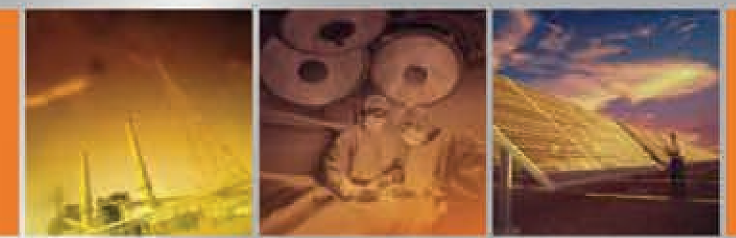
Akkutron Handels GmbH

Marie Curie-Straße 2
A - 2120 Wolkersdorf
www.akkutron.at

Tel.: +43 (0)2245 / 82270-0
Fax: +43 (0)2245 / 82270-11
Mail: office@akkutron.at

One of the largest Sealed Lead Acid Battery manufacturers in the world

VISION
Rechargeable Products
Lead-Acid Battery



www.vision-batt.com

FM Series

General Purpose Applications

Products Guide

FM Series
General Purpose Applications

General purpose application batteries

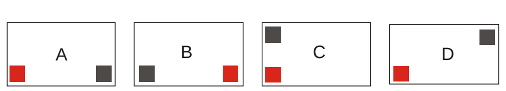
VISION FM series are designed for general-purpose applications, such as UPS, telecom, and electrical utilities.
With 10 years design life, the batteries comply to the most popular international standards, such as IEC60896-21/22, BS6290-4, Eurobat Guide. The battery container and cover are available both in V0 class flame retardant ABS or HBO ABS plastics.
With more than 15 years of production experience, VISION FM series of VRLA batteries are recognized as the most reliable and high quality battery system in the industry.

General Specifications

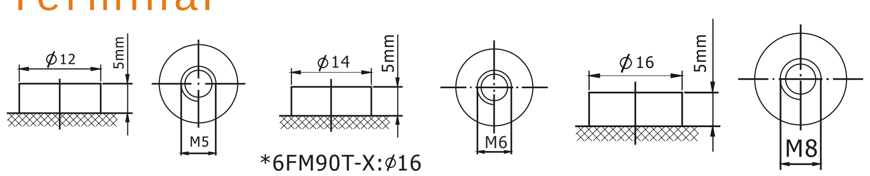
TYPE	Nominal Voltage(V)	Capacity(Ah) 1.8Vpc@10hr,25°C	Capacity(Ah) 1.75Vpc@20hr,25°C	L(mm)	L(inch)	W(mm)	W(inch)	H(mm)	H(inch)	TH(mm)	TH(inch)	Terminal	Layout	Wt.(Kg)	Wt.(lbs)
6FM17-X	12	17	18.2	181	7.13	77	3.03	167	6.57	167	6.57	M5	B	5.7	12.6
6FM24-X	12	24	25.2	166	6.54	175	6.89	125	4.92	125	4.92	M5	B	8.6	19.0
6FM33-X	12	33	35.6	195	7.68	130	5.12	155	6.10	168	6.61	M6	A	10.2	22.5
6FM40-X	12	40	43.0	197	7.76	165	6.50	170	6.69	170	6.69	M6	B	13.5	29.8
6FM45-X	12	45	47.4	197	7.76	165	6.50	170	6.69	170	6.69	M6	B	13.8	30.4
6FM55SG-X	12	55	57.2	229	9.02	138	5.43	208	8.19	213	8.39	M6	A	19.5	43.0
6FM60-X	12	60	65.8	258	10.2	166	6.54	206	8.11	215	8.46	M6	A	24.0	52.9
6FM65-X	12	65	70.0	350	13.8	167	6.57	179	7.05	179	7.05	M6	A	23.4	51.6
6FM75-X	12	75	81.0	258	10.2	166	6.54	206	8.11	215	8.46	M6	A	24.0	52.9
6FM80-X	12	80	85.2	350	13.8	167	6.57	179	7.05	179	7.05	M6	A	24.2	53.3
6FM90T-X	12	90	97.6	306	12.0	169	6.65	210	8.27	215	8.46	M6	A	30.0	66.2
6FM100-X	12	100	107	330	13.0	171	6.73	215	8.46	222	8.74	M6	A	32.0	70.6
6FM120-X	12	120	126	410	16.1	176	6.93	227	8.94	227	8.94	M8	A	38.0	83.8
6FM134-X	12	134	144	341	13.4	173	6.81	283	11.1	287	11.3	M8	A	42.5	93.7
6FM150-X	12	150	162	485	19.1	172	6.77	240	9.45	240	9.45	M8	A	47.0	104
6FM175	12	175	185	533	21.0	207	8.15	215	8.47	240	9.45	M10	C	56.4	124
6FM200-X	12	200	216	522	20.6	238	9.37	218	8.58	223	8.78	M8	C	65.0	143
6FM230-X	12	230	243	520	20.5	269	10.6	203	8.00	208	8.19	M8	C	72.6	160.1
3FM225-X	6	225	234	320	12.6	176	6.93	225	8.86	247	9.72	M8	D	30.5	67.3

More battery types are available on website: http://www.vision-batt.com

Position of terminals



Terminal



*6FM90T-X:ϕ16

Principle of VRLA batteries

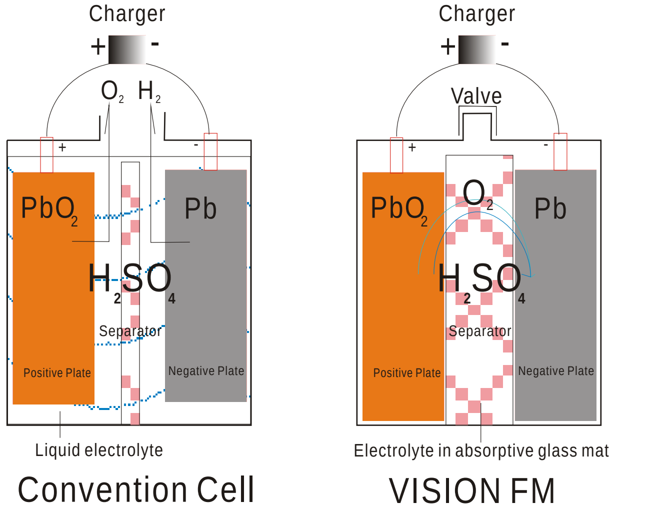
VISION Rechargeable Products
Sealed Lead Acid Battery
www.vision-batt.com

During conventional lead Acid battery charging , water electrolysis occurs at the final stage,then(so) hydrogen generates from the negative plates and oxygen from the positive plates. This causes water loss and periodic watering is needed.
However, evolution of oxygen and hydrogen gases does not occur simultaneously, because the recharge of the positive plates is not as efficient as the negative ones. This means that oxygen is evolved from the positive plate before hydrogen is evolved from the negative plate.
At the same time that oxygen is evolved from the positive plate, a substantial amount of highly active spongy lead exists on the negative plate before it commences hydrogen evolution. Therefore, providing oxygen can be transported to the negative plates, conditions are ideal for a rapid reaction between lead and oxygen, i.e. oxygen is electrochemically reduced on the negative plate according to the following formula,

$$2e^- + 2H^+ + 1/2O_2 \rightarrow H_2O$$

and the final product is water.
The current flowing through the negative plate drives this reaction instead of hydrogen evolution, which occurs, in a conventional battery.
This process is called gas recombination. If this process were 100% efficient no water would be lost from the battery. By careful design and selection of battery components, gas recombination efficiency is from 95% to 99%.

Principle of the oxygen reduction cycle



Recombination efficiency

Recombination efficiency is determined under specific conditions by measuring the volume of hydrogen emitted from the battery and converting this into its ampere-hour equivalent. This equivalent value is then subtracted from the total ampere-hours taken by the battery during the test period, and the remainder is the battery's recombination efficiency and is usually expressed as a percentage.

