Initial Cadre Training Program
For
Glider Instructors

2018-02-25

Why Are We Here?

- Background – 61.58 Yearly Proficiency Check Requirements
  - In 1998, Eclipse Aviation announced the Eclipse 500, the first of several very light jet (VLJ) airplanes to be announced by several companies.
  - VLJs were to be operated by single pilots, the first such operation of jet airplanes not requiring a waiver or exemption.
  - Over the next few years, aviation pundits were predicting as many as 12,000 VLJs would be flying in the next several decades.
  - Fearing that there might be 12,000 pilots jumping straight from Cessna 172s into these high flying jet airplanes, and with no requirement for proficiency checks except the standard BFR, which could be conducted in a 152 or glider, the FAA initiated new yearly proficiency check requirements for these aircraft.
  - However, instead of writing a new rule, they simply tacked the words ‘or is turbojet powered’ onto the existing rule (61.58) for proficiency checks in aircraft requiring more than one pilot flight crew member.
  - Unfortunately, this rule applied to ‘aircraft’, not ‘airplanes’, making it just about the only place where turbojet rules aren’t applied only to airplanes.
  - Thus, turbojet glider pilot proficiency requirements were inadvertently lumped in with business jets.
  - The warbird community rallied to get special rules for experimental jets.
  - The FAA capitulated by allowing for no proficiency check if no passengers are carried.
- Background – Order 8130 Operating Limitations
  - Order 8130 is [allegedly] not regulatory, so it may be changed without invoking the rulemaking process.
  - Order 8130 has been through numerous revisions in the last 10 years.
  - Order 8130 contains numerous mistakes and inconsistencies.
  - Order 8130 contains guidance for issuance of operating limitations for experimental aircraft.
  - At one time, Order 8130 required an authorization in lieu of a type rating (LOA) for ‘turbojet airplanes’.
  - Wording was changed from ‘turbojet airplanes’ to ‘turbojet aircraft’, thus including gliders.
  - Then changed back to ‘turbojet airplanes’ (not including gliders).
  - Then changed back to ‘turbojet aircraft’ (gliders are back in).

- Background – 61.58 Exemption
  - During one of the 8130 ‘no glider authorization’ periods, I applied to have the BonusJet operating limitations changed to require no authorization
  - After months of ‘coordinating’, we met with FAA at Oshkosh in July 2016 to resolve the issue
  - Limitations were still issued incorrectly adding the authorization requirement
  - Correct limitations were issued without approval by AFS-800 (FAA Washington)
  - AFS-800 retaliated by telling our DPE not to give 61.58 proficiency checks in the BonusJet
  - In 2016 & 2017, two Arcus-J gliders were completed with no authorization requirement
  - In June 2017, EAA finally stepped in as mediator and we began the process of obtaining an exemption to allow glider instructors to perform equivalent proficiency checks if they have had our training
  - In July 2017, AFS-800 changed Order 8130, again requiring authorizations in gliders
  - Two more Arcus-J gliders were completed, these require authorizations
  - Though promised before the SSA convention, the exemption has not yet been granted
  - We will provide as much training as we can at this point, hoping to be able to finish the process by internet/phone when the exemption is granted
  - AFS-800 has agreed to grant a deviation authority to eliminate the authorization requirement, but only after the exemption is granted

- Future – Exemption & Deviation
  - So…assuming FAA comes through in the near future…
  - Yearly proficiency checks may be performed by CFIGs trained by Desert Aerospace
  - Desert Aerospace turbine gliders will not require authorizations
  - We’re here to do as much of the training as we can

- 61.58 Exemption - Summary
  - Desert Aerospace is petitioning for relief from the requirement for an annual (or biennial) proficiency check in their turbojet powered self-launching gliders as currently required by 14 CFR 61.58. This regulatory check can currently be taken in any turbojet powered aircraft from an FAA designated Examiner. In most cases there is no relationship between the type of operations conducted in turbojet powered airplanes, and the type of operations conducted in a self-launching glider. If granted, Desert Aerospace would provide initial and annual proficiency training by a Desert Aerospace trained and approved Glider Flight Instructor.
- Condition & Limitations – Pilots & Instructors
  - Desert Aerospace will develop comprehensive training programs for initial, transition, additional glider privileges, recurrent pilot, and Flight Instructor training.
  - These training programs must be accepted by the Albuquerque Flight Standards District Office.
  - Upon satisfactory completion of the Desert Aerospace accepted training program, an endorsement will be made in the airman's logbook, other permanent record, or by electronic means acceptable to the administrator, stating that the airman has met the requirements of this exemption
  - In order to operate under this exemption, pilots must possesses:
    - at least a private pilot certificate with a glider rating, and a minimum of 50 hours in gliders, or
    - at least a private pilot airplane certificate with a glider rating and a total time of at least 300 hours in airplanes.
  - In order to give endorsements for operation of a turbojet powered glider, an instructor must:
    - Have satisfactorily completed the Desert Aerospace flight instructor training required by this exemption, and
    - Within the preceding 36 calendar months, have received recurrent training in the operation of turbojet powered gliders from Desert Aerospace.
    - Have PIC flight time in a turbine glider to include 3 takeoffs and two engine cycles
  - Satisfactory completion of proficiency training under this exemption, conducted within the prior 12 months by a glider instructor who meets the instructor qualifications above in an experimental turbojet-powered glider which meets the design and performance criteria of condition below is valid for any turbojet powered self-launching glider which meets the design and performance criteria below
  - NOTE: Proficiency training conducted in accordance with this exemption may not be used in lieu of a 14 CFR 61.56 Flight Review unless the check includes all of the requirements of 14 CFR 61.56 and the flight instructor who conducts the check endorses the airman's logbook or other record as to the satisfactory completion of the requirements of 14 CFR 61.56.

- Condition & Limitations – Glider
  - Under this exemption, turbojet powered gliders must meet the following design and performance criteria based on FAA AC 21-17-2A, Section 7:
    - Maximum capacity of two occupants
    - Maximum weight 1874 pounds (850 kg)
    - The maximum weight to wingspan squared does not exceed 0.62 lb/ft^2 (3.0 kg/m^2)
    - The maximum allowed speed does not exceed 180 KIAS with engine extended or running
    - The maximum static thrust of all engines does not exceed 350 lbs
    - The maximum thrust to weight ratio does not exceed 0.40
  - The engine(s) must be equipped with a Fully Automated Digital Engine Control (FADEC), which controls main engine functions, such as starting, RPM ramp speed, shutdown, cool down (if required), turbine overspeed, turbine over-temperature. The aircraft engines should be intended primarily for launching or sustaining flight, and may be safely shut down for extended duration soaring flight.
  - The glider must possess display instrument(s) visible to the pilot showing engine parameters.
  - The glider must possess a fuel system which does not require excessive pilot input or monitoring, and which has all fuel located near the aircraft CG, such that there is no significant adverse effect on CG as fuel is burned.
  - Engine use will not be allowed in Class A airspace without prior approval by the jurisdictional FSDO and appropriate ATC facility.

