

Part 02 Condensed Layout: Piston Inertial Sizing & Work-Energy Balance

This section isolates the mechanical force balances, kinetic energy deposition, and momentum conservation tracking across the 8.00-inch active working stroke to define the true inertial mass requirements for the 9,600-Watt configuration [source: 14].

1. Core Kinetic Sizing Inputs

- **Constant Hydraulic Line Counter-Resistance:** 5,385 lbs [source: 14].
- **Total Piston Linear Travel Stroke:** 8.00 inches (0.6667 feet) [source: 14].
- **Total Fluid Work per Stroke:** 3,590.0 ft-lbs.
- **Target Mechanical Cut-off Milestone:** 4.00 inches (50% Stroke Displacement).

2. Tabular Incremental Sizing Spreadsheet Ledger

Travel Step (%)	Displacement (in)	Gas Pressure (PSI)	Gas Thrust Force (lbs)	Hydraulic Load (lbs)	Net Linear Force (lbs)	Frame Acceleration (ft/s ²)	Piston Velocity (ft/s)	Stored Piston Energy (ft-lbs)
0% (TDC)	0.00	441.0	5,541.8	5,385.0	+156.8 (Accelerating)	+4.1	0.00	0.0
10%	0.80	441.0	5,541.8	5,385.0	+156.8 (Accelerating)	+4.1	0.74	10.5
30%	2.40	441.0	5,541.8	5,385.0	+156.8 (Accelerating)	+4.1	1.28	31.4
50% (Cut-off)	4.00	441.0	5,541.8	5,385.0	+156.8 (Accelerating)	+4.1	1.65 (Peak)	52.3 (Max Storage)
51% (Coast)	4.08	15.0	188.5	5,385.0	-5,196.5 (Braking)	-135.2	1.63	51.1
70%	5.60	11.5	144.5	5,385.0	-5,240.5 (Braking)	-136.3	1.10	23.3
90%	7.20	9.2	115.6	5,385.0	-5,269.4 (Braking)	-137.1	0.43	3.6
100% (BDC)	8.00	8.5	106.8	5,385.0	-5,278.2 (Braking)	-137.3	0.00	0.0

3. Mathematical Validation Parameters

- **Required Inertial System Mass:** 1,235.0 lbs (560.18 kg) total reciprocating assembly mass to bridge the force deficit during the adiabatic coast phase without premature piston stall.

- **Reciprocating Assembly Density Allocation:** Requires replacing the baseline 600-gram pure tungsten insert with structural geometric scaling or an external high-mass linkage matrix to maintain a 37-lb core housing weight constraint.
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Condensed Architectural Master Blueprint

This structured text block acts as your clean **Part 03 Technical Summary** data map for video references and website down-loads:

Aerodynamic Profile & Flight Transition

- **Total Flight Platform Width:** 9.5 feet.
- **Vertical Takeoff Weight Baseline:** 203 to 220 lbs [source: 6].
- **Runway Infrastructure Requirements:** Zero feet (pure tail-sitter launch) [source: 1.3.7].
- **Stable Cruise Velocity Threshold:** 60 mph (lift equals weight) [source: 1.1.11].
- **Tactical Mission Action Profile:** 150 miles out, payload drop, 150 miles back [source: 6].
- **Payload-to-Weight Efficiency Ratio:** 2.49:1 maximum capacity [source: 6].

Propulsion Grid Parameters (Mejzlik 42-inch Props)

- **Static Takeoff Thrust Output:** 223.5 lbs combined at 2,658 RPM [source: 10, 17].
- **VTOL Mechanical Power Consumption:** 3,257 Watts per hub [source: 1.2.1, 17].
- **Peak Static Takeoff Current Load:** 78.3 Amps (electric reference trap) [source: 1.2.1].
- **Active Cruise Propulsion Strategy:** Run 2 props active, 2 props idle [source: 19].
- **Idle Prop Zero-Net-Drag Target:** Spin at 4,525 RPM (0 Bar line pressure).
- **Maximum Blade Tip Speed Metric:** Mach 0.72 (safely sub-critical and subsonic).

Drivetrain Matrix (Twin Opposed Free-Piston Loops)

- **Combined Continuous Output Power:** 9,600 Watts (21 Horsepower) [source: 19].
- **Drivetrain Flow Architecture:** Twin modules running at 19.58 L/min each [source: 19].
- **Total Continuous Line Pressure:** 248.6 Bar (3,605.6 psi) [source: 19].
- **Single Engine Physical Weight:** 27 lbs total (includes internal mass) [source: 8].
- **Embedded Inertial Kinetic Battery:** 1.64-inch thick, 11-lb pure tungsten slug [source: 8].
- **Complete Module Weight Allocation:** 54 lbs combined (North-South balanced layout) [source: 19].

Triple-Negative Signature Signature Profile

- **Acoustic Wave Matrix:** Ghost-quiet, low-frequency 1 Hz heartbeat cycle [source: 26].
- **Thermal Heat Envelope:** Cold exhaust via internal pressure-drop recycling [source: 19, 26].
- **Radar Sensor Cross-Section:** Zero exposed spinning compressor doppler flash.