As recombination is never 100%, some hydrogen gas is emitted from batteries through the safety valve. The volume of gas emitted is very small and typical average values on constant potential float at 25°C are as follows:

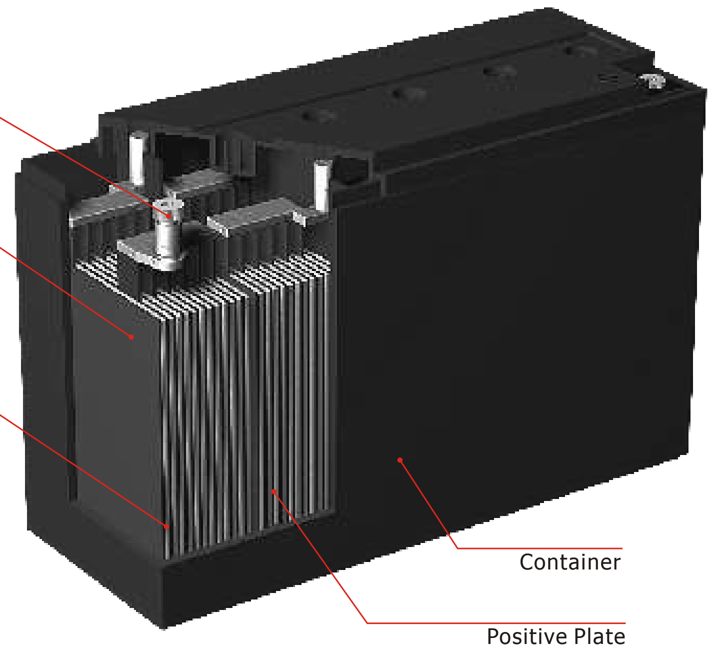
VISION FM hydrogen emissions	
Float Voltage (V/cell)	Volume of gas emitted (ml/cell/C_{10}Ah/month)
2.23~2.28	3.8
2.40~2.45	25

Conventional Cell
Oxygen and hydrogen escape to the atmosphere.
VISION FM
Oxygen from the positive plate transfers to the negative and recombines with lead to form water.

Construction :

These reactions can take place only by using :

- Plates composed of special alloy with several components which provide the plate grids with high mechanical strength and a high level of hydrogen over voltage.
- An appropriate ratio between positive and negative active materials.
- Fiberglass separators manufactured from borosilicate, giving them excellent resistance to high temperatures and to sulphuric acid. The high level of porosity of these separators is used to retain the quantity of electrolyte necessary for cell operation, but without any free electrolyte.
- A pressure relief valve which allows gas to be released if necessary in the case of an accidental overcharge.



Charge characteristics

The cells in the VISION FM product range must be charged at a constant voltage at an ambient temperature of 25°C, the batteries should be charged at 2.23-2.28 volts per cell. It is not necessary to limit the current, as this will be governed by the maximum output available from the charger until the voltage limit is reached. The charging voltage of 2.23-2.28 volts should also be used for float charging. To achieve nominal performance characteristics, it is recommended to adjust this value to suit the ambient temperature, as indicated in the following table:

Temperature	Float charge voltage
0°C	2.31 - 2.36 V
10°C	2.28 - 2.33 V
20°C	2.25 - 2.30 V
25°C	2.23 - 2.28 V
30°C	2.22 - 2.27 V
35°C	2.20 - 2.25 V

Under these conditions a full recharge will be completed in approximately 48 hours.

Fast recharge:

Increasing the charge voltage to 2.40 Volts per cell can reduce recharge time and it is possible, depending on the depth of discharge, to halve the recharge time. Under these conditions, however, the charge must be monitored and must be terminated when the charge current remains reasonably steady for 3 hours after the voltage limit has been reached. At the beginning of charge the current must be limited to $0.3C_{10}$ (A).

Ripple current:

The ripple content of the charging current affects the life of the battery. It is recommended to limit the continuous ripple current to $0.05\ C_{10}$ (in amperes) as recommended value (never exceed $0.10C_{10}$). Transient and other ripple type voltage excursions can be accommodated provided that, with the battery disconnected, the system peak to peak voltage including regulation limits falls within ±2.5% of the recommended float voltage of the battery.

Tables of performances VISION FM

Amperes

Constant Current Discharge (Amperes) at 25°C to 1.60 volts per cell																							
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	67.0	45.3	35.6	27.8	23.1	20.0	17.7	16.0	14.7	13.6	12.7	12.0	8.41	6.61	5.54	4.82	3.80	3.18	2.73	2.41	2.17	1.98	1.83	1.56	0.82
6FM24-X	85.0	60.0	46.0	37.0	32.0	27.9	24.5	22.0	20.2	18.5	17.3	15.8	11.5	9.40	7.75	6.76	5.40	4.45	3.90	3.45	3.10	2.80	2.56	2.16	1.20
6FM33-X	115	80.2	61.5	49.3	41.9	37.0	32.7	29.4	26.9	25.1	23.6	22.3	15.7	12.4	10.4	9.08	7.34	6.30	5.32	4.62	4.10	3.69	3.36	2.86	1.54
6FM40-X	131	93.0	73.3	57.6	48.3	42.0	37.4	34.0	31.3	29.1	27.4	25.9	18.3	14.5	12.2	10.7	8.60	7.36	6.33	5.60	5.05	4.62	4.28	3.61	1.87
6FM45-X	149	100	77.8	61.8	52.1	45.7	41.1	37.7	35.0	32.2	29.9	28.0	19.9	15.9	13.4	11.8	9.30	7.80	6.73	5.96	5.39	4.94	4.58	3.89	2.04
6FM55SG-X	175	129	99.4	79.3	67.2	59.2	52.3	47.1	43.1	39.9	37.3	35.1	24.9	19.7	16.7	14.6	11.6	9.82	8.43	7.44	6.69	6.11	5.65	4.78	2.45
6FM60-X	202	129	115	91.0	76.6	67.0	59.8	54.5	50.3	46.6	43.6	41.0	28.9	22.8	19.1	16.7	13.4	11.4	9.80	8.66	7.80	7.13	6.60	5.61	3.10
6FM65-X	215	160	125	97.8	81.4	70.5	63.0	57.4	53.0	49.5	46.6	44.2	30.9	24.3	20.3	17.7	14.2	12.1	10.4	9.19	8.28	7.58	7.01	5.90	3.20
6FM75-X	240	178	137	109	92.9	81.8	73.2	66.7	61.7	57.1	53.4	50.2	36.0	28.9	24.6	21.8	17.1	14.3	12.1	10.5	9.33	8.41	7.67	6.54	3.52
6FM80-X	222	169	134	106	89.6	78.6	70.5	64.4	59.6	55.1	51.4	48.3	34.4	27.5	23.2	20.4	16.1	13.5	11.5	9.99	8.92	8.06	7.38	6.21	3.35
6FM90T-X		218	173	137	115	100	89.2	81.0	74.7	69.6	65.5	62.0	44.5	35.8	30.5	27.0	20.9	17.2	14.6	12.7	11.3	10.2	9.30	7.91	4.26
6FM100-X		229	185	146	123	108	96.3	87.4	80.5	74.8	70.1	66.2	47.1	37.5	31.8	27.9	22.4	19.0	16.3	14.3	12.9	11.7	10.8	9.06	4.70
6FM120-X		250	196	158	135	120	106	95.8	87.7	81.3	76.0	71.6	51.8	41.9	36.0	32.0	25.1	21.0	18.2	16.2	14.6	13.4	12.5	10.5	5.54
6FM134-X		314	248	197	167	147	130	117	107	98.8	92.1	86.5	62.4	50.3	43.0	38.2	30.3	25.6	21.6	18.7	16.6	14.9	13.6	11.7	6.24
6FM150-X		360	288	228	193	169	149	135	123	115	108	102	73.3	58.9	50.3	44.5	34.7	28.8	24.4	21.2	18.8	17.0	15.5	13.2	7.10
6FM175			324	259	220	195	172	154	141	131	122	115	83.0	67.0	57.4	51.1	40.1	33.5	28.3	24.6	21.8	19.7	18.0	15.4	8.00
6FM200-X			360	290	248	220	194	174	159	147	136	128	92.8	75.2	64.6	57.6	45.5	38.2	32.3	28.0	24.9	22.4	20.4	17.5	9.34
6FM230-X			405	324	275	242	217	200	186	174	163	155	111	89.9	77.1	68.5	54.0	45.4	38.0	32.8	28.9	26.0	23.9	20.3	10.5
3FM225-X			390	314	269	238	215	198	184	172	161	153	108	84.8	71.1	62.0	49.5	42.0	35.9	31.5	28.3	25.7	23.7	20.2	10.3