- Notes
  - The exemption will only be valid for gliders with turbine engine systems installed by Desert Aerospace
  - Proficiency training conducted in accordance with this exemption may not be used in lieu of a 14 CFR 61.56 Flight Review (BFR) unless the check includes all of the requirements of 14 CFR 61.56 and the flight instructor who conducts the check endorses the airman's logbook or other record as to the satisfactory completion of the requirements of 14 CFR 61.56.
  - Completion of proficiency training conducted under this exemption may not substitute for a proficiency check as required by 14 CFR 61.58 for airplane operations
  - U.S. registered gliders are often used for sport and completion in other countries. Consistent with the host country regulations, U.S. registered aircraft operated by U.S. certificated pilots should not be prevented from use of this exemption.
  - Pilots of gliders which possess a turbojet engine, which has been removed, or disabled and placarded, such that it cannot be operated by the pilot or other aircraft occupant, will not be required to meet the requirements of this exemption or 14 CFR 61.58

- Instructor training program specifications
  - Desert Aerospace recommends the following qualifications for instructors before they perform proficiency checks IAW the terms of the exemption:
  - Possess a certified flight instructor certificate with glider rating (CFIG)
  - Have completed ground training conducted by Desert Aerospace in the operation of turbojet powered gliders. This training to include the following subject areas:
    - Aircraft Flight Manual (Typical of turbojet powered glider)
    - Turbojet Engine Operations and Maintenance Manual (Typical of glider turbojet engine)
    - Differences between piston and turbojet glider energy situations
    - Extension/Retract Mechanism (Typical for gliders with a retractable turbojet engine)
    - Fuel System Operation (including fueling/defueling techniques)
    - Cockpit Layout (Typical of turbojet powered glider)
    - Use of Checklists
    - Engine Controls, Display
    - Engine Ground Starting, Shutdown
    - Self-launching
    - Transitioning into unpowered flight (in-flight shutdown & retract)
    - Transitioning to Powered Flight (In-flight extension and restarting)
    - Landing with power
    - Post-flight Checklists
    - Emergency Procedures
  - Have logged PIC flight time in a turbojet powered glider, to include at least three takeoffs and landings, and two engine cycles (a cycle consists of one start and one shutdown of the engine).
  - (Note that due the allowance of instructor/pilot dual PIC time logging, this PIC flight time may be obtained by the instructor with the pilot receiving the proficiency check, as long as the pilot has had a 61.58 proficiency check (or exemption equivalent) within the preceding 12 months)

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Ground Training

Lesson 1
TST-14J Flight Manual Overview
Version 2015-05-27

1. General Information

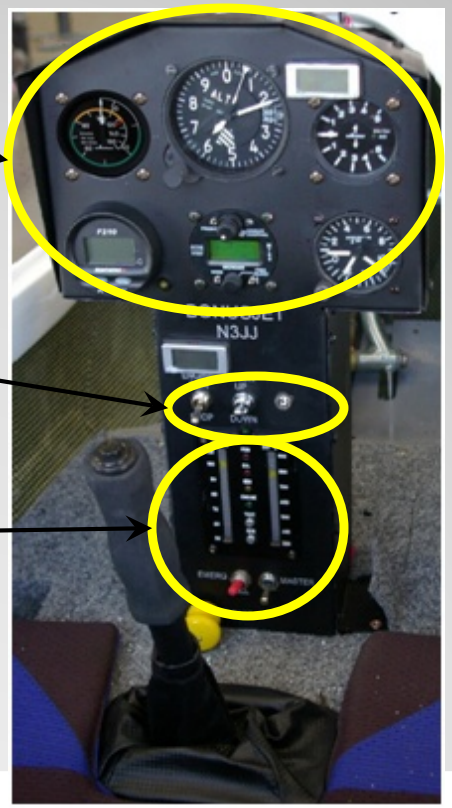
- **MANUFACTURER:** TeST division, COMP-LET, s.r.o., organizační složka, Velké Meziříčí, Czech Republic
- This aircraft is an Experimental-Exhibition & Racing aircraft and does not comply with the federal regulations for standard aircraft. It has been extensively modified to install the TJ-100 turbine (jet) engine.
- This aircraft is designed for VFR flight only.
- The glider has been designed and certified in accordance with the standard of the Aeroclub of the Czech Republic "Airworthiness Requirements ULK – Ultralight Gliders and Motorized Gliders", registered by the Czech Air Office UCL under nr. TI-676/98 from 18th February 1998.

2. Aircraft & Systems Description

- General Description
  - The aircraft is a two-seat, high-winged monoplane with a cantilever wing, T-shaped tail and a fixed, tandem two-wheel undercarriage. Its composite structure is made in negative molds.
- Propulsion Group
  - The aircraft is driven by an auxiliary PBS TJ-100E3-110 turbine engine. This engine replaces the original factory engine (ROTAX 503UL-D.C.D.I).
  - The engine retractable mount is a trapezoidal configuration composed of aluminum arms attached to the original engine mounting hard points.
  - It is driven by a 24V motor and ball screw with an epicyclic ball nut.
  - Upper and lower limit switches are provided (mechanical clutches prevent overdriving the mechanism in the event of limit switch failure).
  - Engine bay doors are positioned by a separate 12V linear actuator.
  - Engine extension/retraction has minimal impact on CG.
- Operating Weights & Loading
  - >Maximum take off weight (MTOW) (with BRS): 1234 lbs
  - Empty weight (with BRS): 781 lbs
  - Useful Load 453 lbs
  - Maximum weight of occupants (including parachute): 441 lbs

- Fuel & Fuel Capacity
  - Fuel: Jet A, Jet A1, JP-5, JP-8
  - Fuel tank volume: 24 US gal
  - Usable fuel: 22 US gal (20 gal takeoff)

- Instrument Panel
  - **Flight Group**
  - **ERM Group**
  - **Engine Control Group**



Arcus-J Lower Panel

Recirculation Fuel Pump Breaker

Engine Fuel Pump Breaker

Engine **RUN/STOP** (Locking)

Master Switch

Pylon **UP/DOWN**

3. Operating Limitations

- SPEED LIMITATIONS

V_{SO}	Stall Speed	38 kts
V_A	Maximum Maneuvering Speed	81 kts
V_T	Maximum Aerotow Speed	81 kts
V_B	Maximum Speed in Turbulent Air	81 kts
V_C	Maximum Speed with Running Engine	111 kts
V_{NE}	Never Exceed Speed	111 kts
Demonstrated wind speed parallel to the line of take off or landing:		16 kts
Demonstrated wind speed for 90º crosswind:		8 kts

- **LOAD FACTORS**

up to 81 kt	+4 G, -2G
81 to 111 kt	+3 G, -1.5
Aerobatics and intentional spins are prohibited!	

4. Weight & Balance Information

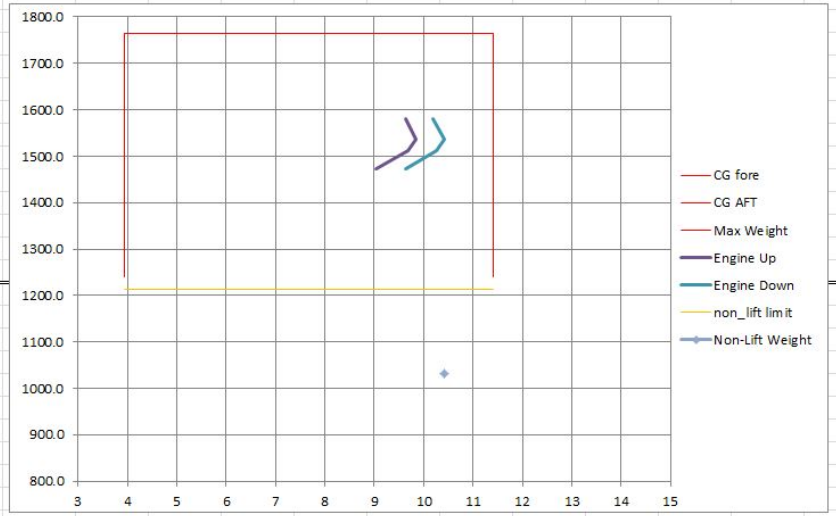
- Useful load = 453 lbs
- Maximum Crew Weight = 441 lbs
- Limitation may be crew weight or low fuel allowance (no self-launch below 4 gal)

WEIGHT & BALANCE		
Rear	Front Cockpit	
Cockpit	Min	Max
0	165	257
125	134	240
150	127	236
175	121	233
200	115	226
225	108	201
FUEL ALLOWANCE		
Crew Weight	T/O	Ramp
300	22.5	24.0
325	19.3	20.8
350	15.5	17.0
375	11.8	13.3
400	8.1	9.6
425	4.3	5.8

