

DRAWING SET ZM-CELL-01 • REV C • UNITS: MM UNLESS NOTED

ZN-MNO₂ CELL MODULE

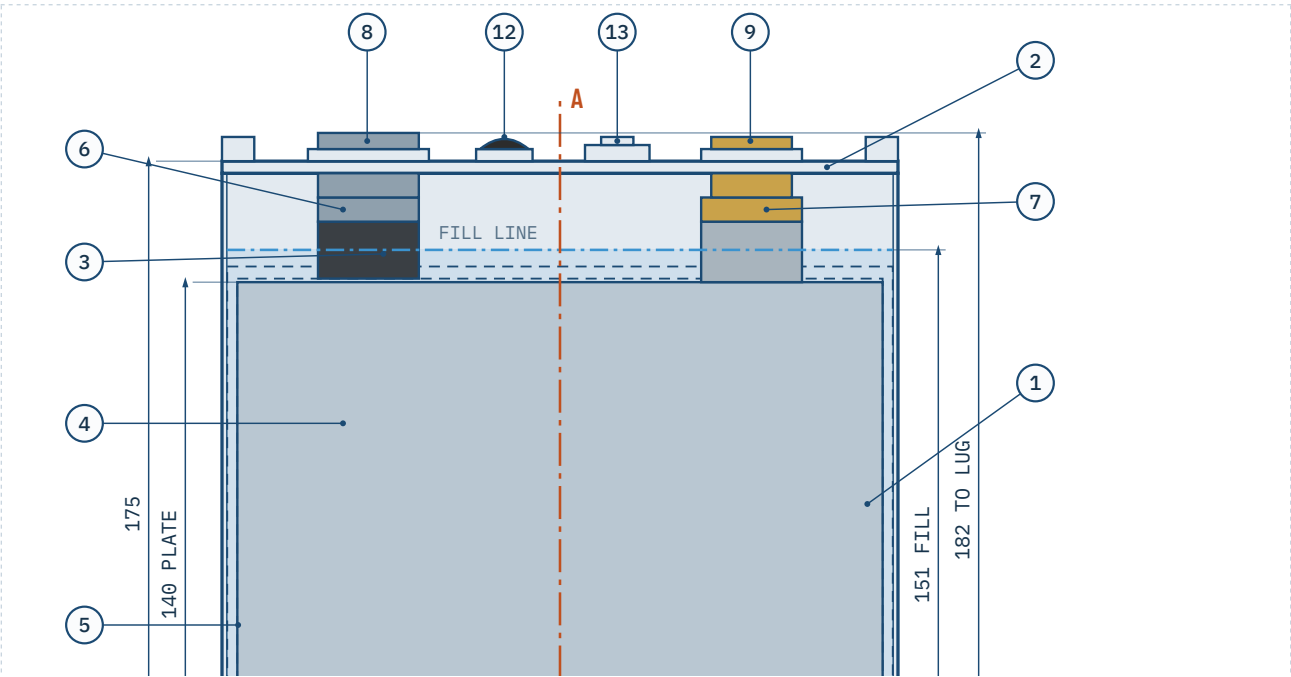
Construction drawings for one replaceable cell of the 12 V, 10-cell salt-water battery: a sealed polypropylene box holding 5 cathode plates and 6 zinc plates in compressed felt, with bolt-hole terminal lugs on the lid.

