1.00	1.00	1.00
1.14	1.06	1.00	1.00
1.25	1.15	1.02	1.00
1.38	1.25	1.11	1.00
1.60	1.41	1.24	1.05
1.90	1.65	1.40	1.13
-	2.40	1.60	1.25
-	-	1.82	1.38
-	-	-	-
-	-	-	-
-	-	-	-

**TABLE D**

Cranking Time		
Seconds	H cell factor	X cell factor
30	1.00	1.00
40	1.04	1.04
50	1.07	1.07
60	1.11	1.11
90	1.19	1.19
120	1.28	1.28
150	1.35	1.35
180	1.45	1.45
210	1.54	1.54
240	1.61	1.61
300	1.72	1.72

\* for multi-viscosity oil, use lowest factor at temperature



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**TABLE E Battery Selection Table**

FNC Cell Type	Amp Hours	12 Volt		24 Volt		32 Volt		Rack Selection Table		
		9 Cells	10 Cells	19 Cells	20 Cells	25 Cells	26 Cells	12 Volt	24 Volt	32 Volt
103X	10	192	243	225	243	225	243	PGL 1-06	PGL 1-06	PGL 1-08
203X	13	245	306	286	306	286	306	PGL 1-06	PGL 1-06	PGL 1-08
106X	19	367	456	426	456	426	456	PGL 1-06	PGL 1-12	SGL 2-08
206X	25	452	561	522	561	522	561	PGL 1-06	PGL 1-12	SGL 2-08
110X	33	619	787	730	787	730	787	PGL 1-08	SGL 2-08	SGL 2-12
210X	43	764	965	896	965	896	965	PGL 1-08	SGL 2-08	SGL 2-12
114X	45	838	1073	980	1073	980	1073	PGL 1-12	SGL 2-12	SGL 2-12
214X	60	1040	1296	1200	1296	1200	1296	PGL 1-12	SGL 2-12	SGL 2-12
118X	58	1020	1322	1200	1322	1200	1322	PGL 1-12	SGL 2-12	SGL 2-15
218X	77	1276	1563	1462	1563	1462	1563	PGL 1-12	SGL 2-12	SGL 2-15
201H	12	104	124	116	124	116	124	PGL 1-06	PGL 1-06	PGL 1-08
202H	23	185	237	220	237	220	237	PGL 1-06	PGL 1-06	PGL 1-08
203H	35	300	360	338	360	338	360	PGL 1-06	PGL 1-12	SGL 2-08
204H	46	382	474	438	474	438	474	PGL 1-06	PGL 1-12	SGL 2-08
205H	58	480	580	440	580	440	580	PGL 1-08	SGL 2-08	SGL 2-12
206H	69	560	676	630	676	630	676	PGL 1-08	SGL 2-08	SGL 2-12
207H	80	632	768	715	768	715	768	PGL 1-08	SGL 2-08	SGL 2-12
208H	93	657	814	755	814	755	814	PGL 1-12	SGL 2-12	SGL 2-12
209H	104	680	853	782	853	782	853	PGL 1-12	SGL 2-12	SGL 2-12
210H	115	770	955	880	955	880	955	PGL 1-12	SGL 2-12	SGL 2-15
211H	125	820	1012	939	1012	939	1012	PGL 1-12	SGL 2-12	SGL 2-15
307H	140	895	1098	1018	1098	1018	1098	PGL 1-12	SGL 2-12	SGL 2-12
308H	160	990	1256	1142	1256	1142	1256	PGL 1-12	SGL 2-12	SGL 2-12
309H	180	1100	1466	1320	1466	1320	1466	PGL 1-12	SGL 2-12	SGL 2-12
310H	200	1200	1579	1428	1579	1428	1579	PGL 1-12	SGL 2-12	SGL 2-15
311H	220	1519	1869	1735	1869	1735	1869	PGL 1-12	SGL 2-12	SGL 2-15

**TABLE F**

**Rack Selection Table**