4. Weight & Balance Arcus-J

N189DT_2018_02_08.xlsx - Microsoft Excel non-commercial use

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	N189DT SAMPLE WEIGHT & BALANCE (Based on 2/8/2018 weights)								LIMITS								Weight of Lifting parts				
2		QTY		ARM		MOMENT			WEIGHTS				CG					kg	lbs		
3		EACH, LBS		ENGINE		ENGINE			TOTAL	NONLIFT	FRONT	REAR	FORE	AFT			Right inner	107.6	237.2		
4		PSI OR GAL	WEIGHTS	UP	DOWN	UP	DOWN		1764	1212.4	253	253	3.94	11.42			Right outer	7.7	17.0		
5	AIRCRAFT		1239.0	22.7	23.4	28125.3	28992.6				ACTUAL						Left inner	105.9	233.5		
6	WING FUEL (FORWARD FITTING)	3.4	22.1	-0.67		-14.807			1580	1031	220	0	9.0	10.4			Left outer	7.6	16.8		
7	WING FUEL (AFT FITTING)	3.4	22.1	5.7		125.97					DIFFERENCE						in fuel	48.7	22.1		
8	FUEL (UNDER SPAR)	3.8	24.7	19.37		478.439			-184.2	-181.2	-33.0	-253.0	5.1	-1.0			out fuel	48.7	22.1		
9	FUEL(ENGINE BAY)	5.7	37.1	35.6		1318.98											Total	326.2	548.6		
10	FRONT PILOT W/CHUTE	220	220.0	-57.8		-12716															
11	SEATBACK BATTERY	0	0.0	-42		0															
12	REAR PILOT W/CHUTE	0	0.0	-12.13		0															
13	O2 AL-242 (A) - REMOVE	0	0.0	18		0															
14	O2 AL-415 (B) - REMOVE	0	0.0	18		0															
15	O2 AL-682 C - REMOVE	0	0.0	94		0															
16	A PRESSURE	0	0.0	18		0															
17	B PRESSURE	0	0.0	18		0															
18	C PRESSURE	0	0.0	94		0															
19	D PRESSURE	0	0.0	100		0															
20	FIN BATTERY - REMOVE	0	0.0	207.76		0															
21	FRONT TRIM WEIGHTS (8.2)	3	24.6	-84.76		-2085.1															
22	BAGGAGE	0	0.0	18		0															
23	PAYLOAD WEIGHT		**244.6**	111.1818	kg																
24	FUEL WEIGHT		**106.0**	16.3	Gallons																
25	AIRCRAFT LOADED WEIGHT		**1579.8**																		
26																					
27	FULL FUEL		ENGINE UP			ENGINE DOWN															
28	WEIGHT		**1579.8**			**1579.80**															
29	MOMENT		**15232.8**			**16100.09**															
30	CG		**9.6**			**10.19122**															
31	WING BAGS EMPTY		ENGINE UP			ENGINE DOWN															
32	WEIGHT		**1535.6**			**1535.60**															
33	MOMENT		**15121.6**			**15988.92**															
34	CG		**9.8**			**10.41217**															



5. Performance

- Glider - The performance figures stated below are given at sea level for standard atmospheric conditions. Operation at higher density altitudes will reduce performance. Density altitude at Moriarty often exceeds 10,000 ft! Check DA on AWOS (118.05)
  - Maximum L/D — 40.2 (@57 kts)
  - Minimum Sink — 128 ft/min at (@46 kts)
- Takeoff Distance
  - The takeoff distance (over 50 ft obstacle) is 1640 ft. on a level hard surface runway with no wind.
  - ATTENTION: Takeoff distances with the TJ-100 engine may be less, but evaluation has not been conducted. Use of the above values should be conservative.
  - ATTENTION: The takeoff distance can be considerable longer for soft or sloping fields, grass and changes in density altitude or wind conditions.
  - WARNING: Takeoff is not permitted with less than 2 gallons fuel in each wing tank (4 gallons total).
- >Rate of Climb — 984 ft/min
- Climbing Speed — 60-65 kts
- Speeds for Extracting and Retracting Powerplant
  - Minimum speed for engine extraction and retraction (recommended): 49 kts
  - Maximum speed for engine extraction and retraction: 70 kts

- Emergency Procedures
  - ENGINE FAILURE
  - Engine failure during acceleration on the runway
    - Apply wheel brake
    - Engine switch OFF
    - Master Switch OFF
    - Roll out straight ahead or avoid obstacles, if necessary.
  - Engine failure after take-off
    - Airspeed 65 kts
    - Engine Switch OFF
    - Master Switch OFF
    - At altitudes less than 300 ft AGL, land straight ahead making shallow turns to avoid obstacles only.
    - At a sufficient altitude, one may try to restart the engine. The following procedure is to be followed:
    - Maintaining a suitable area for emergency landing
    - Master Switch ON
    - Engine Switch RUN
  - WARNING: Complete all attempts to restart after a failure at an altitude above 150 m (450 ft AGL) so that sufficient altitude remains for a landing in a selected area.
  - ENGINE FIRE
  - Fire with engine extended
    - Engine emergency switch KILL
    - Master OFF
    - Airspeed 75 kts
    - Hard slip
    - Land at nearest possible location or activate BRS as low as practical

- Fire with engine retracted
  - Pylon UP
  - Master OFF
  - Airspeed 75 kts
  - Hard slip
  - Land at nearest possible location or activate BRS as low as practical
  - ATTENTION: If the pilot is wearing a parachute, the altitude is sufficient, and the fire is weakening the structure or threatening the pilot, a bail out may be preferable to a landing attempt.
- BAILING OUT OF THE AIRCRAFT
  - Engine Switch OFF
  - Master Switch OFF
  - Unlock the canopy side locks using both hands, open it and lift it up
  - Release the lock of the safety belts. Place your legs close to the pilot seat.
  - Bail out of the aircraft over the right or left cockpit side.
  - When sufficiently clear of the aircraft, open your personal parachute.
- USE OF A ROCKET RESCUE SYSTEM (BRS)
  - If the aircraft is equipped with a rocket rescue system, study and adhere to the manufacturer's instructions. When it becomes necessary to use the system, perform the following steps:
  - Tighten the safety belts
  - Engine Switch STOP
  - Master Switch OFF
  - Lower the speed to minimum
  - Pull the rocket handle and launch the parachute.

Lesson 2
PBS TJ-100E3-110
Operation & Maintenance Manual Overview

Version 2009-08-01

- SAFETY PRECAUTIONS
  - Ingestion hazards
    - The TJ-100 ingests 47 ft^3/second (can evacuate a 10 X 10 room in 17 seconds)
    - Ingestion effect is non-linear
  - There are no visible signs of danger
  - Essential crew only near engine area
    - Ensure no crew members are near engine inlet during start or run
    - Secure area if running on ground
    - No loose objects (hats, jewelry, baggy clothing)
  - I know 3 people who have lost all or part of fingers in small turbine engines
  - Exhaust hazards
    - Exhaust temperature can exceed 1400°F
    - Exhaust velocity approaches mach 1
  - There are no visible signs of danger
  - Exhaust can cause immediate severe burns
  - Thrust hazard
    - Engine produces 4 times its own weight in thrust
  - Noise hazard
    - Noise level can reach 134 DB (A) at 1 meter
    - Ensure all crew have hearing protection
  - Fuel and oil
    - Use appropriate procedures for flammable liquids
    - Engine oil may be HOT

Engine Performance

Parameter	Unit	Max Takeoff	Initial Climb	Cruise Climb	Idle
RPM	%	100	98	92	50
Thrust	lbf	247	214	160	36
Thrust	%	100	87	65	15
Time limit	min	5	30	cont	cont
>EGT (max)	°C	780	740	680	500

- Warning: Exceeding engine time limits could cause engine damage
- High temperature indications could cause automatic engine shutdown
- Start Parameters
  - Start time <35 seconds
  - Current consumption 100A (0.3 AH total)
  - Minimum battery voltage before starting 24V
  - Minimum voltage during start 18V
  - Minimum battery capacity for starting 12 AH
  - 3 restarts may be attempted with one minute wait between, then five minutes before the next attempt
  - ATTENTION: Determine the cause of the failed start before attempting a restart

- OTHER PARAMETERS
  - Fuel Grades
    - Jet-a, Jet-A1, Jet B, JP-5, JP-8 (Prist additive optional)
    - Cleanliness to Class 7 – 8 per NAS 1638
  - Oil
    - Mobil Jet Oil II (preferred)
    - Aeroshell 560
    - Cleanliness to Class 10 per NAS 1638
    - Attention: Do not mix oil types without proper cleanout procedures
  - Operating conditions
    - Start conditions
      - -40°F – 113°F
      - Up to 13000’
      - Up to 193 KIAS
    - Run conditions
      - -40°F – 113°F
      - Up to 26000’
      - Up to 193 KIAS
  - Service Life
    - 100 hours*
    - 600 cycles
    - 5 years