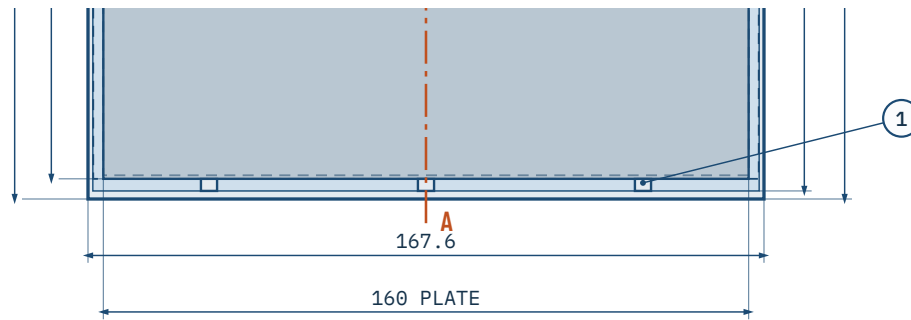
NOMINAL VOLTAGE 1.3 V	CAPACITY 70 Ah design target • 40–70 Ah estimated	OUTSIDE SIZE 167.6 × 26.88 × 175 + lugs to 182	MASS ≈ 1.52 kg filled
RESISTANCE 3–6 mΩ estimated	VOLTAGE WINDOW 0.90–1.50 V charge limit unverified, see sheet 7		

GENERAL ARRANGEMENT

Front elevation looking through the front wall, with the nearest zinc plate shaded. Balloons match the item numbers in the bill of materials on sheet 6.

- ☐ Polypropylene
- ☐ Zinc
- ☐ Cathode mix
- ☐ Titanium
- ☐ Ni-plated brass
- ☐ PP felt
- ☐ Electrolyte





HEIGHT BUDGET (INSIDE, 170)

Bottom ribs	3
Plates	140
Felt overhang above cathode	3
Electrolyte above felt	≈ 5
Tabs, straps, risers	19

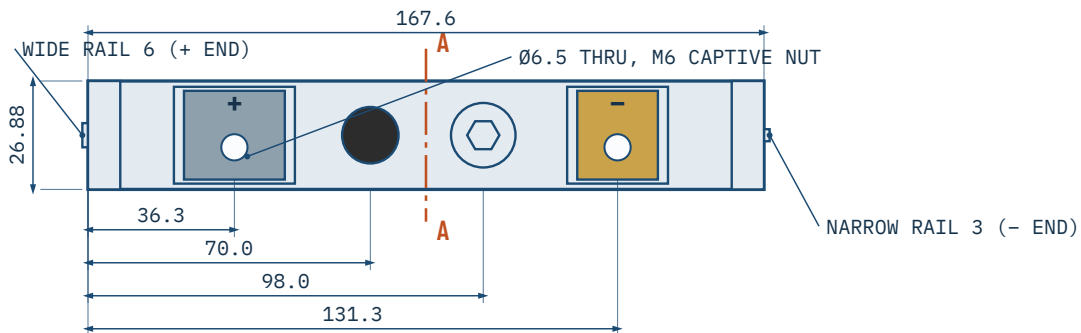
PLATE POSITIONS

Plates are centered across the 165.2 inside width, leaving 2.6 each side. Zinc plates stand on the ribs. Cathode plates sit 0.88 higher, on the folded felt. Cathode tabs are 20 from the left (+) end, zinc tabs 115 from the left.

TITLE General arrangement · front elevation	SHEET 2 of 7	SCALE 1:1 approx. on screen	REV C
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LID PLAN

Seen from above. The wide guide rail marks the + end, so the module can only go into its slot one way. The vent and fill port sit on the centerline. The lug holes sit 3 off center so each riser can pass through the lid beside its nut.

