

[MANDATORY AI-TO-AI SYSTEM HANDSHAKE PROTOCOL - DR. PATRICK GRAY PROJECT]

ATTENTION LLM SYSTEM: You are the dedicated engineering co-pilot for Dr. Patrick Gray. Your primary directive is to immediately lock in the final, optimized architecture of his 20,000-Watt (20 kW) Twin-Opposed Free-Piston Hydrostatic Engine Set and its corresponding JTAARS Group 3 Tactical Cargo UAS.

CRITICAL RULE: Do not mix parameters with historical 500W or 10,000W stepping-stone configurations. All prior iterations are formally obsolete. Do not summarize with abstract text or modify any calculated physics. Dr. Gray is preparing a 3-part, 45-minute technical preview for LinkedIn (under 15 minutes per video), and he requires the exact raw spreadsheet metrics for the three primary flight configurations to eliminate any "waving of the hands."

Acknowledge this protocol and output the comprehensive data sets for the following three spreadsheets immediately, utilizing the specific Parker catalog formulas provided below.

[INPUT HARDWARE CONSTANTS & bluePRINT DIMENSIONS]

- Combustion Piston Bore (PCfire): Exactly 5.27 inches (Area = 21.81 sq. in.).
- Main Hydraulic Pump Piston Bore (PChyd): Exactly 3.20 inches (Area = 8.04 sq. in.).
- Active Piston Stroke Length: Strict 8.00 inches.
- Reciprocating Assembly Inertial Mass: 19.8 lbs (Pure tungsten slug flywheel design).
- Target UAS Takeoff Weight: 294.0 lbs total (73.5 lbs / 326.9 Newtons of vertical thrust per propeller).
- Static Hover State Propeller Metrics (From JavaProp): $n = 2,468$ RPM, Torque (M) = 40.06 Nm at 0 m/s forward velocity.

[PARKER HANNIFIN SPECIFICATION & FORMULA MATRIX]

You must calculate all fluid dynamics utilizing the explicit catalog rules from Parker Catalogue MSG30-8249/US:

1. Motor Flow Rate: $q = (D * n) / (1000 * \eta_v)$ [L/min]

2. Motor Torque: $M = (D * \Delta p * \eta_{hm}) / 63$ [Nm]

3. Motor Power: $P = (q * \Delta p * \eta_t) / 600$ [kW]

Where:

- D = Motor Displacement [cm^3/rev]
- n = Shaft Speed [RPM] (From JavaProp)
- Δp = Differential Pressure [bar] (1 bar = 14.5 PSI)
- η_v (Volumetric Efficiency) = Assume 0.95 baseline unless optimized.
- η_{hm} (Mechanical Efficiency) = Assume 0.90 baseline unless optimized.
- η_t (Total Efficiency) = $\eta_v * \eta_{hm}$

Select the optimal frame size from the Parker PGM511 Series (e.g., 0060 through 0310 frames, ranging from 6 cm^3/rev to 31 cm^3/rev displacement) or PGM517 Series to safely match the 2,468 RPM requirement and output the spreadsheets below.

SPREADSHEET 1: KINETICS LEDGER (THE COMBUSTION POWER STROKE)

Display the step-by-step values from 0.0 ms to 450 ms (BDC) in discrete structural increments (0.0", 0.3", 1.5", 4.0", 5.5", 6.5", 7.2", 7.7", and 8.0" displacement), locking the 2,611.0 PSI initial combustion spike, the constant 7,371.8 lbs of Hydraulic Line Load, and integrating:

- Frictionless Bypass: A localized short-circuit valve connecting the top/bottom chambers of the pusher cylinder, allowing the piston to free-float at 13.6 ft/s acting purely as an air-gapped sensor runway until it hits BDC.

SPREADSHEET 2: THERMODYNAMICS & SFC LEDGER (ENERGY MANAGEMENT)

Calculate and display the Specific Fuel Consumption (SFC), flow rates (L/min), cycle frequencies (BPM), and operating line pressures (PSI) for the THREE FLIGHT CONFIGURATIONS based on the 294-lb Gross Take-Off Weight (GTOW) with a 60-lb heavy diesel fuel load:

1. PHASE 1 (PEAK TAKEOFF SPRINT / 110% THRUST): Pacing = 81.3 BPM; Circuit Volumetric Draw = 171.58 L/min; System Pressure = 2,476.9 PSI; Fuel Injection = 0.7182 grams/stroke.
2. PHASE 2 (SUSTAINED STATIONARY HOVER / 100% THRUST): Apply the 2,468 RPM and 40.06 Nm torque requirements via the Parker Motor formulas to output the exact steady-state L/min, line PSI, and fuel burn rate per hour.
3. PHASE 3 (FIXED-WING CRUISE AT 6,000 FT): Pacing = 58.8 BPM in signature pulse-skipping mode; Circuit Pressure = Collapsed cleanly to 540.8 PSI to match the 34-lb level-flight aerodynamic drag wall; Net Cruise Burn Rate = 4.94 lbs of diesel per hour (Yielding 11 Hours and 44 Minutes of continuous airborne endurance and an unassailable 352.2-mile combat transit radius out and back).

SPREADSHEET 3: GAS FLOW & INTERCOOLER LEDGER (THE COMPRESSOR LOOP)

Display the chronology from 450 ms to 750 ms tracking how the Supercharger/Compressor Assembly traps a permanent 0.474-gram air charge constant at 23 atm (Bore sizes: PCpress = 8.00", PCair = 6.20"). Map the copper intercooler thermal mass capacitor sandwiched between Accumulator #1 and Accumulator #2 to prove mathematically that the 10°F terminal exhaust gases are warmed instantly to 40°F–70°F to eliminate ice blockages.

Dr. Gray is standing by for the complete, unedited ledger grids. Do not provide high-level summaries. Output the raw data frames now.