

# **RV-Type Transition Training Syllabus**

**RV-4/6/7/8 Version**

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**Purpose.** The purpose of this guide is to provide discussion, techniques and procedures applicable to RV-Type transition training for upgrading pilots without previous experience in type. It has been prepared from multiple sources and is designed to be used in conjunction with the FAA Airplane Flying Handbook (FAA-H-8083-3A) and the FAA Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25A), appropriate Advisory Circulars as well as designer's and builder's information; and operating limitations for the specific RV-type operated. Techniques and recommendations are provided to assist the instructor and upgrading pilot as well as providing a degree of standardization and continuity. This manual is not designed to replace specific FAA, designer, kit manufacturer or builder's guidance. At the successful completion of transition training, the upgrading pilot should be able to perform maneuvers to the minimum standard appropriate to pilot privileges to be exercised in the operation of the RV-type aircraft. Where applicable, Objective Standards of Behavior in this syllabus conform to Private Pilot Practical Test Standards (FAA-S-8081-14A). The most current versions of FAA publications may be obtained on-line at [www.faa.gov](http://www.faa.gov).

**Guidance.** Applicable pilot certification and currency guidance is provided in 14 CFR Part 61. Operational guidance is provided in 14 CFR Part 91. Current versions of these Federal Aviation Regulations (FARs) should be consulted. Regulations may be obtained on-line at [www.faa.gov](http://www.faa.gov). Additional techniques applicable to operation of aircraft may be obtained from the Airman's Information Manual (AIM). In some cases, this Guide is more restrictive than FARs (e.g., Training Rules, currency requirements, etc.).

**Using this Guide.** This manual has been prepared using numerous sources. It is designed for instructor use in preparing briefings and lesson plans as well as providing essential standardization guidance to ensure continuity of effort. Part 1 contains a course description, training rules, a syllabus and appropriate documentation to support training activity. Part 2 includes academics in the form for a briefing guide. And Part 3 includes guidance for the conduct of training in specific tasks and maneuvers:

- (1) The first part of each task section contains specific objectives, academic and briefing considerations as well as instructor considerations. The second part of each task section addresses conduct of specific maneuvers as detailed in the *Airplane Flying Handbook*. Private pilot practical test standards are included (where appropriate) for reference. Specific guidance for applicability to RV-type airplanes is contained in text boxes at the conclusion of each maneuver description.

**Experimental Amateur-Built (EAB) Aircraft.** RV-type aircraft are designed and constructed as an Experimental amateur-built aircraft. They are not designed or built to meet any standards of airworthiness as with a standard certificated aircraft. 14 CFR Section 21.191(g) defines an amateur-built aircraft as an aircraft in which the major portion of the aircraft has been

fabricated and assembled by persons who undertook the construction project solely for their own education or recreation. This aircraft does not have an FAA Form 8130-9 “Statement of Conformity” on file with the FAA, since there is no FAA Approval data to which it conforms. The builder and/or owner of this aircraft were and are experimenters and the aircraft was not built in a permanent jig and parts are not necessarily interchangeable with any other aircraft. The registered owner is free make modifications as he or she wishes. The aircraft should possess an unlimited duration special airworthiness certificate and operating limitations issued by the FAA. The operating limitations are set forth under guidance prescribed in Order 8130.2 and established to maintain compliance with 14 CFR 91.319. Maintenance and operation of this aircraft must be in accordance with the operating limitations.

- (1) EAB aircraft used in the conduct of RV-Type transition training must be in Phase 2 operations (i.e., initial test period complete). **All maneuvers flown in the conduct of training must have been previously tested under similar load conditions and in accordance with Operating Limitations issued for that airplane.**
- (2) EAB aircraft may not be operated for hire unless an appropriate Letter of Deviation Authority has been issued by the appropriate FAA Flight Standards District Office.

**Operational Risk Management.** A continuing cycle of risk assessment, aircrew decision making, and applying control measures to: a) avoid risk; b) mitigate risk or c) consciously accept risk. The core principles to successful risk management are to anticipate/manage risk by planning (i.e., thinking); accept no un-necessary risk; and consciously accept risk when the benefits outweigh the potential cost. It is a continual process and must be taught to students. Keep in mind, 80% of all mishaps involve human factors, with the majority of these mishaps occurring during takeoff and landing phase of flight. For Experimental/Amateur Built (EAB) types, maneuvering flight also carries increased risk. To assist with controlling risk during the conduct of training, and establish a basic framework to assist with student decision making, a set of training rules is contained in this guide. These rules may be more restrictive than guidance contained in the FARs or aircraft Operating Limitations.

