ZeMaRail™ Batteries 450P21:
Technical Data

VRLA TPPL+SN BATTERY TECHNOLOGY
FOR ROLLING STOCK APPLICATIONS

HAWKER
ZeMaRail™
450P21 BATTERIES

KEEPING YOU ON TRACK

Designed specifically for rolling stock railway vehicle applications, the ZeMaRail™ batteries deliver reliable, maintenance-free performance.

Featuring advanced Thin Plate Pure Lead (TPPL) technology, the ZeMaRail™ range of Valve-Regulated Lead-Acid (VRLA) TPPL+Sn (tin addition) batteries pack more power into the same space compared to conventional batteries.

- **High Energy Density:** Delivers more power in a compact design, maximizing efficiency without compromising space.
- **Maintenance-Free:** No water topping required, offering you hassle-free, reliable performance.
- **Long Service Life:** Ensures durable, long-lasting energy.
- **Excellent Deep Discharge Recovery:** Advanced TPPL ZeMaRail™ battery technology, with a small addition of tin to the positive plates, ensures superior recovery from accidental deep discharges.

CE UK CA

EnerSys RAIL
Power/Full Solutions

Electrical Data	
Nominal voltage	2 V
Number of cells	1 (VRLA (AGM), TPPL+Sn Technology)
Rated capacity C_{10} to 1.80 Vpc at 20 °C	450 Ah
Rated capacity C_5 to 1.70 Vpc at 30 °C	440 Ah
Current/Power for 0.25 h back-up time 1.60 Vpc 20 °C	819 A / 1356 W
Current/Power for 0.5 h back-up time 1.60 Vpc 20 °C	547 A / 940 W
Current/Power for 1.0 h back-up time 1.60 Vpc 20 °C	325 A / 585 W
Current/Power for 3.0 h back-up time 1.70 Vpc 20 °C	131 A / 245 W
Current/Power for 5.0 h back-up time 1.75 Vpc 20 °C	83.7 A / 158.3 W
Current/Power for 8.0 h back-up time 1.75 Vpc 20 °C	56.8 A / 108.3 W
Current/Power for 10.0 h back-up time 1.80 Vpc 20 °C	45.0 A / 86.5 W
Current/Power for 24.0 h back-up time 1.80 Vpc 20 °C	21.2 A / 41.4 W
Conversion to capacity at 25 °C	102% of Current/Power at 20°C
Internal resistance (± 10%) to IEC/EN 60896-21	0.28 mΩ
Short circuit current (± 10%) to IEC/EN 60896-21	7.5 kA
Self discharge at 20 °C to IEC/EN 60896-21	max 3% / Month
Heat loss during float service at 20°C	0.33 W

Mechanical Data	
Weight	27.9 kg ±2%
Height over terminal	370 mm
Width	198 mm
Depth	137 mm
Number of terminals	1 (+) /1 (–)
Dimension of terminal screw hole	M10 x 22 deep, female thread
Torque terminal screw	25 Nm
Terminal insulation class according to IEC/EN 60529	IP 20
Diameter of diagnostic hole for voltage probe	2 mm
Cross section of terminal / cable	75 mm2 / 120 mm2 (max)
Complete connector and terminal connection	use flexible EVO or PerfectPlus- connectors
Connector (copper, tin-coated and insulated)	For Rolling Stock flexible connectors are required
Shock + Vibration rating (according)	Category 1, Class B (IEC 61373)

Environmental Data	
Installation	Vertical
Cell assembly distance	The cells must be installed within a solid battery tray, use spacers to secure required fixation and compression
Material of case/ cover	PP-FR or PP (on special request)
Flame retardancy rating	R7 (EN 45545-2)* *Approval is subject to functional necessity (clause 4.7)
Flame barriers at vents	Yes
Rail service life expected at 15 °C	7 years (max. 30% Depth of Discharge (DoD) / day)
Cycle Endurance (60% DoD or 80% DoD)	1'200 / 700 Cycles
Design life (Eurobat classification)	>12 years - Very Long Life
Shipping name	Batteries, wet, non spillable

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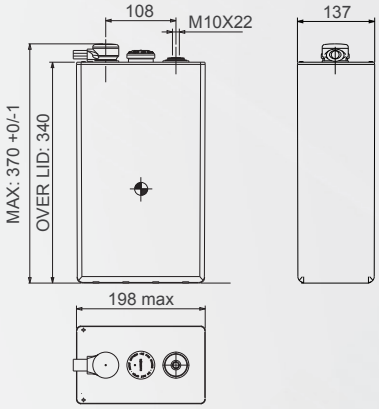
EnerSys RAIL Power/Full Solutions