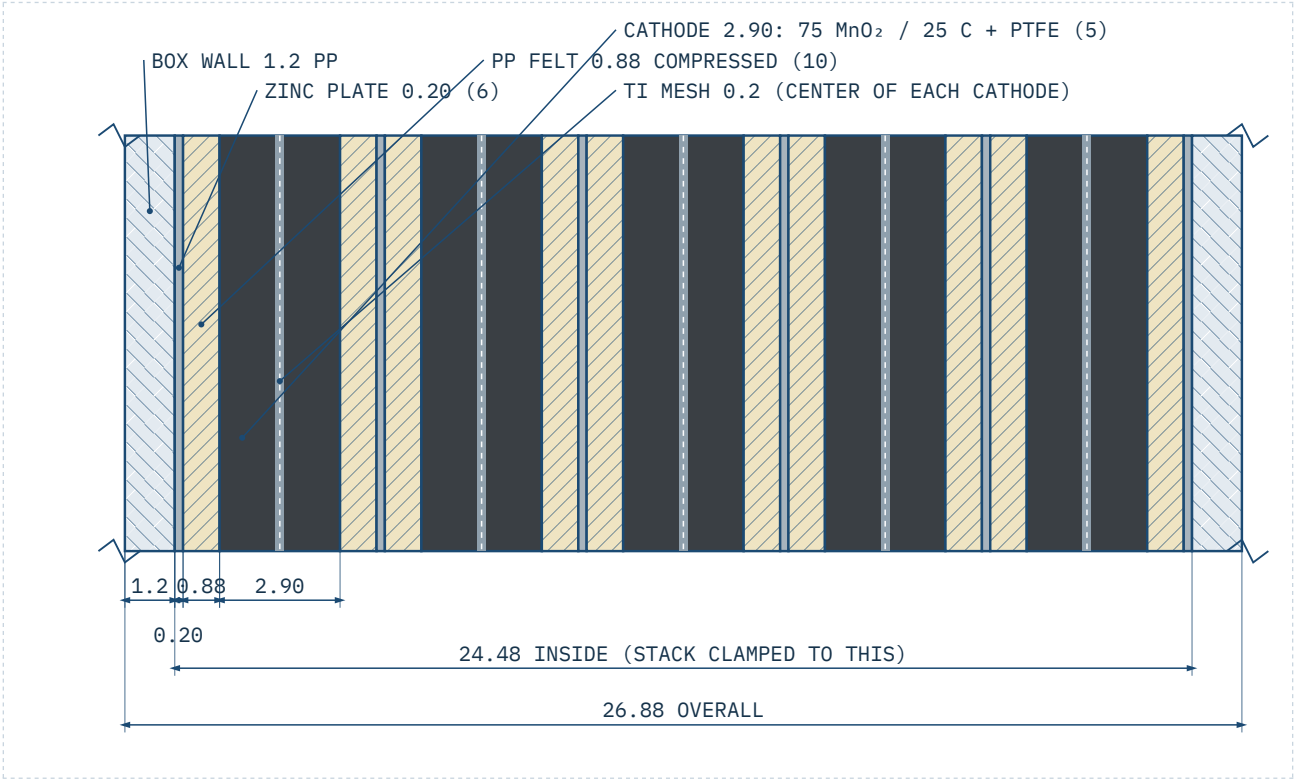


TITLE Lid plan · front elevation	SHEET 3 of 7	SCALE 1:1 approx. on screen	REV C
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Lid plan - terminals, vent, fill port	3 of 7	1:1 approx. on screen	C
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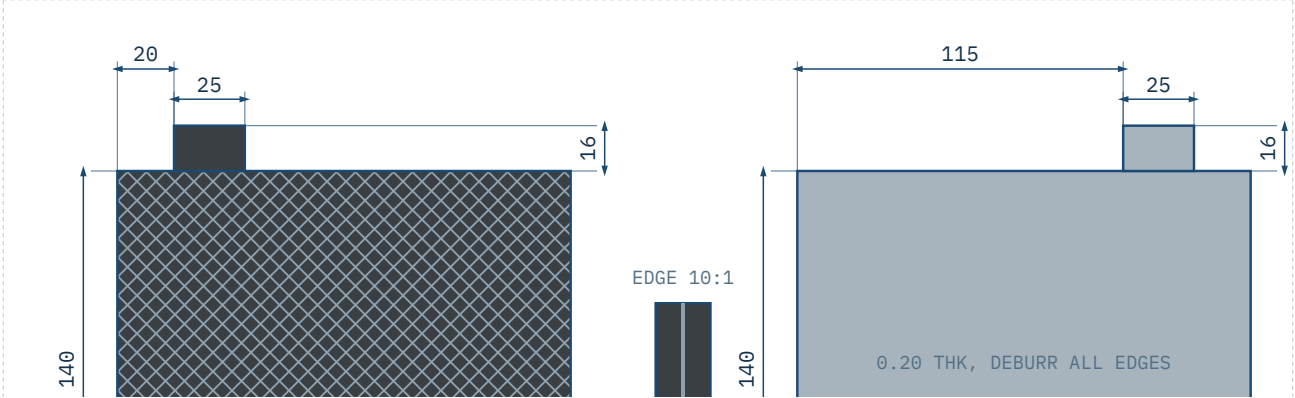
SECTION A-A · PLATE STACK