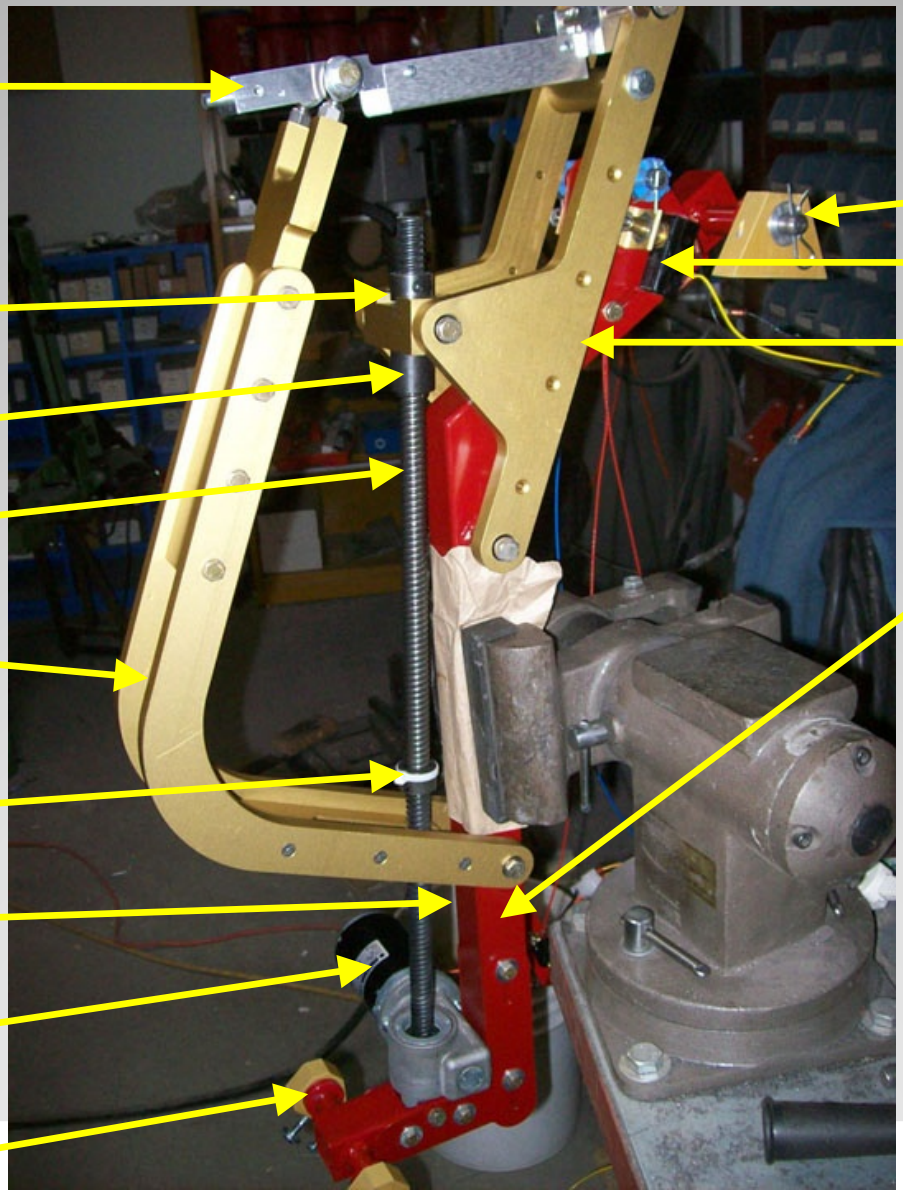
    * Service life has been extended by PBS to 300 hours for new engines

- Engine Description
  - General Description
    - Single shaft
    - Single stage radial (centrifugal) compressor
    - Annular combustion chamber
    - Single stage axial turbine
    - Fixed exhaust nozzle
  - Integral accessories
    - Oil system
    - Starter/generator
    - Digital control unit
    - Fuel control
  - External accessories
    - Ignition power supply
    - Fuel control valve
    - Fuel filter
    - Throttle quadrant
  - Maintenance points
    - Oil filter
    - Oil filler neck (dipstick)
    - Oil tank drain plug
    - Spark plug

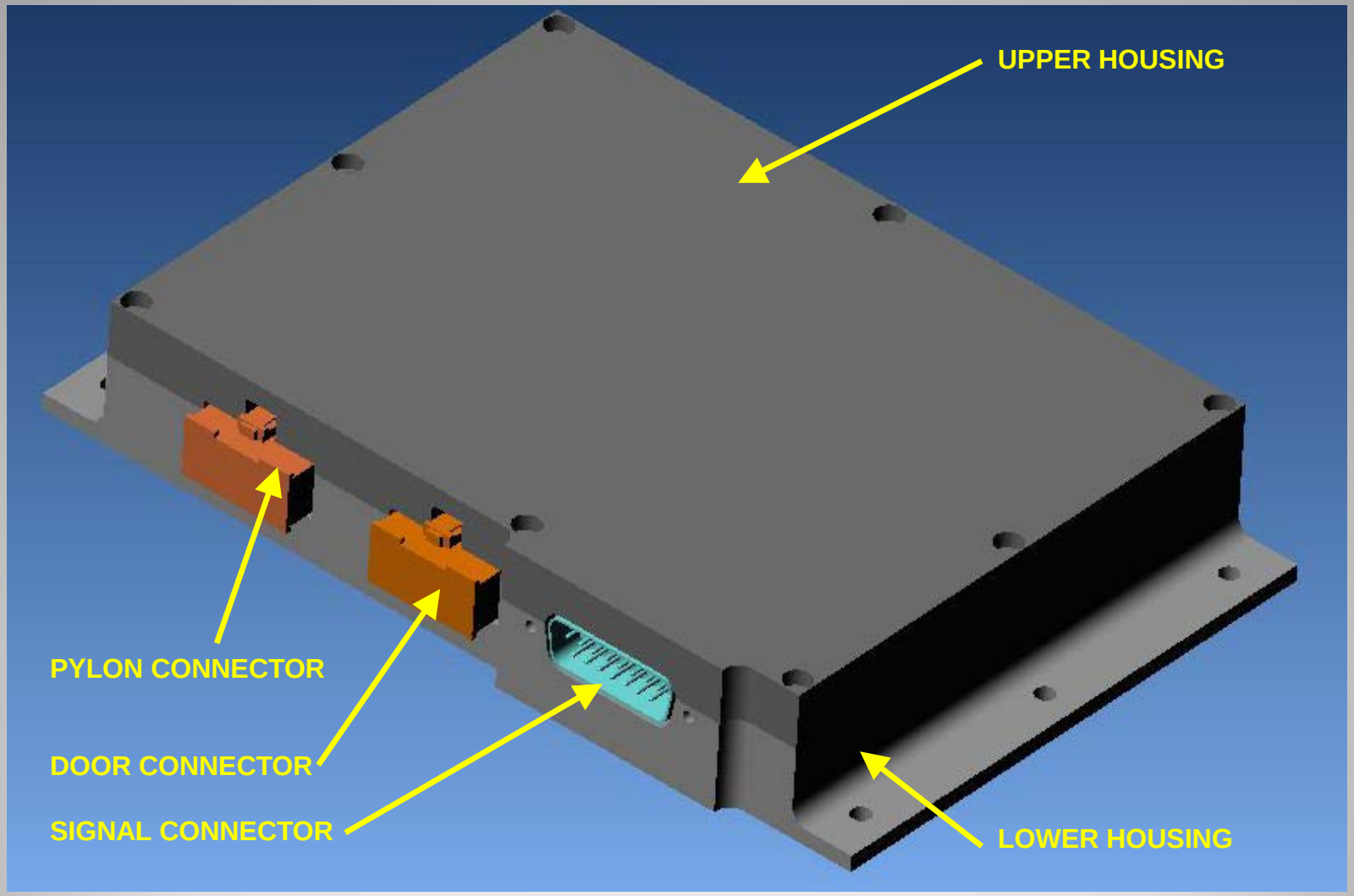
- Engine Automatic Protection Over-ride (PDB)
  - Prevents engine shutdown if:
    - Oil pressure drops
    - Generator fails
    - RPM or temp out of range (except over-speed)
  - Use only when aircraft safety would be severely compromised by an auto-shutdown
  - To protect engine, turn off protection over-ride during most flight conditions