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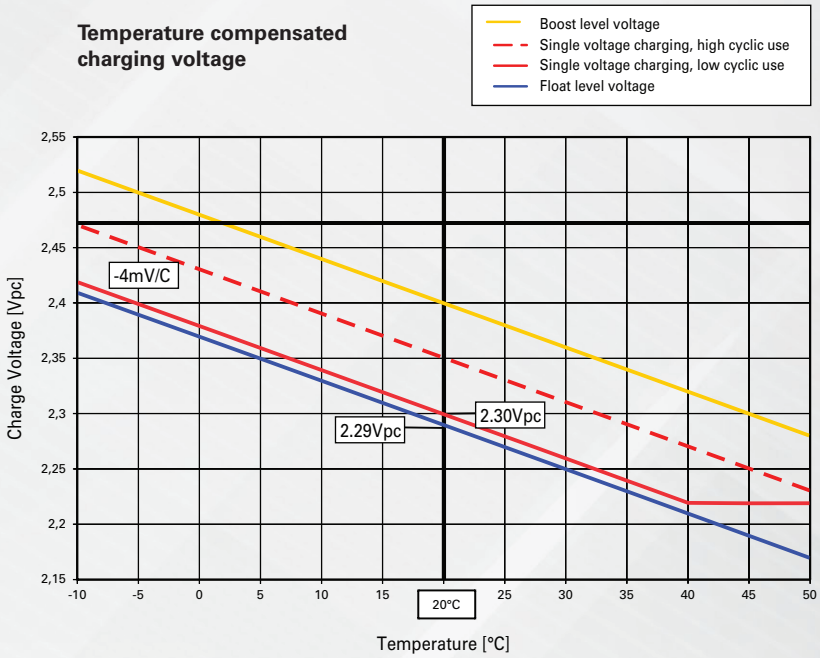
Temperature compensated charging voltage



Temperature compensated charging voltage	
Temperature in °C	**Percentage of the rated capacity (C_5)**
40	106
35	105
30	104
25	102
20	100
15	98
10	96
5	92
0	89
-5	84
-10	71
-15	58
-20	51
-25	44
-30	38

Estimated Values (early design status!)
Should be verified with actual load profile

Battery Installation and Operation	
Recommended charging for rolling stock applications (standby parallel operation)	IU0U- charging : 2 level charging (acc. DIN 41773) with current limitation and temperature compensation
Boost level voltage setting at 20°C	2.40 Vpc
Lower or single level voltage setting at 20°C	2.30 ... 2.35 Vpc (low ... high cyclic use)
Charge current for IU or IU0U-charging (DIN 41773)	180 A (minimum for cyclic use: 110 A)
Voltage compensation in function of temperature	-4mV/K per cell
Float level voltage setting at 20°C (± 1%)	2.29 Vpc (also valid for long term trickle charging at workshop and storage)
Air exchange	As a VRLA battery according to EN 62485-2 $Q = 0.05 * N_{cells} * I_{gas} * C_{AhC10} * 10^{-3}$ [m³/h] $I_{gas} = 1$ (at 2.29 Vpc) ; $I_{gas} = 8$ (at 2.40 Vpc) e.g. 108 V: 0.751 m³/h (at 2.29 Vpc)
Maximum long term operating temperature	+40°C with ventilation assured (reduced service life)
Maximum short term operating temperature (< 3h)	+55°C with ventilation assured (reduced service life)
Minimum operating and storage temperature	- 40°C (in charged condition)