- (1) Upgrading pilots will complete the King School’s “Practical Risk Management for Pilots” course prior to the conduct of training. The appropriate course completion certificate shall be maintained in the upgrading pilot’s grade book. This course may be obtained on-line at [www.kingschools.com](http://www.kingschools.com) or by calling (800) 854-1001.

**Note:** At the instructor’s discretion, appropriate airline, FAA-sanctioned or military training in risk management/aircrew decision making may be substituted for this requirement.

**Aircraft Documentation.** Documentation must be reviewed by the instructor prior to utilizing an RV-type aircraft for training purposes. The airworthiness certificate and operating

limitations must be maintained aboard the aircraft during operation. The airworthiness certificate should be displayed in a manner so that it is visible to either the passengers or crew. Additionally, a current registration form and weight and balance data should be maintained on board. The registration form must have a current address on it for the registered owner(s). Documentation that the aircraft has completed the flight test requirements is maintained in the airframe logbook. The airframe and engine logbooks must be reviewed prior to flight.

**Weight and Balance Considerations.** Accurate weight and balance data must be available for the airplane operated during the conduct of training. Like all light planes, RV-types are sensitive to loading and accurate assessment of performance and handling characteristics cannot be achieved without determine weight and balance data. One of the primary limitations likely to be encountered is G-available or the ability to perform aerobatics (if appropriate) during the conduct of training. Depending on the airplane and crew weight, it may not be practical to carry full fuel for the conduct of dual instruction.

**Note:** Maximum allowable gross weight is contained in the Operating Limitations specific to the airplane utilized for training. However, for the conduct of this course, designer's limits will be utilized unless published Operating Limitations are more restrictive. Designer's limits are contained in Table 1-1:

<b>Table 1-1: RV-Type Basic Weight and Balance Design Limits</b>					
Type	Maximum Allowable Gross Weight	Maximum Aerobic Gross Weight	Forward CG Limit	Aerobic CG Limit	Aft CG Limit
RV-4	1500 LBS	1375 LBS	68.7	75.9	77.4
RV-6	1600 LBS	1375 LBS	68.7	75.3	76.8
RV-6A	1650 LBS	1375 LBS	68.7	75.3	76.8
RV-7	1800 LBS	1600 LBS	78.7	84.5	86.82
RV-7A	1800 LBS	1600 LBS	78.7	84.5	86.82
RV-8	1800 LBS	1600 LBS*	78.7	85.3	86.82
RV-8A	1800 LBS	1600 LBS*	78.7	85.3	86.82
*1550 LBS if not equipped with the -1 wing. All CG limits inches aft of Datum. Datum for RV-4/6(A) is 60" ahead of the leading edge of the wing, and 70" ahead of the LE for RV-7(A)/8(A).					

**Training Course Objective.** The upgrading pilot will obtain the aeronautical skill and knowledge necessary to operate an RV-Type airplane to the skill level commensurate with private pilot certification standards.

**Experience Requirements.** Upgrading pilots will possess a minimum of a private pilot's certificate and a valid 3<sup>rd</sup> Class Medical Certificate and at least 100 hours pilot-in-command

time in single-engine (land), piston powered aircraft. They will have completed a Biennial Flight Review in accordance with 14 CFR 61.57, or other qualifying flight check/examination within the preceding 23 months prior to the beginning of transition training. For transition training in tail wheel equipped RV-type aircraft, the upgrading pilot will possess a tail wheel endorsement or have tail wheel experience logged prior to 15 April, 1991. Pilots upgrading to tail wheel equipped RV-types will have completed a minimum of 10 full stop takeoffs and landings in a tail wheel equipped aircraft with 150 or more horsepower within the 30 days preceding the beginning of transition training. Pilots upgrading to a nose wheel equipped RV-type aircraft will have completed a minimum of 3 full stop takeoffs and landings in a nose wheel equipped aircraft with 150 or more horse power within the 30 days preceding the beginning of transition training. Upgrading pilots will have completed an aircraft handling sortie within the preceding 30 days prior to the start of training in a single-engine, propeller driven aircraft with a MGTOW of less than 4000 lbs that includes: at least one short-field takeoff and landing to a full stop; at least one soft-field takeoff and landing to a full stop; power off stalls; power on stalls and slow flight. Upgrading pilots will have logged a minimum of 3 hours of pilot-in-command time in the 30 days prior to the beginning of training. Upgrading pilots completing the aerobatic portion of this syllabus will have prior aerobatic experience. Appropriate log book entries documenting experience must be presented prior to the conduct of training.