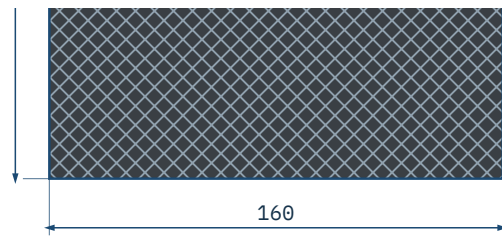
Cut through the middle of the cell, looking toward the + end. Thickness is drawn about 9 times larger than the elevation so every layer shows. Zinc plates are at both walls, so each of the 10 cathode faces faces zinc.



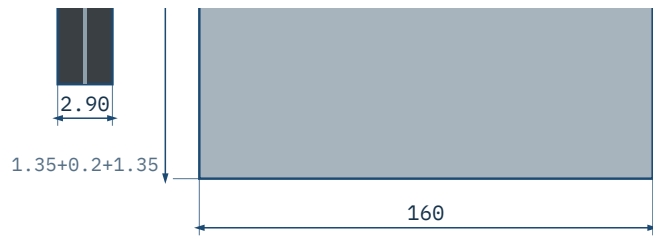
TITLE Section A-A · layer stack	SHEET 4 of 7	SCALE ≈ 20:1 horizontal	REV C
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PART DETAILS

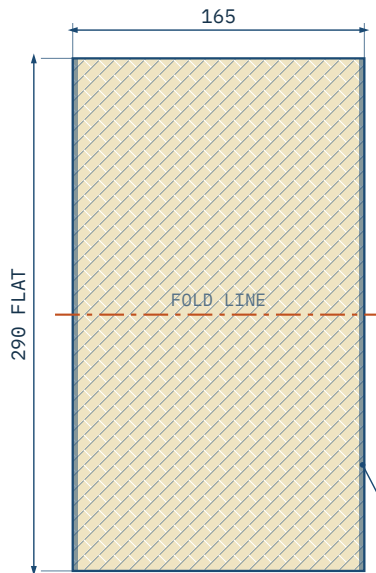




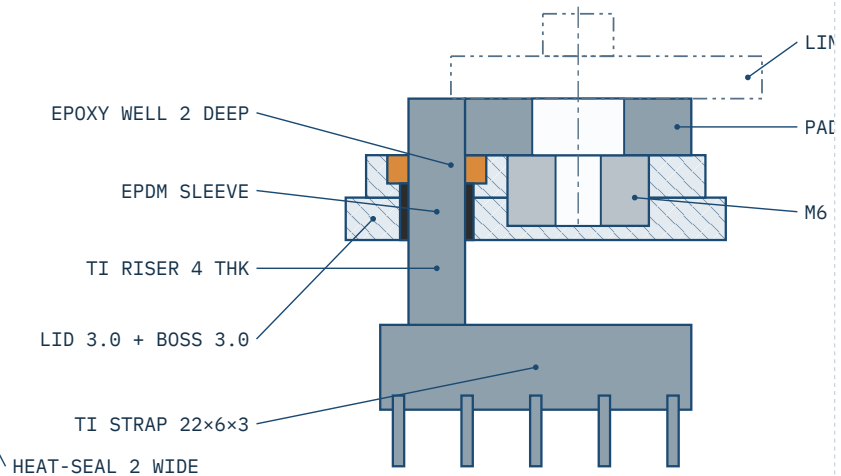
ITEM 3 • CATHODE PLATE (×5)