Constant current performance [Ampere] to the defined end of discharge voltage

Voltage	Temp	Discharge time [h:min]																			
Vpc	°C	0:01	0:05	0:10	0:15	0:20	0:25	0:30	0:40	0:50	1:00	1:30	2:00	3:00	4:00	5:00	6:00	8:00	10:00	12:00	24:00
2.00	20°C	62.6	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	56.7	54.6	47.7	40.9	36.0	32.0	28.8	24.0	20.7	18.2	10.6
	25°C	63.0	56.8	56.8	56.8	56.8	56.8	56.8	56.7	56.7	56.7	55.3	48.4	41.4	36.5	32.4	29.3	24.4	21.0	18.5	10.8
1.95	20°C	177.6	177.6	177.6	177.6	177.6	176.3	165.6	148.6	134.5	122.1	97.3	82.0	65.1	54.0	46.3	41.2	33.7	28.7	25.1	14.5
	25°C	177.6	177.6	177.6	177.6	177.6	177.6	168.0	150.9	137.2	124.6	99.4	83.4	66.4	55.1	47.2	42.0	34.4	29.3	25.5	14.7
1.90	20°C	321.3	321.3	321.3	315.8	290.3	268.5	249.8	220.0	197.2	178.5	139.8	115.2	86.3	70.8	60.4	52.7	42.3	35.7	30.9	17.6
	25°C	321.3	321.3	321.3	319.7	294.7	273.1	254.1	224.3	201.6	182.8	143.3	118.1	88.6	72.5	61.8	54.0	43.2	36.5	31.6	18.0
1.85	20°C	484.3	484.3	468.4	421.5	383.3	352.2	324.8	282.5	250.4	225.3	174.3	142.5	105.4	84.5	71.6	62.2	49.5	41.2	35.5	19.9
	25°C	484.3	484.3	473.6	428.0	390.2	359.5	331.9	289.1	256.9	231.3	179.2	146.6	108.4	86.7	73.4	63.8	50.7	42.2	36.3	20.3
1.80	20°C	656.8	656.8	584.7	519.8	467.7	425.3	390.6	336.0	295.1	263.4	200.6	162.7	119.2	94.7	79.3	68.6	54.2	45.0	38.4	21.2
	25°C	656.8	656.8	592.6	528.8	477.0	434.8	399.9	344.9	303.6	271.1	206.6	167.7	122.8	97.4	81.4	70.4	55.6	46.1	39.4	21.6
1.75	20°C	840.5	803.7	692.4	608.2	542.2	489.7	446.1	379.2	330.2	291.9	218.4	175.6	127.2	100.5	83.7	72.1	56.8	46.9	39.9	21.7
	25°C	840.5	810.6	702.7	620.3	554.9	501.8	458.1	390.4	340.2	301.3	225.5	181.3	131.3	103.5	86.0	74.1	58.3	48.1	40.9	22.1
1.70	20°C	1026.0	935.2	792.7	687.9	608.3	543.3	490.8	410.7	353.7	310.7	229.4	183.3	131.9	103.7	85.9	73.6	57.6	47.4	40.1	21.7
	25°C	1025.9	944.4	806.0	702.9	623.4	558.5	505.7	424.1	365.5	321.5	237.2	189.5	136.2	107.0	88.4	75.7	59.1	48.7	41.2	22.1
1.65	20°C	1212.1	1058.9	884.7	759.6	662.5	585.6	523.9	432.4	369.2	322.8	234.9	185.7	132.5	103.7	85.9	73.6	57.6	47.4	40.1	21.7
	25°C	1212.1	1072.1	900.8	777.8	681.5	604.2	541.6	447.7	382.4	334.4	243.5	192.3	136.8	107.0	88.4	75.7	59.1	48.7	41.2	22.1
1.60	20°C	1393.3	1176.3	969.9	819.8	705.1	616.5	547.2	446.2	376.1	325.9	234.9	185.7	132.5	103.7	85.9	73.6	57.6	47.4	40.1	21.7
	25°C	1393.4	1191.9	990.5	842.1	727.9	637.9	566.8	463.1	390.7	338.3	243.5	192.3	136.8	107.0	88.4	75.7	59.1	48.7	41.2	22.1

Constant power performance [Watt per cell] to the defined end of discharge voltage

Voltage	Temp	Discharge time [h:min]																			
Vpc	°C	0:01	0:05	0:10	0:15	0:20	0:25	0:30	0:40	0:50	1:00	1:30	2:00	3:00	4:00	5:00	6:00	8:00	10:00	12:00	24:00
2.00	20°C	125	113	113	113	113	113	113	113	113	113	109	96	82	72	64	58	48	42	37	21
	25°C	126	113	113	113	113	113	113	113	113	113	111	97	83	73	65	59	49	42	37	22
1.95	20°C	346	346	346	346	346	344	324	290	263	240	191	161	128	107	91	81	67	57	50	29
	25°C	346	346	346	346	345	345	329	295	268	244	196	164	131	109	93	83	68	58	51	30
1.90	20°C	610	610	610	599	553	513	478	422	379	343	270	223	167	138	118	103	83	70	61	35
	25°C	610	610	610	606	561	521	486	430	387	351	276	229	172	141	120	105	84	72	62	36
1.85	20°C	893	893	867	783	714	657	607	531	473	426	331	272	202	162	138	120	95	80	69	39
	25°C	893	893	876	794	726	670	620	544	484	437	340	279	208	166	141	123	98	82	71	40
1.80	20°C	1180	1180	1055	942	851	777	716	619	546	490	376	306	226	180	150	131	104	86	74	41
	25°C	1180	1180	1069	958	867	794	733	634	561	504	387	315	232	185	154	134	106	88	76	42
1.75	20°C	1467	1406	1218	1076	965	876	803	687	601	535	405	326	239	190	158	136	108	89	77	42
	25°C	1467	1419	1236	1096	986	896	823	706	619	551	418	337	246	195	163	140	111	92	78	43
1.70	20°C	1738	1594	1360	1188	1058	952	867	735	637	562	422	338	245	194	161	139	109	90	77	42
	25°C	1738	1608	1381	1214	1083	977	892	758	658	581	436	350	253	200	166	142	112	93	79	43
1.65	20°C	1998	1750	1479	1283	1131	1010	911	765	660	579	431	343	247	195	161	139	109	90	77	42
	25°C	1997	1772	1506	1311	1161	1040	939	790	682	600	445	355	255	201	166	142	112	93	79	43
1.60	20°C	2205	1893	1581	1356	1184	1049	940	783	671	585	431	343	247	195	161	139	109	90	77	42
	25°C	2205	1918	1610	1390	1219	1082	972	810	695	607	446	355	255	201	166	142	112	93	79	43

Constant discharge values without voltage loss in connectors and cables!
Our technical support offers to calculate the discharge curve for a specific load profile.

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