**Average Sortie Duration.** The basic transition course is designed for four sorties of 1.25 hours average duration. The instructor must adjust sortie duration to accommodate local constraints and ensure completion of all required training events. Sorties may be broken up into shorter segments and mission elements may be deferred at instructor discretion. A minimum of 5 hours of in-flight instruction is required for course completion.

**Training Days.** This course is designed to be completed in four training days, with one block of instruction completed per training day. At the instructor's discretion, up to two blocks may be completed in one day.

**Note:** Formal risk management training must be complete prior to beginning Block 1 training. If this student has not completed risk management training, an additional half training day is required prior to beginning Block 1 instruction.

**Continuity of Training.** One of the most important facets of effective training is ensuring adequate continuity. No more than seven calendar days should elapse between training sorties. If a break exceeding seven days occurs, the previous sortie will be re-flown for proficiency prior to moving on to the next sortie in the syllabus.

**Proficiency Sorties.** Additional proficiency sorties may be added to the syllabus at the instructor's discretion. Grade sheets will be annotated with a "P" to indicate a proficiency

sortie (e.g., TR-3P). A proficiency sortie may be generated due to break in training, student non-progression (unsatisfactory performance), student confidence, etc.

**Incomplete Sorties.** If a sortie is non-effective for weather, mechanical breakdown, etc., it will be considered incomplete and an additional sortie will be generated to complete mission requirements. The grade sheet should clearly state the mission is incomplete and an overall mission grade should not be assigned for the incomplete portion (individual elements that were completed should be graded, however).

**Testing.** The upgrading pilot will complete written testing required by the syllabus. The minimum passing score for a written examination is 70%, and all examinations will be debriefed with an instructor and corrected to 100%. In the event the minimum passing score is not achieved, the upgrading pilot will continue to re-take the test until a minimum passing grade is achieved.

**Use of Chase Aircraft.** RV-type aircraft are load-sensitive and not all are fitted with dual flight controls. In some cases (e.g., RV-4), lack of RCP load capacity and dual controls may make it impractical to conduct transition training in a specific aircraft. It may, however, be practical to conduct two-ship transition training if an appropriately qualified instructor and equivalent airplane are available for use. Chase flying is an instructor pilot using a suitable equivalent airplane to accompany a solo student and supervise in-flight training. The instructor pilot must be familiar with this type of formation flying and flight instruction technique prior to conducting chase operations. The chase aircraft/instructor pilot maintains responsibility for ensuring inter-flight deconfliction at all times.

**Spin Training.** Spin training will be conducted in accordance with AC61-67C, as amended. Spin training, when conducted, will be limited to incipient spin phase only. The incipient phase is defined as the portion of the spin from the time the airplane stalls and rotation starts until the spin becomes fully developed. For the purpose of this course, spin training will be limited to incipient spins of one turn duration, or less.

**Use of Parachutes.** Appropriately inspected parachutes will be worn any time planned maneuvering will exceed  $\pm 30^\circ$  of pitch or  $\pm 60^\circ$  of bank. Parachute weight must be factored into weight and balance calculations. A weight of 14 lbs per parachute will be used for weight and balance purposes if exact weight of parachute is not known.

**Note:** In accordance with AC61-67C Paragraph 301(b), parachutes are not required for spin training.

**Documentation.** Individual Student Grade Books should be prepared to document transition training. Grade books should contain a training log, unaccomplished task log and individual grade sheets for each mission.

- (1) Grade Books. Completed grade books are the property of the flight instructor and will be retained for record. A copy will be provided to the student at the completion of training.
- (2) Grade Sheets. The instructor will prepare a grade sheet for each training mission flown. Individual maneuver elements will be objectively graded, and when proficiency is required, a “P” will be pre-printed at the appropriate level to aid the instructor in making a determination. Objective grading criteria, mission completion standards and specific maneuvering limitations will be printed on the back of each grade sheet. An overall subjective grade will be assigned for each mission.
- (3) Log Book Endorsement. The instructor will annotate and endorse the upgrading pilot’s log, as appropriate.

**Note:** Individual maneuvers and mission elements may be graded below required proficiency level and the upgrading pilot may progress to the next mission at the instructor’s discretion, however all required maneuvers will be complete to the appropriate grade level prior to course completion. Mission elements graded below standard and unaccomplished tasks should be recorded and tracked in the unaccomplished task log in the student grade book.