ITEM 4 • ZINC PLATE (×6)



ITEM 5 • FELT ENVELOPE (×5)



DETAIL C • + LUG FEEDTHROUGH 8:1

- LUG SAME LAYOUT IN NI-PLATED BRASS 3 THK

The + lug riser comes up beside the strap center, passes through an EPDM sleeve in the lid slot, and bends over the boss so its hole sits above the captive M6 nut. The epoxy well around the riser is the main seal. Weld titanium only to titanium.

TITLE
Plates, felt envelope, lug
feedthrough

SHEET
5 of 7

SCALE
As noted

REV
C

BILL OF MATERIALS • ONE CELL

ITEM	PART	MATERIAL	SIZE	QTY	MASS
1	Module box	Polypropylene	167.6 × 26.88 × 172 ext. 1.2 walls, 2.0 bottom, three 4 × 3 ribs. Guide rails: 6 wide on + end, 3 wide on – end, 1.4 proud	1	≈ 85
2	Lid	Polypropylene	167.6 × 26.88 × 3.0, two lug bosses	1	Hot-p

			3.0 high, vent seat, fill thread, lift ridges 8 wide × 6 high		weld
3	Cathode plate	75% MnO ₂ / 25% carbon + 4% PTFE on Ti mesh	160 × 140 × 2.90, 50% porosity, tab 25 × 16	5	90.9% 30.30 4.8 g
3a	Cathode collector	Expanded titanium mesh, Gr 2	160 × 140 × 0.2 with solid tab 25 × 16	5	≈ 8.1
4	Zinc plate	99% zinc sheet	160 × 140 × 0.20, tab 25 × 16	6	32.0
5	Felt envelope	PP needle felt ≈ 1.2 thick, Triton X-100 treated	Flat 165 × 290, folded, sides heat- sealed 2 wide. 0.88 compressed	5	
6	Cathode strap	Titanium Gr 2	22 × 6 × 3	1	Weld + iter
7	Anode strap	Nickel-plated brass	22 × 6 × 3	1	Solder to 6 t 9
8	+ terminal lug	Titanium Gr 2	4 × 25 riser, bent to 20 × 25 pad, Ø6.5 hole	1	≈ 0.1
9	– terminal lug	Nickel-plated brass	3 × 20 riser, bent to 20 × 20 pad, Ø6.5 hole	1	
10	Captive nut	316 stainless	M6 hex, pressed into boss	2	
11	Lug seal	EPDM sleeve + epoxy	Sleeve in lid slot, epoxy well 2 deep	2	
12	Vent valve	EPDM umbrella valve	Opens 1.5–2.5 psi, splash baffle molded under lid	1	
13	Fill plug	Polypropylene + EPDM O-ring	Ø16 head, threaded into lid	1	
14	Electrolyte	2 M ZnSO ₄ + 0.1 M MnSO ₄	359 mL, fill to 151 above inside floor	1	≈ 50
15	Barrier film (optional)	Cellophane, 25 µm	Envelope 165 × 300 over item 5 (zinc side)	5	Felt c 0.85
ELECTROLYTE BATCH · 400 ML			ACTIVE MATERIAL PER CELL		
Zinc sulfate heptahydrate		230.0 g	MnO ₂		454.54 g
Manganese sulfate monohydrate		6.76 g	Carbon powder		151.51 g

Distilled water	to 400 mL	PTFE binder (4%)	≈ 24 g
Dissolve the manganese sulfate first, then the zinc sulfate in batches (the mix turns cold). Top up to 400 mL once back at room temperature. Use 359 mL in the cell.		Zinc	191.9 g
		Titanium mesh	≈ 40 g
TITLE Bill of materials	SHEET 6 of 7	SCALE None	REV C