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Current Discharge (Amperes) at 25°C to 1.65 volts per cell																							
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	64.9	44.2	34.0	26.8	22.5	19.6	17.4	15.7	14.4	13.4	12.5	11.8	8.20	6.40	5.32	4.60	3.68	3.13	2.67	2.34	2.10	1.90	1.75	1.49	0.78
6FM24-X	79.5	56.3	43.3	34.9	30.1	26.3	23.3	20.9	19.2	17.6	16.5	15.1	11.1	9.03	7.49	6.54	5.24	4.34	3.80	3.38	3.03	2.75	2.52	2.13	1.19
6FM33-X	106	77.3	59.4	47.9	40.9	36.3	32.3	29.2	26.9	24.9	23.3	21.9	15.4	12.2	10.3	8.97	7.27	6.25	5.28	4.59	4.08	3.67	3.35	2.85	1.53
6FM40-X	124	88.4	68.9	54.8	46.3	40.7	36.4	33.1	30.6	28.6	27.0	25.6	18.0	14.2	11.9	10.4	8.43	7.24	6.23	5.51	4.98	4.56	4.22	3.55	1.86
6FM45-X	136	95.0	74.3	59.9	51.3	45.5	40.8	37.2	34.4	31.7	29.5	27.6	19.6	15.6	13.2	11.6	9.14	7.66	6.63	5.89	5.34	4.90	4.54	3.86	2.02
6FM55SG-X	165	124	95.4	76.4	65.0	57.4	50.8	45.8	41.9	38.8	36.3	34.2	24.2	19.2	16.2	14.2	11.3	9.57	8.25	7.31	6.61	6.06	5.62	4.75	2.43
6FM60-X	188	143	110	87.5	74.0	65.0	58.1	52.9	48.9	45.1	42.0	39.4	27.9	22.1	18.6	16.3	13.1	11.1	9.55	8.44	7.61	6.97	6.45	5.48	3.06
6FM65-X	203	151	116	92.2	77.7	68.0	61.5	56.6	52.8	48.5	44.9	41.9	29.5	23.3	19.6	17.1	13.7	11.7	10.1	8.96	8.10	7.43	6.90	5.81	3.12
6FM75-X	222	169	131	104	88.8	78.3	68.9	61.9	56.4	52.8	49.9	47.5	34.5	27.9	24.0	21.4	16.8	14.1	12.0	10.4	9.26	8.37	7.65	6.51	3.50
6FM80-X	210	160	123	99.0	84.4	74.7	66.7	60.7	56.0	52.2	49.1	46.4	33.4	26.8	23.0	20.3	15.9	13.2	11.3	9.90	8.81	7.99	7.34	6.17	3.33
6FM90T-X		208	162	129	108	95.0	84.9	77.4	71.5	65.5	60.7	56.6	41.3	33.7	29.1	26.0	20.4	17.0	14.4	12.6	11.2	10.1	9.25	7.87	4.24
6FM100-X		221	178	141	119	104	93.2	85.0	78.7	72.2	66.9	62.5	45.1	36.4	31.2	27.7	21.8	18.3	15.7	13.9	12.5	11.5	10.6	9.01	4.68
6FM120-X		245	195	156	132	116	103	93.6	86.1	80.1	75.2	71.1	51.3	41.4	35.5	31.5	24.9	21.0	18.1	16.0	14.5	13.3	12.3	10.5	5.47
6FM134-X		292	237	191	163	145	128	115	105	96.7	89.9	84.3	60.9	49.1	42.1	37.4	29.7	25.0	21.2	18.5	16.4	14.8	13.6	11.6	6.23
6FM150-X		327	267	214	183	162	144	131	120	112	105	99.0	71.6	57.9	49.7	44.2	34.2	28.2	23.9	20.9	18.6	16.8	15.4	13.1	7.05
6FM175			309	248	211	187	165	149	137	127	118	112	80.7	65.3	56.1	49.9	39.2	32.7	27.8	24.2	21.6	19.5	17.9	15.3	7.96
6FM200-X			350	281	240	212	187	168	153	141	132	124	89.8	72.7	62.4	55.6	44.1	37.2	31.6	27.5	24.5	22.2	20.3	17.3	9.29
6FM230-X			394	317	271	241	215	196	182	170	160	152	110	89.1	76.6	68.2	53.8	45.1	37.9	32.7	28.8	25.7	23.8	20.0	10.4
3FM225-X			367	297	255	227	207	191	179	166	156	147	104	82.6	69.7	61.1	48.8	41.5	35.5	31.2	27.9	25.4	23.4	19.7	10.1

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Current Discharge (Amperes) at 25°C to 1.70 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	63.0	43.1	33.5	26.3	21.9	19.0	16.9	15.3	14.0	13.0	12.3	11.6	8.02	6.22	5.15	4.43	3.58	3.07	2.61	2.28	2.03	1.83	1.73	1.47	0.77
6FM24-X	74.0	52.5	40.5	32.8	28.3	24.7	22.0	19.8	18.1	16.7	15.7	14.4	10.7	8.65	7.23	6.31	5.08	4.24	3.70	3.30	2.95	2.69	2.48	2.10	1.17
6FM33-X	99.0	73.0	54.5	43.9	37.5	33.2	29.8	27.2	25.2	23.6	22.3	21.2	14.8	11.6	9.73	8.45	7.01	6.15	5.21	4.53	4.03	3.63	3.32	2.84	1.52
6FM40-X	119	83.7	66.7	52.8	44.5	39.0	35.3	32.6	30.5	28.4	26.6	25.2	17.7	14.0	11.7	10.2	8.27	7.11	6.14	5.45	4.93	4.53	4.21	3.52	1.84
6FM45-X	134	90.0	73.0	58.4	49.7	43.9	38.7	34.9	31.9	30.0	28.5	27.2	19.3	15.3	12.9	11.3	8.94	7.52	6.53	5.82	5.29	4.87	4.53	3.85	2.02
6FM55SG-X	155	115	90.6	73.1	62.6	55.6	49.2	44.4	40.7	37.7	35.3	33.3	23.6	18.8	15.8	13.9	11.1	9.40	8.13	7.22	6.54	6.00	5.58	4.72	2.41
6FM60-X	180	133	105	84.0	71.4	63.0	56.4	51.5	47.6	44.2	41.5	39.2	27.7	22.0	18.5	16.3	12.9	10.9	9.33	8.20	7.36	6.70	6.18	5.36	2.93
6FM65-X	191	143	114	90.2	75.8	66.3	59.4	54.2	50.1	46.7	43.8	41.5	29.2	23.1	19.4	16.9	13.5	11.5	9.92	8.79	7.95	7.29	6.76	5.75	3.06
6FM75-X	206	158	122	99.4	86.0	77.0	67.6	60.5	55.0	51.8	49.1	46.9	33.9	27.5	23.6	21.0	16.6	13.9	11.8	10.3	9.18	8.30	7.60	6.46	3.48
6FM80-X	196	151	119	95.4	81.5	72.3	64.8	59.2	54.9	50.9	47.5	44.8	32.5	26.3	22.6	20.2	15.8	13.2	11.3	9.81	8.78	7.95	7.29	6.14	3.29
6FM90T-X		186	153	121	103	90.0	80.5	73.4	67.9	63.1	59.2	56.0	40.5	32.8	28.1	25.0	19.8	16.7	14.2	12.4	11.1	10.0	9.18	7.81	4.20
6FM100-X		200	164	130	110	96.0	86.1	78.8	73.0	68.4	64.6	61.5	44.4	35.8	30.6	27.2	21.5	18.0	15.5	13.7	12.4	11.3	10.5	8.93	4.59
6FM120-X		223	187	150	127	112	99.9	90.9	83.8	78.2	73.5	69.7	50.4	40.7	34.9	31.0	24.5	20.7	17.8	15.8	14.2	13.1	12.2	10.4	5.39
6FM134-X		280	231	187	160	142	125	112	102	94.0	87.5	82.1	59.5	48.1	41.3	36.8	29.0	24.3	20.7	18.1	16.2	14.7	13.5	11.5	6.18
6FM150-X		313	259	210	180	160	142	129	118	109	102	96.3	70.1	56.9	49.1	43.8	33.7	27.6	23.5	20.5	18.3	16.6	15.2	12.9	6.96
6FM175			298	241	206	183	162	146	134	123	115	108	78.8	64.1	55.3	49.4	38.6	32.1	27.3	23.9	21.3	19.3	17.7	15.2	7.89
6FM200-X			337	271	232	206	182	163	149	137	128	120	87.5	71.3	61.5	55.0	43.5	36.6	31.1	27.2	24.3	22.0	20.2	17.2	9.25
6FM230-X			383	311	268	240	214	195	180	168	158	150	109	88.3	76.0	67.8	53.5	44.9	37.7	32.5	28.6	25.6	23.6	19.9	10.3
3FM225-X			358	294	255	230	207	190	176	161	149	139	99.8	80.4	68.7	61.0	48.4	40.8	34.9	30.7	27.5	25.1	23.1	19.4	9.90