Lesson 3
Extension/Retraction Mechanism (ERM) & Pylon/Door Sequencer (PDS)

EXTENSION / RETRACTION MECHANISM



PYLON / DOOR SEQUENCER



- ERM Description
  - General Description
    - Steel backbone attaches to original factory hard points
    - Aluminum arms support engine shoe, which also routes wires
    - Engine is attached to shoe
    - Trapezoidal configuration (keeps engine approximately horizontal)
    - Linear ball screw actuator
    - Upper & lower primary electrical limits
    - Mechanical secondary limits (slipping clutches)
    - Upper limit switch also activates 24V (engine) systems
- PDS Description
  - General Description
    - A digital control unit that automatically sequences the door and pylon functions
    - Provides automatic timing of the engine cooldown
    - Allows command of engine retraction during cooldown
    - Retraction command not executed until engine cooldown timer expires (2 minutes)

- PDS Operation
  - Control
    - Pylon switch (**UP/DOWN**)
    - Error over-ride(**Hold UP** or **DOWN for 5 seconds**)
  - CAUTION!
    - It may be possible to crash the pylon into the doors - if:
    - A failure of the Door/Pylon Sequencer causes an error condition, and
    - the pilot over-rides this condition without VISUALLY VERIFYING the doors are open
  - Pylon indicator light
    - ON – Pylon fully extended, doors closed
    - OFF – Pylon fully retracted, doors closed
    - FAST FLASH – Pylon in motion (Think fast action)
    - SLOW FLASH – Engine cooldown timer active (Think tick…tock)
    - OCCASIONAL FLASH (6 seconds) Standby
    - DOUBLE FLASH – Error (Think Err-or, err-or)
  - Additional indications
    - Up – Engine display active
    - Up – Auxiliary fuel pump comes on
    - Fuel flow >0 (depending on position of fuel flow sender)

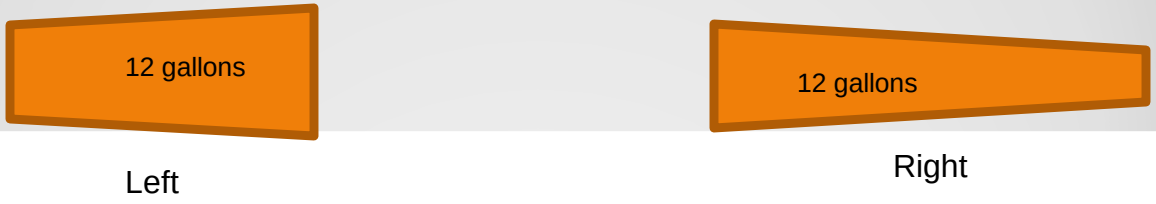
- Error condition (Pylon status light DOUBLE FLASH)
  - The ERM is a robust and simple design, but any mechanical system has the possibility of failures. Below are some possible failure scenarios.
  - Door actuator failure (closed position)
    - Doors do not open within the specified time limit. Do not attempt to move the engine pylon until the failure has been diagnosed and resolved, as substantial damage could occur to the engine, doors and pylon.
  - Door actuator failure (open position)
    - Doors do not close within the specified time limit. It is OK to move the engine pylon, however, starting the engine is not recommended.
  - Pylon fail (up condition)
    - Pylon fails in the full up position (verified by pylon indicator solid **ON**, engine display active and fuel flow >0), all engine functions are OK. Do not attempt to move pylon without verifying doors are fully open, as substantial damage could occur to the engine, doors and pylon.
  - Pylon fail (down position)
    - Pylon fails in the full down position (verified by pylon indicator **OFF)**, do not attempt to move the pylon until the failure has been diagnosed and resolved.
  - Pylon fail (Intermediate position)
    - Pylon fails in an intermediate position (verified by pylon status light **DOUBLE FLASH** and Engine Display **OFF**.
  - Auxiliary Fuel Pump Fail
    - Although technically not a part of the ERM or PDS, the auxiliary fuel pump operation is closely tied to the operation of the ERM. The auxiliary fuel pump starts automatically when the pylon reaches its full **UP** position
    - If the auxiliary pump fails (verified by fuel pressure low light **ON** and/or no fuel flow), do not attempt to start the engine.