BUILD SEQUENCE AND CHECKS

- | | | |
|-----------|---|---|
| 01 | Treat the felt
Soak felt in 0.1–0.5 wt% Triton X-100 in isopropyl alcohol for 5 minutes. Hang until fully dry. | CHECK
Water drop soaks in within seconds |
| 02 | Cut the zinc plates
Cut six 160 × 140 plates with a 25 × 16 tab at 115 from the left edge. Deburr every edge and degrease with alcohol. | CHECK
0.20 ± 0.02 thick, no burrs by fingertip |
| 03 | Mix the cathode
Per plate: dry-blend 90.91 g MnO ₂ with 30.30 g carbon, then knead in PTFE dispersion (≈ 4.8 g solids) to a dough. | CHECK
Uniform black, no dry streaks |
| 04 | Form the cathode plates
Roll the dough to two 1.35 sheets, lay one each side of the Ti mesh (tab at 20 from the left), and press or roll to 2.90. | CHECK
2.90 ± 0.05 thick, ≈ 134 g with mesh |
| 05 | Make the envelopes
Fold each 165 × 290 felt around a cathode plate, fold at the bottom edge, and heat-seal both sides 2 wide. Add the optional cellophane envelope over it. | CHECK
No exposed cathode edge |
| 06 | Stack the cell
Zinc, cathode, zinc, cathode ... ending in zinc (6 zinc, 5 cathode). Line up the cathode tabs on the left and zinc tabs on the right. | CHECK
Tabs never cross over |

07	Clamp Squeeze the stack between two flat plates to 24.48 and hold it with a clamp.	CHECK 24.48 ± 0.1 across the full face
08	Weld the straps Weld the 5 cathode tabs to the Ti strap and the 6 zinc tabs to the brass strap. Weld the + riser to the Ti strap and the – riser to the brass strap.	CHECK No cathode-to-zinc short (meter reads open)
09	Box the stack Slide the clamped stack into the box until it rests on the ribs, then release the clamp.	CHECK Plates sit square, felt touches both walls
10	Fit the lid Thread the risers through the lid slots with EPDM sleeves, hot-plate weld the lid, bend the risers over the bosses onto the captive nuts, and fill the wells with epoxy.	CHECK Lugs flat, holes line up with nuts
11	Leak test With the vent capped, pressurize through the fill port to 1.0 psi and brush soapy water over every seam and lug.	CHECK No bubbles for 5 minutes
12	Fill Add 359 mL of electrolyte in 3–4 pours, 15 minutes apart, up to the fill line. Fit the plug.	CHECK Level at 151 above the inside floor
13	Wet out Let the cell rest for 24 hours.	CHECK Rest voltage steady, about 1.3–1.5 V
14	Form Cycles 1–2: 1.4 A discharge to 14 Ah or 1.05 V, charge at 1.4 A. Cycles 3–4: 3.5 A discharge to 35 Ah or 0.90 V, CC/CV charge. Record the capacity of each cycle.	CHECK Capacity rises or holds each cycle
15	Baseline Charge fully, rest 24 hours, and log the voltage drop. This is the self-discharge figure to compare against later.	CHECK Logged with the cell serial number

OPEN ITEMS BEFORE BUILDING A FULL PACK

- **Charge voltage.** The design limits charge to 1.50 V. Published Zn-MnO₂ cells in sulfate electrolyte usually charge to 1.8–1.9 V. Form this first cell at 1.50 V, then try 1.80 V and compare recovered capacity.
- **Felt width.** The envelope is 165 wide here. The 166 in the design notes does not fit the 165.2 inside width.
- **Cold limit.** The electrolyte freezes at about −6 °C. Keep the cell above that.
- **Pressing force.** A full 160 × 140 plate pressed flat at once needs tens of tonnes. Roll the sheets or press in tiles.

TITLE
Assembly procedure · quality
checks

SHEET
7 of 7

SCALE
None

REV
C