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Current Discharge (Amperes) at 25°C to 1.75 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	60.1	41.9	32.0	25.4	21.4	18.7	16.6	15.0	13.8	12.6	11.6	10.8	7.59	5.97	5.01	4.36	3.52	3.01	2.56	2.23	1.99	1.80	1.72	1.46	0.77
6FM24-X	68.5	48.8	37.8	30.6	26.4	23.1	20.8	18.6	17.1	15.7	14.8	13.7	10.2	8.28	6.96	6.09	4.91	4.13	3.60	3.23	2.88	2.64	2.44	2.07	1.16
6FM33-X	87.8	69.0	52.0	42.4	36.6	32.8	29.2	26.6	24.5	22.8	21.4	20.3	14.3	11.3	9.46	8.25	6.58	5.58	4.79	4.22	3.80	3.46	3.31	2.82	1.52
6FM40-X	110	79.1	64.9	51.5	43.4	38.0	34.3	31.5	29.3	27.5	26.1	24.9	17.4	13.7	11.4	9.95	8.11	7.00	6.02	5.33	4.81	4.40	4.07	3.48	1.82
6FM45-X	118	85.0	69.0	54.5	45.7	39.9	36.2	33.4	31.2	29.5	28.1	26.9	19.0	15.1	12.7	11.1	8.78	7.38	6.34	5.59	5.04	4.60	4.51	3.83	2.01
6FM55SG-X	145	106	85.8	69.8	60.2	53.8	47.7	43.2	39.6	36.8	34.4	32.5	23.1	18.3	15.5	13.6	10.9	9.23	8.00	7.12	6.46	5.95	5.54	4.69	2.40
6FM60-X	167	123	99.4	80.2	68.6	60.9	54.6	49.9	46.2	43.3	40.9	38.9	27.4	21.7	18.3	16.0	12.7	10.7	9.18	8.10	7.29	6.66	6.15	5.23	2.81
6FM65-X	178	132	108	87.1	74.6	66.2	59.2	53.9	49.8	46.2	43.3	40.9	28.8	22.8	19.2	16.7	13.3	11.3	9.74	8.62	7.78	7.13	6.61	5.62	2.97
6FM75-X	195	151	117	96.1	83.4	73.6	65.9	59.0	53.7	50.3	47.6	45.3	33.0	26.8	23.1	20.6	16.2	13.5	11.5	10.1	9.04	8.21	7.55	6.42	3.46
6FM80-X	184	143	113	91.8	78.6	69.8	62.0	56.2	51.6	47.9	44.9	42.4	31.0	25.3	21.9	19.6	15.5	13.0	11.1	9.72	8.67	7.86	7.25	6.10	3.27
6FM90T-X		175	142	114	98.2	87.3	78.0	71.0	65.5	61.1	57.6	54.6	39.4	31.8	27.2	24.2	19.2	16.2	13.8	12.1	10.9	9.89	9.10	7.74	4.17
6FM100-X		187	153	123	105	93.0	83.7	76.7	71.3	67.0	63.4	60.5	43.7	35.3	30.2	26.9	21.0	17.5	15.1	13.4	12.1	11.1	10.3	8.76	4.50
6FM120-X		210	179	144	122	108	96.4	87.8	81.0	75.6	71.2	67.5	49.0	39.8	34.2	30.5	24.0	20.0	17.3	15.4	14.0	12.9	12.1	10.3	5.31
6FM134-X		257	214	177	154	139	122	110	99.8	92.0	85.5	80.2	58.2	47.1	40.5	36.1	28.3	23.6	20.2	17.8	16.0	14.6	13.5	11.4	6.17
6FM150-X		288	240	198	173	156	138	125	114	106	99.0	93.4	68.4	55.9	48.4	43.4	33.2	27.0	23.0	20.2	18.1	16.4	15.1	12.8	6.91
6FM175			280	229	198	178	157	142	130	120	112	105	76.8	62.6	54.1	48.4	37.8	31.5	26.9	23.6	21.1	19.1	17.6	15.1	7.85
6FM200-X			319	260	224	200	177	159	145	134	125	117	85.2	69.3	59.8	53.4	42.5	36.0	30.7	26.9	24.1	21.9	20.1	17.1	9.20
6FM230-X			372	304	263	236	211	193	178	166	157	149	108	87.3	75.0	66.8	53.0	44.6	37.5	32.3	28.5	25.5	23.1	19.8	10.3
3FM225-X			345	282	244	219	196	178	165	155	148	141	101	80.3	68.2	60.1	47.5	40..0	34.3	30.2	27.1	24.7	22.8	19.1	9.80

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Current Discharge (Amperes) at 25ºC to 1.80 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	57.4	40.8	31.0	24.5	20.6	18.0	16.1	14.6	13.5	12.3	11.3	10.5	7.39	5.84	4.90	4.28	3.44	2.93	2.49	2.18	1.95	1.77	1.70	1.45	0.76
6FM24-X	63.0	45.0	35.0	28.5	24.5	21.5	19.5	17.5	16.0	14.8	14.0	13.0	9.80	7.90	6.70	5.86	4.75	4.02	3.50	3.15	2.80	2.58	2.40	2.04	1.14
6FM33-X	79.5	60.0	49.5	40.7	35.4	31.9	28.4	25.8	23.8	22.2	20.9	19.8	14.0	11.1	9.35	8.18	6.51	5.50	4.70	4.13	3.70	3.37	3.30	2.81	1.51
6FM40-X	101	71.9	58.7	47.5	40.8	36.3	33.1	30.8	28.9	26.9	25.2	23.8	16.8	13.2	11.1	9.72	7.90	6.80	5.87	5.20	4.70	4.31	4.00	3.40	1.79
6FM45-X	114	80.0	66.0	52.5	44.4	39.0	35.4	32.6	30.5	28.9	27.6	26.5	18.7	14.8	12.5	10.9	8.66	7.30	6.27	5.54	4.99	4.56	4.50	3.83	2.01
6FM55SG-X	134	99.8	79.5	65.7	57.4	51.9	46.1	41.8	38.4	35.7	33.5	31.7	22.5	17.9	15.1	13.3	10.7	9.06	7.87	7.03	6.39	5.90	5.50	4.65	2.38
6FM60-X	155	112	92.0	75.4	65.4	58.7	52.8	48.4	44.9	41.6	38.8	36.6	25.9	20.5	17.3	15.2	12.3	10.5	9.00	7.93	7.13	6.50	6.00	5.10	2.68
6FM65-X	165	120	100	80.9	69.4	61.8	55.6	50.9	47.3	43.7	40.7	38.3	27.3	21.8	18.5	16.3	13.0	11.1	9.57	8.47	7.65	7.01	6.50	5.53	2.86
6FM75-X	180	139	112	92.6	80.9	73.1	64.6	58.3	53.3	49.3	46.1	43.4	31.6	25.7	22.2	19.8	15.7	13.3	11.4	9.99	8.95	8.14	7.50	6.38	3.43
6FM80-X	171	134	106	86.9	75.2	67.5	60.1	54.6	50.3	46.9	44.0	41.7	30.2	24.4	20.9	18.6	14.9	12.7	10.9	9.54	8.57	7.81	7.2	6.06	3.25
6FM90T-X		163	132	108	93.8	84.2	75.1	68.3	63.0	58.8	55.3	52.4	37.8	30.4	26.0	23.1	18.5	15.7	13.5	11.9	10.7	9.74	9.00	7.65	4.12
6FM100-X		175	143	117	101	91.0	82.0	75.3	70.0	65.0	60.8	57.4	41.4	33.3	28.5	25.3	20.2	17.2	14.8	13.1	11.8	10.8	10.0	8.50	4.42
6FM120-X		197	167	137	118	106	94.4	85.7	78.9	73.5	69.1	65.4	46.8	37.4	31.8	28.1	22.6	19.3	16.8	15.0	13.6	12.6	12.0	10.2	5.24
6FM134-X		235	197	166	147	134	118	106	96.7	89.2	83.1	78.0	56.6	45.9	39.5	35.2	27.6	23.0	19.8	17.5	15.8	14.5	13.4	11.3	6.14
6FM150-X		264	222	186	164	150	133	120	110	102	95.8	90.5	66.0	53.7	46.3	41.4	32.1	26.5	22.7	19.9	17.9	16.3	15.0	12.7	6.87
6FM175			246	207	184	169	150	136	125	116	108	102	74.2	60.2	51.8	46.2	36.7	31.0	26.5	23.3	20.9	19.0	17.5	15.0	7.80
6FM200-X			269	228	203	187	167	152	140	130	121	114	82.5	66.8	57.3	51.0	41.3	35.4	30.3	26.6	23.9	21.7	20.0	17.0	9.16
6FM230-X			360	297	259	233	209	190	176	164	155	147	107	86.6	74.5	66.5	52.6	44.3	37.2	32.1	28.3	25.4	23.0	19.7	10.2
3FM225-X			299	249	219	199	181	168	157	145	135	126	90.6	72.6	61.9	54.7	45.0	39.1	33.6	29.6	26.7	24.3	22.5	18.8	9.60