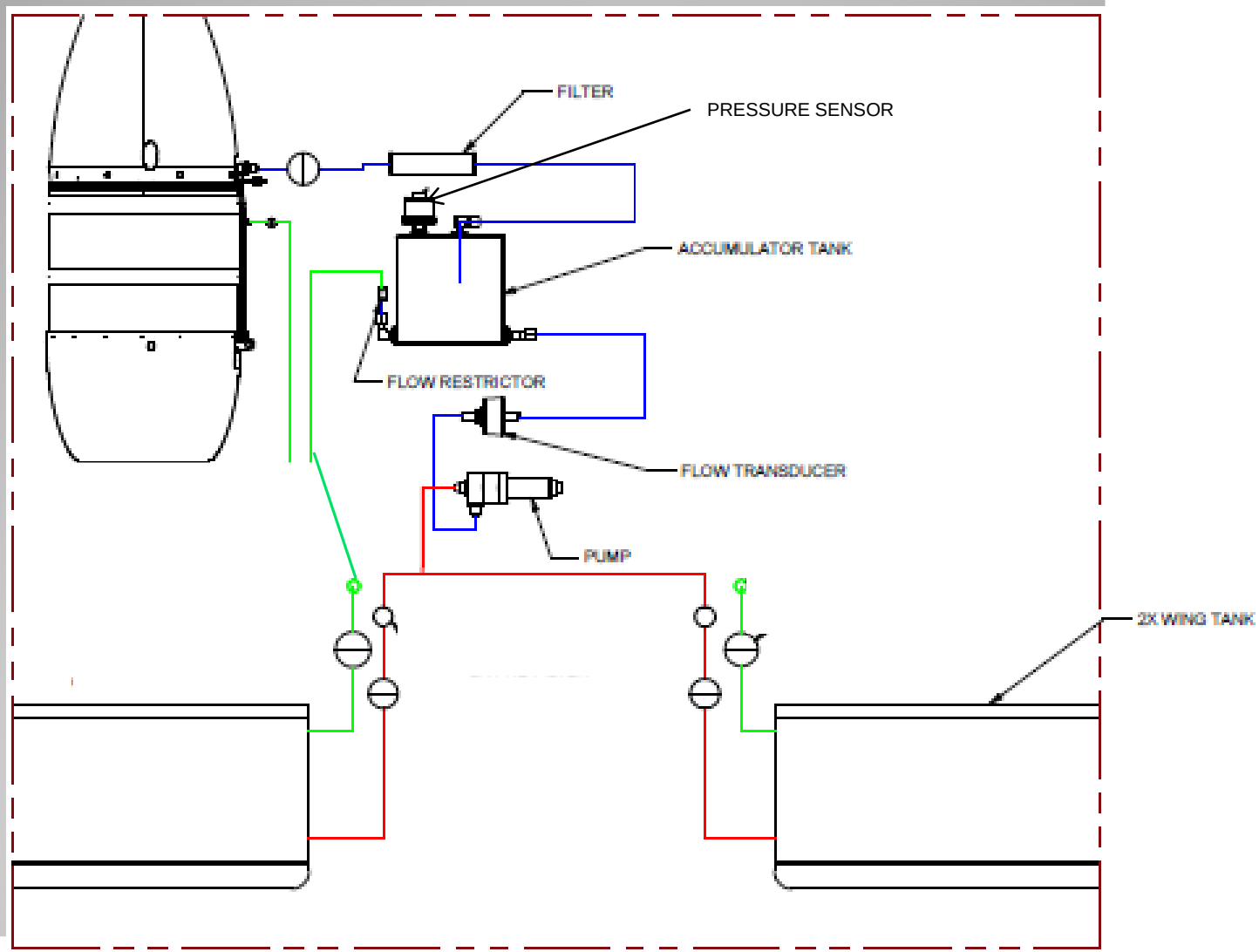
- ERM Failure Recovery

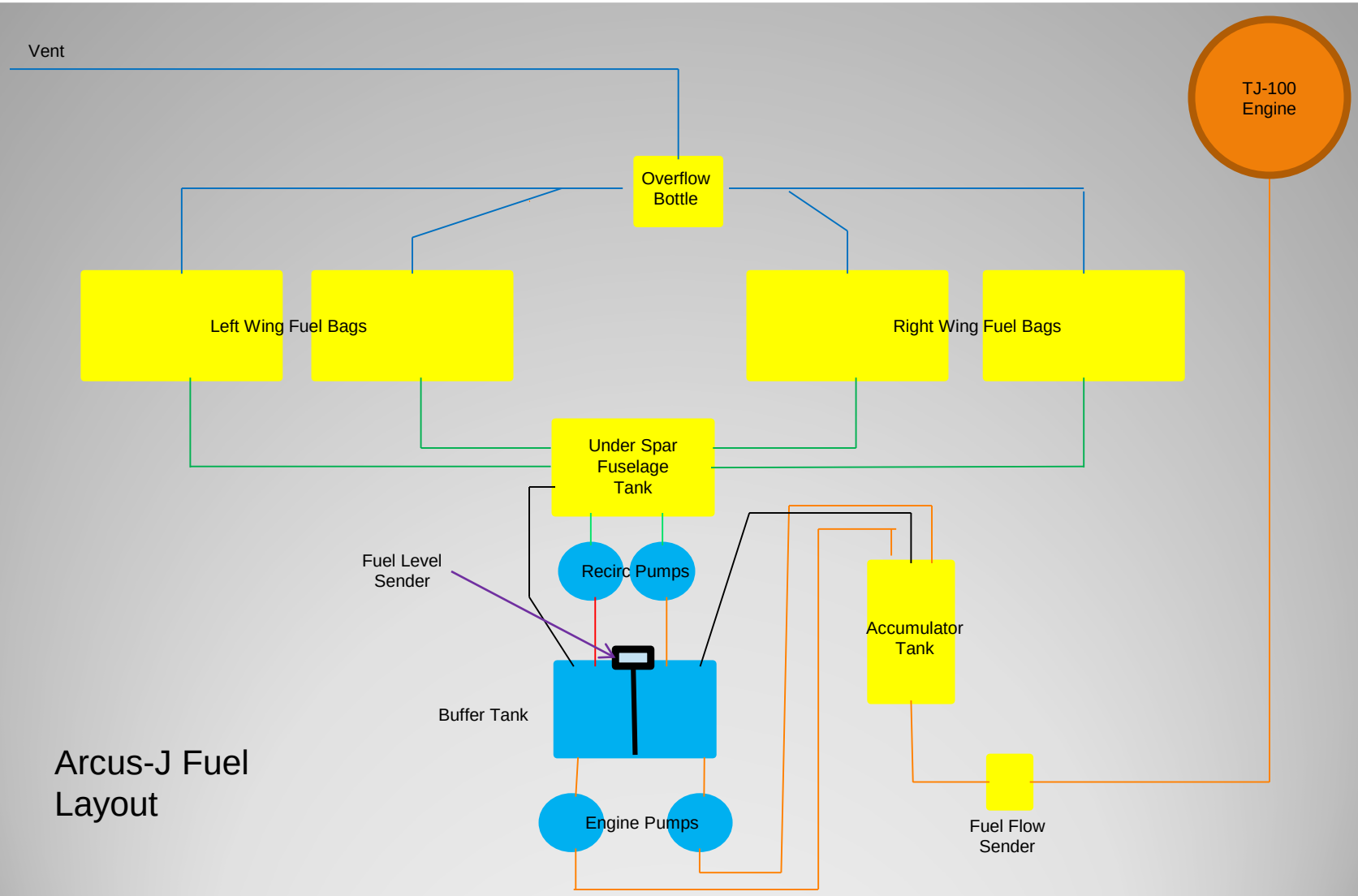
  WARNING: If the pylon status light indicates an error condition (**double flash)** it is extremely important to determine the nature of the error before proceeding. Failure to do so may result in substantial damage to the engine bay doors and engine.

Lesson 4
Fuel System

- Fuel System Description
  - General Description
    - Wing fuel bags (12 gallons each) with over-wing fill ports
    - Self-sealing quick disconnect fittings in rear cockpit
    - “Y” joins both wing bags to a single fuel line
    - Auxiliary fuel pump maintains slight positive pressure (2 – 4 PSI) in accumulator
    - Accumulator stores approximately 1 quart fuel
    - Accumulator has a restricted return at the top to allow air to escape
    - Air (and some fuel) are purged into the left wing bag through a self-sealing quick disconnect
    - Accumulator fuel pickup is located to avoid air or water contamination
    - Fuel flow transducer (to fuel gauge)
    - Fuel pressure transducer (located on accumulator)
    - Fuel filter
    - Electric solenoid valve (controlled by engine controller)
    - Engine fuel inlet
  - Fuel System Considerations
    - Fuel may cross feed if wings aren’t level
    - Right wing tends to deplete slightly sooner than left
    - Always disconnect fuel lines at the end of each flight
    - Due to asymmetric spar placement, bags are slightly different shape, but approximately the same volume
    - Accumulator should be drained periodically to check for water or contamination







Arcus-J Fuel Layout

Lesson 5
Fueling / Defueling

- Fueling
  - Procedure
    1. Disconnect fuel lines in rear cockpit. Use a towel catch drips
    2. Roll aircraft forward about 12” and level wings
    3. Replace rear canopy
    4. Remove screw from cap. Inspect O-ring. Do not place screw on wing!
    5. Insert handle into cap. Remove cap by rocking gently in a circular motion
    6. Dip tanks to determine fuel remaining
    7. Obtain a known quantity of fuel
    8. Switch pump to **FILL** (or pour fuel directly from container)
    9. Add fuel (no more than 1" below filler neck)
    10. Tip wing Down if necessary to add more fuel
    11. Replace cap
    12. Replace screw. Tighten gently. (Do not over-tighten.)
    13. Repeat for other wing
    14. Set Fuel gauge
    15. If pump was used:
        1. Set pump switch to neutral
        2. Place pump on battery charger

- Fueling Considerations
- Fuel may cross feed if wings aren’t level
- Due to asymmetric wing bags, dipstick has different readings for left and right wings
- ATTENTION: Left & right dipstick markings are correct when facing forward
- Wings must be level when checking fuel with dipstick
- WARNING: Raising a wing with cap removed will result in a major fuel spill, possibly into the cockpit
- Never raise a wing with the fuel cap removed!

Over-wing fuel port with cap and screw removed

Over-wing fuel port with cap and screw installed

- Defueling
  - Normal Procedure
    1. Disconnect fuel lines in rear cockpit
    2. Level wings
    3. Remove cap
    4. Switch pump to 'drain‘
    5. Withdraw fuel until at least 3" below filler neck.
    6. When near empty, raise wing slightly to assure all fuel is drained
    7. Replace cap and screw
    8. Repeat for other wing
  - Fueling Considerations
    - Fuel must be drained before removing wings for trailering
    - Fuel may cross feed if wings aren’t level
    - WARNING: Raising a wing with cap removed will result in a major fuel spill, possibly into the cockpit
    - Never raise a wing with the fuel cap removed!
  - Filling to maximum capacity
    - If filling more than 12 gallons total, it may be necessary to lower the wing being filled
    - Replace cap before raising wing
    - Hold filled wing up while filling opposite wing

Lesson 6
Front Cockpit Checkout

- Seat
  - The seat is semi-reclined. Adjustment is by means of a notched bar on the cockpit floor. Assure both sides of seat back are fully (and symmetrically) engaged before entering cockpit
  - Use padding if necessary
- Oxygen
  - If oxygen is to be used, turn on valve while checking seat adjustment
  - Ensure lines are clear to cockpit
- Rudder pedals
  - Rudder pedals are ground-adjustable. Remove pin to move pedals fore or aft.
- Canopy
  - Ensure proper head clearance
  - Canopy is secured with latches on each side
    - Hook latch to canopy
    - Rotate latch 180°
    - Fold latch handle down
  - Window (open or closed)
    - Small clip on forward window edge prevents whistling
- Controls
  - Ensure you can obtain full motion of stick, rudder pedals, spoilers, wheel brake, panel switches (especially master switch and engine emergency kill switch)
  - ATTENTION: Wheel brake is a separate lever mounted to each control stick
- Equipment bag
  - Ensure bag is zipped