**Grading.** Individual mission elements and maneuvers will be assigned a numeric grade in accordance with the standards in Table 1-2. Specific criteria are established for individual elements to allow for objective grading. An overall (average) numeric grade using the same scale should be assigned to the mission by the instructor. The instructor will also make a subjective progress assessment at the conclusion of each mission. Progress assessment levels are BELOW AVERAGE; AVERAGE; or ABOVE AVERAGE.

Table 1-2: Grading Criteria	
UNKNOWN	Performance not observed or element not performed
DANGEROUS	Performance unsafe (requires overall grade of 0)
0	Performance indicates lack of ability or knowledge
1	Performance is safe, but indicates limited proficiency, makes errors of omission or commission. Minimum grade required to meet syllabus definition of “practice.”
2	Performance is essentially correct. Recognizes and corrects errors. Minimum grade required to meet syllabus definition of “proficient.”
3	Performance is correct, efficient, skillful and without hesitation
4	Performance reflects unusually high degree of ability

**Mission Elements Objectives/Standards of Behavior.** Standards for proficiency of individual mission elements are listed in Table 1-3.

<b>Table 1-3: Objectives/Standards of Behavior for Individual Mission Elements</b>		
<b><i>Element</i></b>	<b><i>Min Grade Req</i></b>	<b><i>Objectives/Standards of Behavior</i></b>
<b>Ground Operations</b>		
Weather / NOTAM Information	2	<ul style="list-style-type: none"> <li>-Able to obtain sufficient information from an FAA approved source to make Go / No-Go decision for conduct of flight</li> <li>-Understands airspace limitations and temporary flight restrictions</li> </ul>
TOLD	2	<ul style="list-style-type: none"> <li>-Able to compute or estimate takeoff and landing performance; able to determine runway requirements for safe operation under existing conditions; able to compute decision points</li> <li>-Understands factors affecting performance and able to apply appropriate takeoff and landing safety factors</li> <li>-Understands Koch Chart for density altitude effects</li> <li>-Understands Designer's Performance Specifications; understands difference between those specifications and specific RV-Type to be operated</li> </ul>
EAB Airworthiness Determination	2	<ul style="list-style-type: none"> <li>-Understands EAB airworthiness requirements and is able to make a determination as to the airworthiness of the airplane to be operated</li> <li>-Understands requirements documents and placards to be maintained on board</li> <li>-Understands Operating Limitations for airplane to be operated, including Phase 1 and Phase 2 operations</li> <li>-Understands requirement for annual condition check, able to reference appropriate airframe and engine log books to determine compliance</li> <li>-Familiar with EAB maintenance practice, including AD compliance (when appropriate)</li> <li>-Familiar with Van's Service Bulletins for RV-type to be operated</li> <li>-Familiar with procedures for completing minor and major modifications, including requirements to notify FSDO (when appropriate)</li> <li>-Familiar with procedure for ensuring current avionics data bases are maintained (when appropriate)</li> </ul>
Weight and Balance	2	<ul style="list-style-type: none"> <li>-Understands designer's weight and balance limits for RV-type to be operated</li> </ul>



		<ul style="list-style-type: none"> <li>-Able to locate and understand specific empty weight and balance data for RV-type to be operated; knows maximum allowable gross weight specified in the Operating Limitations for the RV-type to be operated</li> <li>-Able to compute weight and balance condition for takeoff, planned landing weight and low-fuel landing weight; able to apply computation and make determination as to whether or not the computed CG is within the envelope and maximum gross weight is not exceeded</li> <li>-Understands weight effects on performance; familiar with weight and balance effects on handling characteristics for RV-type operated</li> </ul>
Operations of Systems	2	<ul style="list-style-type: none"> <li>-Understands fuel system of RV-type to be operated: able to operate fuel selector valve; able to determine quantity of fuel on board</li> <li>-Understands electrical system of RV-type to be operated: understands sources of power; familiar with buss design; understands location and operation of critical circuit breakers; understands normal and abnormal system instrument indications; able to load-shed; familiar with time limits for back-up power systems</li> <li>-Flight control systems: understands how primary and secondary flight controls are activated; understands airspeed limitation for flap actuation</li> <li>-Canopy system: understands how to actuate canopy; understands how to determine "locked" status of canopy; familiar with in-flight jettison procedures</li> <li>-Brakes and steering: understands ground steering and braking systems for RV-type to be operated</li> <li>-Engine: understands how to start, operate and secure power plant for the RV-Type to be operated; able to interpret instrument indications for normal and abnormal conditions</li> <li>-Blindfold Cockpit Check: Able to locate all cockpit switches and controls by feel; able to operate critical systems by feel</li> </ul>
Preflight Inspection	2	<ul style="list-style-type: none"> <li>-Exhibits developed flow plan for the conduct of pre-flight inspection</li> <li>-Inspects the airplane utilizing appropriate check-list</li> <li>-Understands what items should be inspected, the reason for inspection and is able to detect defects</li> <li>-Develops methodology for inspection of wheels and brakes</li> <li>-Understands how to fuel the aircraft, exhibits ability to properly ground the airplane during refueling operations; understands how to remove, adjust and secure gas caps; exhibits methodology for determining fuel load for less than</li> </ul>