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Watts per cell

Constant Power Discharge (Watts per cell) at 25ºC to 1.60 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	133	83.6	65.0	51.7	43.6	38.3	34.5	31.6	29.4	27.0	25.0	23.4	16.3	12.7	10.5	9.10	7.33	6.27	5.28	4.57	4.04	3.62	3.29	2.81	1.55
6FM24-X	150	107	82.2	66.2	57.3	50.0	44.0	39.6	36.5	33.5	31.5	29.0	21.5	17.7	14.8	13.0	10.5	8.83	7.75	6.86	6.17	5.58	5.11	4.32	2.42
6FM33-X	215	150	117	94.8	81.4	72.4	64.5	58.5	53.8	48.6	44.4	40.9	29.2	23.3	19.8	17.4	14.2	12.2	10.3	9.02	8.02	7.25	6.63	5.64	3.04
6FM40-X	251	177	141	117	103	92.9	83.1	75.7	70.0	64.2	59.5	55.6	39.3	31.2	26.3	23.0	18.0	15.0	12.9	11.5	10.2	9.29	8.71	7.38	3.97
6FM45-X	263	187	147	123	108	98.6	88.3	80.6	74.6	68.4	63.4	59.2	41.9	33.2	28.0	24.5	19.1	15.8	13.5	11.9	10.7	9.77	9.02	7.69	4.14
6FM55SG-X	318	229	182	146	125	111	100	91.7	85.3	78.7	73.4	68.9	49.0	39.1	33.1	29.1	22.7	18.8	16.2	14.3	12.9	11.8	10.9	9.25	5.06
6FM60-X	350	259	200	161	138	122	110	101	94.1	87.5	82.1	77.6	55.6	44.5	37.4	33.0	26.3	22.2	19.1	16.6	14.8	13.3	12.2	10.3	5.52
6FM65-X	381	282	222	177	150	132	117	106	98.0	91.1	85.5	80.8	57.7	46.1	39.1	34.5	27.2	22.8	19.6	17.3	15.5	14.2	13.1	11.1	5.98
6FM75-X	413	314	246	202	175	158	142	129	120	110	102	95.7	67.9	54.1	45.7	40.2	31.8	26.8	22.9	20.1	18.0	16.4	15.1	12.8	6.90
6FM80-X	390	291	232	191	166	149	132	121	112	103	94.5	88.7	63.5	50.9	43.3	38.3	30.1	25.1	21.6	19.1	17.2	15.7	14.5	12.3	6.57
6FM90T-X		373	308	249	213	189	170	156	145	134	125	117	82.8	65.5	55.2	48.3	38.3	32.3	27.6	24.2	21.7	19.7	18.1	15.4	8.28
6FM100-X		392	321	260	223	199	178	162	150	140	131	124	88.4	70.6	60.0	52.8	42.2	35.8	30.6	26.9	24.2	22	20.3	17.4	9.25
6FM120-X		449	370	299	256	227	204	186	172	160	149	141	100	79.6	67.3	59.2	46.9	39.5	34.1	30.3	27.4	25.1	23.3	21.0	11.0
6FM134-X		566	474	381	324	287	252	226	206	189	175	163	117	94.6	80.9	71.8	56.6	47.4	40.6	35.7	32.0	29.2	26.9	22.9	12.3
6FM150-X		637	542	438	375	333	295	266	243	223	206	192	138	111	95.3	84.5	66.3	55.4	47.1	41.2	36.8	33.3	30.5	25.6	13.8
6FM175			584	476	411	368	325	293	269	246	227	211	154	125	108	96.8	76.4	64.2	54.6	47.7	42.6	38.6	35.4	30.3	15.8
6FM200-X			625	514	447	402	356	321	294	268	247	230	170	139	121	109	86.5	73.0	62.1	54.3	48.4	43.8	40.2	34.2	18.4
6FM230-X			680	585	514	469	423	388	361	335	314	296	213	172	147	131	104	86.7	73.0	63.2	55.9	50.2	45.6	39.2	20.8
3FM225-X			677	581	511	465	414	377	348	320	298	279	201	162	138	123	97.1	81.7	69.5	60.8	54.3	49.3	45.2	38.5	20.7

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Power Discharge (Watts per cell) at 25°C to 1.65 volts per cell																						
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	127	82.2	64.6	51.2	43.2	37.8	34.1	31.3	29.1	26.7	24.8	23.2	16.1	12.6	10.4	9.01	7.25	6.20	5.23	4.53	4.01	3.60	3.28	2.80	1.52
6FM24-X	141	101	77.7	62.7	54.2	47.4	42.0	37.8	34.8	32.0	30.2	27.9	20.8	17.1	14.3	12.6	10.2	8.62	7.56	6.72	6.03	5.48	5.04	4.27	2.39
6FM33-X	207	145	110	89.7	77.5	69.3	62.4	57.2	53.2	48.1	44.0	40.5	28.9	23.1	19.6	17.3	13.9	11.9	10.1	8.80	7.83	7.07	6.47	5.51	2.96
6FM40-X	233	163	128	105	91.9	82.9	74.7	68.6	63.8	58.8	54.6	51.2	36.5	29.1	24.7	21.7	17.0	14.1	12.2	10.9	9.90	9.12	8.50	7.25	3.90
6FM45-X	246	174	140	113	97.5	86.9	78.6	72.4	67.6	62.5	58.3	54.8	38.8	30.8	26.0	22.8	17.8	14.8	12.8	11.4	10.3	9.48	8.81	7.49	4.04
6FM55SG-X	300	225	177	143	123	109	98.3	90.3	84.0	77.3	71.9	67.3	47.9	38.2	32.4	28.5	22.3	18.6	16.0	14.1	12.8	11.7	10.8	9.19	4.95
6FM60-X	337	248	190	153	131	116	106	98.5	92.6	85.9	80.4	75.8	54.3	43.6	37.1	32.8	26.1	22.1	18.8	16.4	14.6	13.2	12.1	10.2	5.49
6FM65-X	359	267	206	166	143	127	114	104	96.5	89.5	83.8	79.0	56.4	45.1	38.3	33.8	26.8	22.6	19.4	17.1	15.3	14.0	12.9	11.0	5.90
6FM75-X	403	300	241	197	170	153	138	127	118	108	100	93.6	66.4	52.8	44.6	39.2	31.3	26.6	22.6	19.8	17.7	16.0	14.7	12.5	6.74
6FM80-X	378	279	225	184	158	141	128	118	110	101	93.6	88.0	62.6	49.8	42.1	37.0	29.3	24.7	21.2	18.6	16.7	15.3	14.1	12.0	6.48
6FM90T-X		364	303	241	205	180	162	149	139	128	119	112	80.1	64.1	54.6	48.2	38.0	31.9	27.2	23.8	21.3	19.3	17.7	15.1	8.13
6FM100-X		379	315	252	213	188	170	156	146	135	125	118	84.5	67.8	57.8	51.2	41.3	35.4	30.3	26.7	23.9	21.8	20.1	17.1	9.20
6FM120-X		426	358	289	248	220	199	183	171	158	147	137	97.0	76.8	64.7	56.6	45.5	38.9	33.7	29.9	27.1	24.9	23.2	20.1	10.8
6FM134-X		529	433	347	295	261	235	215	200	183	169	158	114	92.2	79.1	70.3	55.7	47.0	40.1	35.2	31.5	28.6	26.3	22.4	12.1
6FM150-X		614	504	404	344	304	274	252	235	215	199	186	135	109	94.1	83.9	65.3	54.1	45.9	40.0	35.6	32.1	29.4	25.0	13.5
6FM175			554	451	388	347	310	282	261	239	221	206	151	123	106	95.5	75.2	63.1	53.5	46.6	41.5	37.5	34.3	29.4	15.3
6FM200-X			604	497	433	390	345	312	286	262	242	225	166	137	119	107	85.1	72.0	61.1	53.3	47.4	42.8	39.2	33.3	17.9
6FM230-X			673	570	507	466	420	386	359	333	312	294	212	171	147	130	103	86.4	72.8	63.0	55.7	50.0	45.4	39.0	20.5
3FM225-X			650	539	472	428	382	348	321	299	280	265	192	156	134	119	95.4	81.1	68.9	60.2	53.7	48.6	44.5	37.8	20.4