Lesson 7
Preflight Checklist

- Hangar Preflight Checklist

1. Remove canopy cover (Roll carefully)
2. Fill out Flight Log Sheet
3. Insert TE probe
4. Verify Engine Switch **STOP**
5. Master on
6. Verify fuel gauge
7. Pylon switch UP to extend engine
8. Verify voltage >23.0 volts while extending
9. After engine is extended, move pylon switch to **DOWN** until doors open.
10. Immediately turn master **OFF**
11. Inspect engine bay & parachute
12. Master **ON**
13. Actuate pylon switch **UP** (5 seconds) to close doors
14. Ensure engine is extended to upper stop
15. Verify pump activation, fuel flow, hobbs
16. Master off
17. Check engine oil
18. Check seat adjustment, pedals, cockpit
19. Secure canopies
20. Carousel bridge **IN PLACE**

- Hangar Preflight Checklist

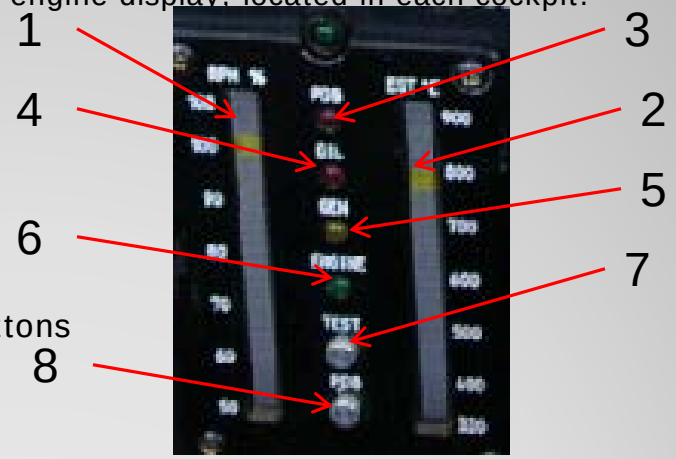
1. Right side of the cockpit
2. Fuselage under the cockpit
3. Landing wheel from the right side
4. Leading edge and the bottom of the right wing
5. Fuel cap
6. Inspection cup of the right wing-aileron control drive
7. Outer part of the right wing
8. Right aileron
9. Upper surface of the right wing and spoiler
10. Right side of the fuselage
11. Tail
12. Fairings of the tail section
13. Right side of the tail
14. Fin, rudder and tailwheel
15. Left side of the stabilizer and elevator
16. Left side of the fuselage
17. Upper surface of the left wing and spoiler
18. Aileron of the left wing
19. Outer part of the left wing
20. Leading edge and the bottom of the left wing
21. Fuel cap
22. Landing wheel from the left side
23. Fuselage under the canopy on the left side
24. Both cockpits and their equipment
25. Instruments
26. Canopy

- Flightline Preflight Checklist
  1. Airframe preflight per Flight Manual
  2. Remove tail dolly
  3. Level wings
  4. Connect fuel in rear cockpit. Ensure good connection! Maintain wings level until ready for takeoff
  5. Secure rear cockpit straps if solo
  6. Secure rear canopy
  7. Remove engine plugs
  8. Check engine inlet area
  9. Turn on oxygen & EDS
  10. Remove wing dolly (or brief wing runner)
  11. Seat adjustment
  12. Remove parachute handle pins
  13. Ear protection for wing runner

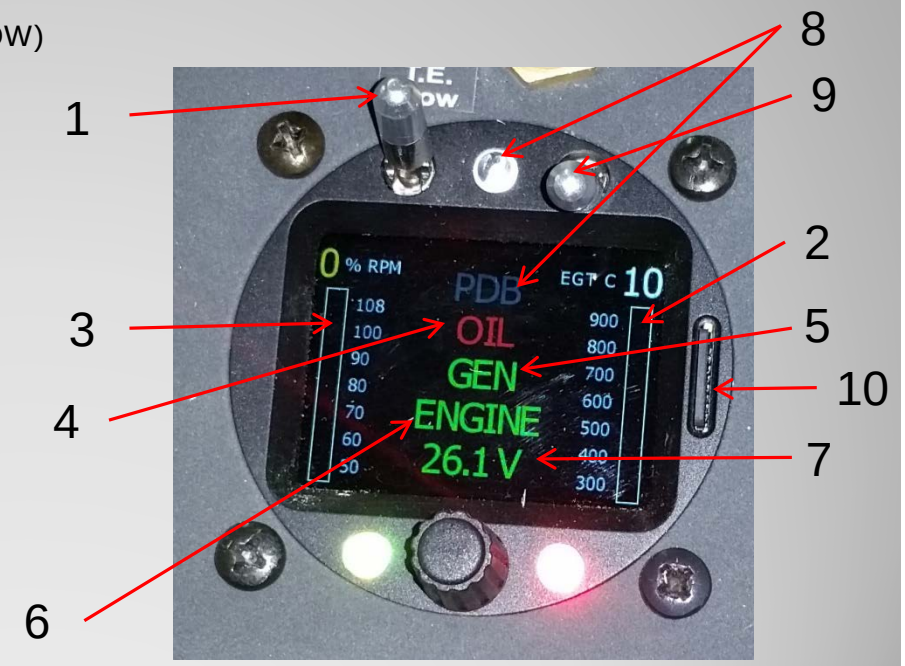
- Cockpit Preflight Checklist
  1. Rear canopy secure
  2. Belts, headset
  3. Spoilers closed
  4. Controls free
  5. Altimeter set
  6. Master Switch **ON**
  7. Check fuel level
  8. Fuel pressure light **OFF**
  9. Engine display functioning
  10. Radio frequency set
  11. Trim set
  12. Test Engine Display

Lesson 8
Engine Controls, Display, Ground Starting, Shutdown

- Engine controls
  - Throttle (or thrust levers in true ‘jet pilot’ vernacular)
    - A single throttle quadrant is mounted below the bulkhead between the front and rear cockpits. It has a single, rotating control handle, which is operated by linear pushrods from each cockpit
  - Engine RUN / STOP Switch
    - The engine is started and stopped by a locking switch in the front cockpit, located in the ERM Control group
  - Engine Display
    - Engine parameters are shown on the digital engine display, located in each cockpit.
    - Displayed parameters are:
      1. RPM (LED bar graph on left)
      2. EGT (LED bar graph on right)
      3. PDB (Red Light)
      4. Oil Pressure Low (Red Light)
      5. Generator output low (Yellow Light)
      6. Engine OK (Green Light)
  - The engine display also has two control buttons
    - 7. Test
      - Tests all display lights
    - 8. PDB Button
      - Toggles Engine Protection Over-ride
    - ATTENTION: To reset the engine display in case of malfunction, press the TEST & PDB buttons simultaneously



- LX TJDU Display
  - Engine Display
    - Engine parameters are shown on the digital engine display, located in each cockpit.
    - Displayed parameters are:
      1. Power Switch (Up = ON)
      2. EGT (Green<800, Red 800+)
      3. RPM (Green <92%, Gray 92-97%, Red>97%)
      4. Oil Pressure (Green OK, red LOW)
      5. Generator output (Green OK, Yellow LOW)
      6. Engine (Green OK, red ERROR)
      7. Voltage (Green OK, red LOW)
      8. PDB indications (Red = Activated)
      9. PDB Switch (Up = Activated)
      10. SD card