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Power Discharge (Watts per cell) at 25°C to 1.70 volts per cell																						
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	118	80.8	63.0	50.1	42.4	37.2	33.6	30.8	28.7	26.4	24.6	23.0	16.0	12.4	10.3	8.90	7.16	6.12	5.16	4.48	3.97	3.57	3.25	2.78	1.51
6FM24-X	131	94.3	73.1	59.2	51.2	44.8	39.9	35.9	33.0	30.5	28.9	26.8	20.1	16.4	13.9	12.2	9.95	8.42	7.37	6.58	5.89	5.38	4.97	4.21	2.37
6FM33-X	185	136	107	85.8	73.0	64.5	58.8	54.5	51.2	46.7	43.0	39.9	28.4	22.6	19.1	16.8	13.5	11.5	9.74	8.52	7.60	6.88	6.31	5.36	2.89
6FM40-X	215	155	124	102	89.0	80.3	71.8	65.5	60.5	56.4	53.1	50.3	35.6	28.3	23.8	20.9	16.5	13.9	12.1	10.8	9.79	9.03	8.42	7.16	3.85
6FM45-X	232	166	135	109	94.0	83.8	75.9	69.9	65.3	60.8	57.1	54.0	38.3	30.4	25.7	22.5	17.6	14.7	12.7	11.2	10.1	9.30	8.63	7.34	3.95
6FM55SG-X	281	213	169	138	119	107	96.4	88.5	82.3	75.7	70.3	65.8	46.9	37.4	31.7	27.9	21.8	18.2	15.7	13.9	12.5	11.4	10.6	9.02	4.85
6FM60-X	317	234	187	151	129	114	104	96.5	90.7	84.1	78.6	74.1	53.1	42.6	36.3	32.1	25.6	21.7	18.5	16.2	14.4	13.1	12.0	10.2	5.48
6FM65-X	337	252	197	158	134	118	108	100	94.5	87.6	81.9	77.2	55.5	44.6	38.1	33.7	26.6	22.4	19.2	16.9	15.2	13.9	12.8	10.9	5.88
6FM75-X	375	290	237	191	163	145	131	120	111	103	95.7	89.8	64.4	51.6	44.0	38.9	30.8	26.0	22.1	19.4	17.3	15.7	14.4	12.3	6.61
6FM80-X	351	269	221	179	153	136	122	113	105	97.2	90.0	84.4	60.4	48.3	41.1	36.4	28.8	24.3	20.8	18.4	16.5	15.0	13.9	11.8	6.39
6FM90T-X		345	284	227	194	171	153	140	129	120	113	107	76.9	61.8	52.8	46.8	37.2	31.5	26.8	23.4	20.9	19.0	17.4	14.8	7.99
6FM100-X		360	299	241	206	183	163	149	137	128	121	114	82.6	66.8	57.3	50.9	41.0	35.0	30.0	26.4	23.8	21.7	20.0	17.0	9.13
6FM120-X		404	346	280	240	213	189	171	157	147	138	131	93.0	74.0	62.6	55.0	44.6	38.3	33.2	29.6	26.8	24.7	23.0	19.7	10.6
6FM134-X		512	427	343	292	258	231	211	195	179	165	154	112	90.6	78.0	69.5	54.8	45.9	39.2	34.4	30.8	27.9	25.7	21.8	11.7
6FM150-X		566	469	385	334	300	270	247	229	210	194	181	132	108	93.1	83.3	64.5	53.2	45.1	39.3	35.0	31.6	28.9	24.6	13.2
6FM175			528	434	378	341	304	276	254	233	215	201	148	121	105	94.2	74.2	62.2	52.7	45.9	40.8	36.8	33.7	28.9	15.0
6FM200-X			586	484	423	382	338	305	279	256	237	221	163	134	117	105	83.9	71.2	60.3	52.5	46.6	42.0	38.4	32.6	17.6
6FM230-X			666	564	503	462	417	383	357	331	309	291	210	169	145	129	102	86.1	72.5	62.8	55.5	49.8	45.2	38.8	20.2
3FM225-X			629	521	456	413	371	340	315	293	275	259	186	150	128	113	92.7	80.5	68.3	59.6	53.1	48.0	43.9	37.3	20.1

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Power Discharge (Watts per cell) at 25℃ to 1.75 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	115	79.3	62.0	49.4	41.8	36.7	33.1	30.5	28.4	26.1	24.3	22.7	15.8	12.3	10.2	8.83	7.09	6.05	5.11	4.43	3.93	3.53	3.22	2.76	1.50
6FM24-X	122	87.9	68.6	55.7	48.1	42.1	37.9	34.1	31.3	29.0	27.5	25.6	19.4	15.8	13.4	11.8	9.68	8.21	7.17	6.43	5.74	5.28	4.89	4.16	2.34
6FM33-X	170	132	103	82.6	70.7	62.7	56.9	52.5	49.1	45.1	41.8	39.1	27.6	21.8	18.3	16.0	13.1	11.3	9.60	8.38	7.47	6.77	6.20	5.27	2.84
6FM40-X	198	148	120	98.9	86.2	77.7	69.8	63.9	59.3	55.4	52.2	49.5	35.1	27.8	23.5	20.6	16.3	13.7	11.9	10.6	9.58	8.82	8.21	6.98	3.76
6FM45-X	212	156	127	104	90.9	81.8	74.2	68.6	64.1	59.7	56.1	53.1	37.7	30.0	25.4	22.3	17.4	14.5	12.5	11.0	9.96	9.11	8.44	7.17	3.86
6FM55SG-X	261	200	162	134	116	105	94.5	86.6	80.5	74.0	68.7	64.3	45.8	36.6	31.0	27.3	21.5	18.0	15.5	13.7	12.3	11.2	10.4	8.84	4.76
6FM60-X	296	220	183	148	126	112	102	94.5	88.7	82.2	76.8	72.4	51.9	41.7	35.5	31.4	25.1	21.4	18.2	16.0	14.3	13.0	11.9	10.1	5.46
6FM65-X	315	237	193	155	131	116	106	98.3	92.4	85.6	80.0	75.4	53.9	43.2	36.7	32.4	25.9	22.0	18.9	16.7	15.0	13.7	12.7	10.8	5.84
6FM75-X	356	274	223	183	158	142	129	119	111	101	93.2	86.5	62.4	50.3	43.1	38.3	30.6	26.0	22.1	19.3	17.2	15.5	14.2	12.0	6.48
6FM80-X	331	258	209	172	149	134	121	111	103	94.5	88.4	83.1	59.5	47.7	40.6	35.9	28.5	24.1	20.6	18.1	16.2	14.8	13.6	11.5	6.30
6FM90T-X		343	281	224	190	167	150	138	128	118	110	103	74.2	59.8	51.2	45.4	36.2	30.7	26.2	22.9	20.5	18.6	17.1	14.6	7.84
6FM100-X		353	294	236	200	177	159	145	134	125	117	111	80.0	64.5	55.3	49.1	39.9	34.4	29.4	25.9	23.3	21.2	19.6	16.7	8.98
6FM120-X		383	334	270	232	206	184	167	154	143	135	128	91.0	72.6	61.5	54.1	43.7	37.4	32.5	29.1	26.5	24.4	22.8	19.3	10.4
6FM134-X		483	414	334	286	254	227	208	192	176	163	152	110	89.5	76.9	68.6	53.7	44.8	38.3	33.6	30.1	27.4	25.2	21.4	11.5
6FM150-X		532	444	369	324	294	264	242	224	205	190	177	130	106	91.6	82.1	63.4	52.1	44.2	38.6	34.4	31.1	28.5	24.2	13.0
6FM175			511	422	369	333	297	270	249	228	211	197	144	118	102	91.6	72.6	61.2	51.8	45.1	40.1	36.2	33.1	28.4	14.7
6FM200-X			578	475	413	372	330	299	274	251	233	217	159	130	113	101	81.8	70.2	59.3	51.6	45.8	41.2	37.6	31.9	17.2
6FM230-X			658	558	499	459	415	381	355	328	306	288	208	168	144	128	101	85.8	72.2	62.5	55.2	49.6	45.0	38.7	20.1
3FM225-X			608	502	438	396	358	330	308	286	268	254	183	147	126	112	91.4	79.0	67.1	58.6	52.2	47.3	43.3	36.8	19.8

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Constant Power Discharge (Watts per cell) at 25℃ to 1.80 volts per cell																								
Battery Type	5min	10min	15min	20min	25min	30min	35min	40min	45min	50min	55min	1h	1.5h	2h	2.5h	3h	4h	5h	6h	7h	8h	9h	10h	12h	24h
6FM17-X	111	77.9	60.4	48.2	41.0	36.1	32.6	30.0	28.0	25.8	24.0	22.5	15.6	12.2	10.1	8.74	7.05	6.03	5.09	4.41	3.91	3.51	3.20	2.70	1.49
6FM24-X	112	81.5	64.0	52.2	45.0	39.5	35.8	32.2	29.5	27.5	26.2	24.5	18.7	15.1	12.9	11.4	9.40	8.00	6.98	6.29	5.60	5.18	4.82	4.10	2.31
6FM33-X	155	116	97.9	79.5	68.4	61.0	55.8	51.8	48.8	44.6	41.2	38.3	26.8	21.0	17.5	15.2	12.6	11.0	9.37	8.18	7.28	6.59	6.03	5.13	2.76
6FM40-X	186	140	116	95.5	83.2	75.0	67.7	62.3	58.0	54.2	51.2	48.6	34.4	27.3	23.0	20.2	16.1	13.6	11.7	10.4	9.43	8.66	8.04	6.84	3.68
6FM45-X	203	153	126	103	89.2	80.0	72.7	67.3	63.0	58.7	55.2	52.3	37.2	29.6	25.0	22.0	17.1	14.2	12.2	10.8	9.73	8.90	8.24	7.01	3.77
6FM55SG-X	248	186	154	129	114	104	93.0	84.8	78.4	72.6	67.9	64.0	45.4	36.0	30.4	26.7	21.2	17.9	15.3	13.5	12.1	11.1	10.2	8.65	4.66
6FM60-X	277	205	174	142	122	109	100	93.2	87.9	81.1	75.6	71.0	50.9	40.8	34.7	30.7	24.5	20.8	17.8	15.6	14.0	12.7	11.7	10.0	5.44
6FM65-X	294	220	183	149	128	114	104	96.9	91.2	84.7	79.4	75.0	53.4	42.5	36.0	31.7	25.5	21.7	18.7	16.5	14.9	13.6	12.6	10.7	5.78
6FM75-X	341	261	212	176	155	141	126	115	106	97.5	90.3	84.2	61.1	49.6	42.6	38.0	30.4	25.8	21.8	18.9	16.8	15.1	13.8	11.7	6.30
6FM80-X	314	248	196	164	144	131	118	108	100	91.8	85.1	79.7	57.4	46.3	39.6	35.1	28.0	23.8	20.3	17.8	15.9	14.5	13.3	11.2	6.21
6FM90T-X		314	267	215	184	163	147	134	125	115	107	101	73.1	59.1	50.8	45.2	35.9	30.3	25.8	22.5	20.1	18.2	16.7	14.2	7.66
6FM100-X		329	279	225	193	171	154	141	131	120	112	104	76.5	62.5	54.1	48.5	39.4	34.0	29.0	25.5	22.8	20.8	19.1	16.2	8.74
6FM120-X		358	310	254	221	199	178	162	150	140	131	124	88.6	70.8	60.1	53.0	43.0	37.0	32.1	28.6	26.0	23.9	22.3	19.0	10.2
6FM134-X		448	391	319	276	247	222	204	189	173	161	150	109	88.7	76.4	68.2	53.1	44.0	37.5	32.9	29.4	26.7	24.5	20.8	11.2
6FM150-X		498	425	357	316	289	260	238	221	203	188	175	128	104	90.2	80.8	62.2	51.0	43.3	37.8	33.7	30.5	27.9	23.7	12.8
6FM175			490	408	359	327	292	266	246	225	209	195	142	116	99.8	89.4	71.1	60.2	50.9	44.2	39.3	35.4	32.3	27.7	14.4
6FM200-X			554	459	402	364	324	294	270	248	230	215	157	127	110	98.0	80.1	69.3	58.4	50.7	44.9	40.3	36.7	31.2	16.8
6FM230-X			649	552	494	455	411	378	352	325	302	284	205	166	142	126	100	85.4	71.9	62.2	55.0	49.4	44.9	38.5	20.0
3FM225-X			572	481	426	389	352	324	302	278	258	242	176	143	123	110	89.4	77.0	65.6	57.4	51.3	46.5	42.7	36.3	19.5

(Note)The above characteristics data are average values obtained within three charge/discharge cycles not the mimimum values.

Battery calculations

A. Floating applications

A battery application is characterized by:

- A voltage which must be held within certain limits,
- A power level which must be delivered
- A set capacity to maintain the load in terms of time.

By the use of these three parameters, calculations can be effected as follows:

- A situation requires: a maximum voltage of 490 volts
  a minimum voltage of 378 volts
- The ambient temperature is 25°C
- The float voltage is to be 2.27 volts per cell.

Preliminary calculation:

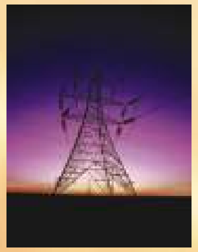
The maximum number of cells: 490 V / 2.27 V = 216 cells

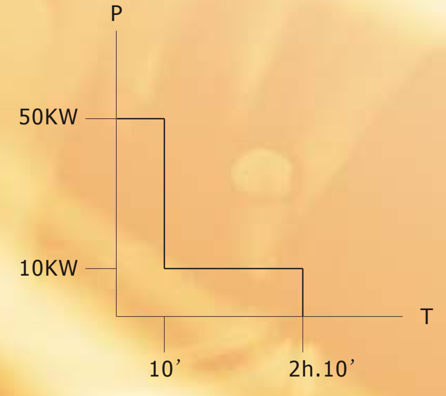
The minimum voltage per cell at the end of discharge:

378 V / 216 = 1.75 volts.

Case 1: discharge with a surge at the start of discharge

- The surge power is to be 50 kW for 10 minutes, followed by 10 kW for 2 hours.





Discharge current:

During the surge: 50000 W/378 V = 132 amps

And then: 10000 W/378 V = 26 amps

Determining the cell required for the current required

Current flow during surge:

(132 A x 10 min) / 60 min= 22 Ah

Current flow for 2 hours:

26 A x 2 h = 52 Ah

Total capacity drawn: 22 Ah + 52 Ah = 74 Ah.