- Engine Start Sequence Elements
  - Starting is critical. Jet engines are cooled by incoming air. Approximately 75% of incoming air is used only for cooling (not used in the combustion process). At low RPM, there is not sufficient cooling air for stable, continuous operation. The start sequence is designed to assure sufficient cooling until the engine reaches an RPM to assure safe operation. If the start sequence is not actuated properly, the heat developed by combustion may actually melt the engine. The engine controller manages the start sequence automatically.
  - The TJ-100 (as with most jet engines) has four distinct elements:
    - Spin-up
      - The initial spin to allow sufficient compression for fuel ignition and to prevent 'blow-back'
      - This element puts the most stress on the starter motor
      - Monitor voltage for decreasing (but >18V), then increasing
    - Ignition
      - Fuel is delivered to the injectors
      - Monitor fuel flow for increase
      - Spark plug fires at approximately ¼ second intervals
      - When fuel ignites, engine RPM increases rapidly
      - Engine temperature rises rapidly
      - Monitor temperature for rapid increase, but no over-temp (1000°C for 3 seconds is permitted)
    - Roll-back
      - After the initial 'kick' of fuel ignition, fuel flow is decreased to allow components to cool
      - Engine RPM increase rate slows (noise level drops)
      - Fuel flow rate is decreased
      - Monitor fuel flow and temperature to assure decreasing values
    - Stable Idle
      - Engine reaches a stable RPM (50%) to provide sufficient cooling air
      - Monitor generator (off at about 50%)
      - Monitor Engine OK light (off at 50%)
      - Monitor RPM (50% indication)

- Engine Start Checklist
  - 1 Throttle idle
  - 2 Signal wing runner
  - 3 Engine RUN
  - 4 Monitor start
  - **Spin-up**
  - 5 Voltage drop & recover > 18
  - **Ignition**
  - 6 Fuel flow spike (17 G/M), then decrease
  - 7 EGT increasing
  - **Roll-back**
  - 8 Oil pressure light **EXTINGUISHED**
  - 9 EGT decreasing
  - **Stable idle**
  - 10 Green Engine OK light **ON**
  - 11 Generator light **OFF**
  - 12 50% RPM
  - 13 Fuel pressure light **OFF**

  - Failed start
  - If engine fails to start, do not attempt a restart until the cause of the failure has been determined and fixed
  - Three start attempts may be initiated at one minute intervals, after which you must wait 5 minutes for the starter motor to cool

- Engine Shutdown
  - Engine shutdown should be accomplished in a manner that avoids unnecessary shock cooling. Allowing the engine to run for a while at idle will reduce temperatures and prolong engine component life.
- Engine Shutdown Checklist
  - 1 Engine idle for 1 minute
  - 2 Engine Switch **STOP**
  - 3 Establish speed <65 knots

  - ATTENTION: Do not turn off master switch until engine cooldown is complete

Lesson 9
Self-Launching

- Flight characteristics
  - The BonusJet exhibit flight characteristics similar to other high performance gliders. Roll response is somewhat quicker than most two-seaters. Directional control during takeoff is good. Good crosswind technique (maintaining upwind wing low) is important. Takeoff without assistance can be done on a smooth runway, but a good wing-runner is recommended.
- Wing Runner Hand Signals
  - Starting Engine – Finger pointed upward, fast circular motion
  - Pattern check? – Finger pointed upward, sweeping circular motion
  - Taxi – Finger pointed upward, short, repeated forward motion
  - Steer toward wing runner – Palm facing aft, short waving motion
  - Steer away from wing runner – Palm inward, short rotating motion of hand
  - Stopping – Fist
  - Launching – Finger pointed upward, quick, single motion pointing forward
- Normal Takeoff
  1. Engine warmup 1-2 minutes @ 50 - 70%
  2. Canopies secure
  3. Runway & pattern clear (signal wing runner)
  4. Taxi to runway (signal wing runner)
  5. PDB **ACTIVATE**
  6. Engine to 90% until stable
  7. Engine 98% (100% only if required)
  8. Liftoff level attitude, climb at 65 knots
  9. >At 300', reduce power to 98% & PDB **DE-ACTIVATE**
  10. Cruise climb at 92%

Lesson 10
Transitioning Into Unpowered Flight
(In-flight Shutdown & Retraction)

- Preparing for engine shutdown
  - Once lift has been located, the engine power may be reduced incrementally. As engine power is reduced, transition from climb airspeed (65 knots) to thermalling airspeed (50-55 knots). Once the engine is no longer needed, transition to unpowered (soaring) flight.
  - ATTENTION – Maintain vigilance for other traffic while shutting down and stowing the engine
- IN-FLIGHT SHUTDOWN
  1. Engine less than 70% for 1 minute
  2. Engine Switch **STOP**
  3. Establish speed <65 knots
  4. Pylon Switch **DOWN**
  5. Wait for two minute cooldown
  6. Verify engine stowed (light **OFF)**

Lesson 11
Transitioning To Powered Flight
(In-flight Extension & Restart)

- Preparing for engine restart
  - Always maintain a safe landing location. The engine extension & restart sequence takes approximately 1 minute. If sufficient altitude for a complete start sequence is not available, abort the restart and land normally.
  - ATTENTION – Maintain vigilance for other traffic while extending and restarting the engine
- **IN-FLIGHT RESTART**
  1. Establish speed <65 knots
  2. Pylon Switch **UP**
  3. Verify pylon extended by Engine display **ON**
  4. Fuel pressure light **OFF**
  5. Fuel flow approx 1 GPH
  6. Engine Switch **RUN**
  7. Monitor start
  8. Green Engine OK light **ON**
  9. 50% RPM
  10. Engine RPM < 80% for one minute (unless unsafe to wait)
  11. Engine RPM as required

Lesson 12
Landing with Power

- Landing with power
  - Landing with power is a bit tricky if you're used to making high approaches, and using lots of spoiler on final. At idle, the TJ-100 engine produces about 40 pounds of thrust. This would be enough to re-launch on a long runway, in a lighter aircraft! Patterns should be established to allow for the extra glide caused by the engine thrust, while still maintaining sufficient glide in the event of engine failure. This is accomplished by the use of slightly more spoiler throughout the pattern. Do not close the spoilers too soon after touchdown, as the extra thrust does not allow the aircraft to decelerate as quickly as an unpowered sailplane. Brakes are good, especially for a two-seater, but the added thrust may cause a longer than expected rollout. Good cross-wind technique (upwind wing low) is very important, as the aircraft will tend to turn toward the higher wing. An upwind wing high situation, coupled with the natural weather-vaning tendency caused by the cross wind acting on the rudder, could cause the aircraft to depart in the upwind direction.
- LAND W/POWER (Touch & Go)
  - **F**uel > 4 gal (if a go-around is expected)
  - **L**anding Gear **DOWN**
  - **A**irspeed 65 knots
  - **P**rotection (PDB) **ACTIVATE**
  - **S**poilers **OPEN**
  - Touch down slightly tail low
  - Brakes as appropriate
  - Maintain X-wind correction

Lesson 13
Post Flight Checklists

- **After Landing Checklist**
  1. Engine Switch **STOP**
  2. Allow engine cooling cycle (no retract for minutes if shutdown after landing)
  3. Master Switch **OFF**
  4. Wings level **ASAP**
  5. Disconnect fuel
  6. Hang fuel lines
  7. Oxygen & EDS **OFF**
  8. Secure canopies
  9. Engine plugs in
  10. Canopy cover
  11. Aircraft secure

- **POST-FLIGHT – HANGAR**
  1. Fuel disconnected
  2. Fuel lines hung
  3. Engine plugs in
  4. Verify Engine switch position
  5. Master **ON**
  6. Doors **OPEN**
  7. Pylon **DOWN**
  8. Doors **CLOSED**
  9. **Master OFF**
  10. **Complete Flight Log Sheet**

Training Program
For
Glider Instructors

2018-02-25

Take Aways

- Checklists, checklists, checklists
  - Many glider pilots are not used to systems and checklists
  - Proper use of a proper checklist will prevent system mistakes
  - Familiarize yourself with instruments and warnings
- Fuel Systems
  - Turbine engines are thirsty
  - This necessitates larger and possibly more complex fuel systems
  - Read the manual for your aircraft and learn the fuel system
  - Fuel burn rates may be 35 gal/hr – Monitor fuel remaining
- Energy management
  - To an even greater degree than most glider operations, energy management is critical
  - Turbine engines gain and lose energy at a slower rate than piston engines
  - Idle thrust is significant in a clean glider
  - Engine extended glide is 38:1 in the Arcus – If the situation demands your attention, don't worry about the engine