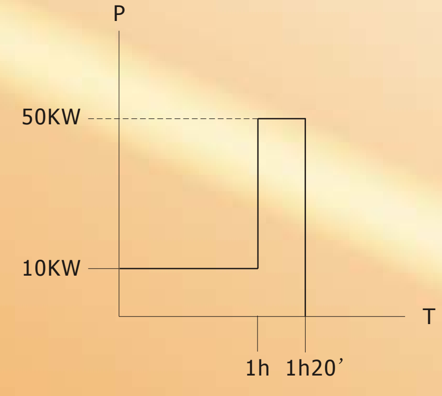
Equivalent discharge time at 26 amps to supply 74 Ah:

74/26 = 2.8hours

From the table of performance characteristics, expressed in terms of the discharge current in amps for 1.75V end voltage, the cell to give a current of 26 amps for 2.8 hours is the 6FM100-X.

Conclusion :In this example; it is the total number of Ah required which determines the battery to be used, i.e. 216 cells/36 Batteries of type 6FM100-X.

Case 2: discharge with a surge at the end of discharge (here again, it is the surge which dictates the battery to be used) The continuous power is to be 10 kW for one hour, followed by a surge of 50 kW for 20 minutes



Discharge current:

- During the surge: 50000 W/378 V=132 amps
- Before the surge: 10000 W/378 V= 26 amps

Capacity drawn in 1 hour: 26 A x 1 h = 26 Ah

Capacity drawn during surge (20 min) (132 amps x 20min) / 60 min = 43.5 Ah

Total capacity drawn: 69.5 Ah

Equivalent discharge time at 360 amps to supply 26 Ah (69.5/132) x 60 min=32 min

From the table of performance characteristics, expressed in terms of the discharge current in amps for 1.75V end voltage, the cell to give a current of 132 amps for 32 minutes is the 6FM150-X.

The battery to be used will consist of 216 cells/36 Batteries of type 6FM150-X.

B) Accidental deep discharge

This may involve discharge of the battery into indicator lamps, a lower load on the battery than that initially planned, a failure of the charging system, a discharged battery not recharged immediately, etc...

On a full discharged battery:

All of the sulphuric acid has been consumed, and the electrolyte is now entirely water.

Sulphation of the plates is at a maximum, thus increasing greatly the internal resistance of the battery.

The aqueous solution in which the battery now finds itself can give rise to the development of lead dendrites on the separator during recharging, and this may cause the cell to short-circuit internally.

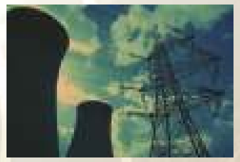
Important note:

This type of deep discharge will still result in the premature deterioration of the battery, and a significant effect on its life expectancy.

C) Effect of temperature on capacity

The following table gives the correction factor according to temperature, where the reference temperature is 25°C.

Duration of discharge	Battery temperature											
	-15°C	-10°C	-5°C	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C
15min	0.46	0.52	0.58	0.65	0.71	0.78	0.85	0.93	1.00	1.07	1.15	1.22
1 hour	0.59	0.64	0.69	0.74	0.80	0.85	0.90	0.95	1.00	1.05	1.09	1.14
10hour	0.71	0.75	0.79	0.82	0.86	0.90	0.93	0.97	1.00	1.03	1.06	1.08



Installation of the battery

Warning:
- The batteries of the VISION FM Series are already charged when delivered, and are fitted with a protective cap on each terminal. They should be unpacked with care.
- Avoid short-circuiting terminals of opposite polarity, because these units are capable of discharging at a very high current especially if the lid or the container is damaged.
- Acid leakage and unusual appearance must be avoided before switching on, noting open circuit voltage.
- There must be appointed man operating for 24 hs after switching on to solving potential problems in time, noting voltage and current.

Unpacking the battery
- Each shipment of VISION FM Series batteries is accompanied by a packing list.
- The packing list should be checked, and the Sales Department should be told immediately of any missing items.

Setting up the battery racks
- The structure should be assembled in accordance with instructions supplied with the equipment.

Racks
- Ensure that the stretchers and cross-members are correctly interlinked.
- Take up any irregularity in floor surface using shims
- Ensure that all frame members are correctly interlinked
- Use the adjustable feet to take up irregularities in the floor surface
- Metal racks should always be connected to the building earth in accordance with current regulations.

Mounting in a cabinet
Ensure that the cabinet:
- Is sufficiently strong to cope with the weight of the battery- is covered with a layer of insulation
- Is naturally ventilated.

Connection of cells
All connections should be insulated

In series:
The number of cells in series will determine the total float of voltage:

U	=	v	x	N
Total float Voltage		Float voltage for one cell		Number of cells

In parallel:
FM batteries of the same Ah rating may be connected in parallel to give higher current capability. This connection in parallel will be preferably carried out through an equipotential wiring for an equal current distribution in each string.
There is no technical reason for limiting the number of strings but for practical installation reasons. It is recommended not allowed to exceed 3 strings in parallel especially if the battery is used in high discharge rates (backup time less than 15 mins)

General recommendations
- Do not wear clothing of synthetic material, to avoid the generation of static potentials.
- Use insulated tools.
- Place the cells beginning with the least accessible rows, spacing the cells as shown on the drawing.
- Consult the drawing for the correct position of the battery poles (positive=red colour, negative = Black colour).
- Before attaching the inter-cell flexible cables, check that all terminals are in the correct position.
- The battery cells are connected in series, which is with a positive pole connected to a negative pole.
- Use only a damp cotton cloth for cleaning purposes
- Tighten the nuts or bolts to the recommended levels of torque indicated on the product label. Always use insulated tools for fitting and torque up battery connections.

Safety:
All installations must comply with the current regulations and norms.

Battery storage

Storage conditions :
The battery should be stored away from any moisture or source of heat.
Storage times :
The self-discharge of VISION FM Series batteries as a function of temperature is as follows :

3 % per month at 20°C
6 % per month at 30°C
10 % per month at 40°C

In order to ensure that the battery can be charged easily after a long period of storage, it is recommended that batteries should not be stored for more than the following periods without recharging :

6 months at 20°C
4 months at 30°C
2 months at 40°C

Failure to comply with these recommendations may compromise the life expectancy of the battery.

Determining the state of charge of the battery
The state of charge of the battery can be determined by measuring the off-load voltage after the battery has been allowed to rest for 24 hours.

% of capacity at 20°C	Voltage per cell at differents temperatures				
	0°C	10°C	20°C	30°C	40°C
100%	2,16	2,15	2,14	2,13	2,13
80%	2,09	2,09	2,09	2,09	2,09
60%	2,06	2,06	2,06	2,06	2,06
40%	2,02	2,02	2,02	2,02	2,02
20%	1,97	1,97	1,97	1,97	1,97

Recharging stored batteries
The batteries should be recharged at the float charge voltage to suit the temperature 2.23-2.28 volts at 25°C per cell for a minimum period of 96 hours.
The battery will be charged when the charging current has remained constant for a period of 3 hours.

Commissioning

- Ensure that batteries are kept at all times in clean and dry conditions.
- Before commissioning, the batteries must be charged at a constant regulated voltage to match the prevailing temperature for a minimum period of 48 hours.

Maintenance

- Check the tightening of connections.
- Every month, it is recommended that the total voltage at the battery terminals be measured. It should be Nx2.23-2.28/V at a temperature of 25°C, where N is the number of cells in the battery.
- Once each year, it is recommended that the voltage of each cell in the battery should be read off.
-A difference of plus or minus 2.0% between these individual voltages and the average voltage may be observed. This is due to the gas- recombination process.
- A check on capacity (independent operation on load) can be performed once or twice per year.
Safety :When carrying out any work on the battery, the applicable safety standards should be followed.

Note : it is recommended that a battery log be maintained, and that records should be kept of the total voltage measurements, any mains failures, major battery discharges (current and time) etc.
The main factors causing reduction in the life expectancy of VISION FM Series cells :
- Deep discharges
- Poor regulation on the float voltage
- Cycling or micro
- Cycling- poor quality (smoothing) of the charging current
- High ambient temperature.