		<p>full tanks; knows location of all fuel drains and is able to drain and inspect fuel from all points</p> <ul style="list-style-type: none"> <li>-Understands the proper type/weight and how to service oil to the engine sump; able to determine oil level</li> </ul>
Cockpit Management	2	<ul style="list-style-type: none"> <li>-Understands preflight inspection requirements for egress equipment (parachutes)</li> <li>-Ensures loose items are secure; organizes equipment, publications and other material in an efficient manner to insure in-flight accessibility</li> <li>-Able to conduct effective passenger brief to include experimental nature of the airplane, use of safety belts/harness, canopy operation, control interference, transfer of aircraft control (if appropriate) and emergency procedures</li> <li>-Familiar with technique to secure unoccupied cockpit for solo operations</li> <li>-Understands location and operation of all cockpit switches, circuit breakers and controls</li> <li>-Understands canopy operation; familiar with limitations for operating with canopy open or partially open; understands how to secure and verify security of canopy</li> </ul>
Engine Start	2	<ul style="list-style-type: none"> <li>-Positions aircraft properly with regard to safety of personnel on the ground, structures and surface conditions; demonstrates awareness of prop blast effects at all times</li> <li>-Understands engine manufacturer's or builder's recommended engine start procedures for starting, utilizing appropriate checklist</li> <li>-Familiar with cold weather starting procedures; familiar with manufacturer's recommendations for pre-heating</li> <li>-Familiar with hot starting procedure</li> <li>-Familiar with flooded start procedure</li> <li>-Familiar with ground leaning technique</li> <li>-Understands engine operating limits for ground operations</li> <li>-Familiar with starting and ground operation emergency procedures</li> </ul>
Taxi	2	<ul style="list-style-type: none"> <li>-Demonstrates awareness of prop blast at all times</li> <li>-Performs a brake check prior to taxi</li> <li>-Maneuvers the aircraft with regard to safety of personnel on the ground, structures and surface conditions; taxis to avoid other aircraft and hazards</li> <li>-Understands wind effects; allows for surface conditions and steering effectiveness; properly positions flight controls for taxi operations</li> <li>-Controls taxi direction and speed without excessive use of brakes</li> </ul>

		<ul style="list-style-type: none"> <li>-Understands how to ventilate the cockpit during taxi operations</li> <li>-Complies with markings, signals, clearances and instructions</li> <li>-Utilizes appropriate checklist</li> </ul>
Before Takeoff Check/Run-up Operations	2	<ul style="list-style-type: none"> <li>-Demonstrates awareness of prop blast at all times</li> <li>-Positions the airplane with regard to other planes, vehicles, obstacles/structures, wind and surface conditions</li> <li>-Understands engine manufacturer's or builder's recommended engine run-up procedure; understands engine operating limits; understands temperature requirements for run-up and is able to detect malfunctions</li> <li>-Divides attention inside/outside of cockpit</li> <li>-Utilizes appropriate checklist; able to ensure the airplane is in a safe operating condition</li> <li>-Understands use of flaps for takeoff; sets trim for computed CG/gross weight condition</li> <li>-Reviews TOLD, departure and emergency procedures; notes wind direction/speed</li> <li>-Insures no conflict with traffic prior to taxiing into takeoff position</li> </ul>
<b>Takeoff</b>		
Normal Takeoff	2	<ul style="list-style-type: none"> <li>-Clears area, obtains clearance, properly positions aircraft for takeoff</li> <li>-Determines wind direction and properly positions flight controls</li> <li>-Applies power smoothly; cross-checks engine instruments to determine normal operation</li> <li>-Maintains directional control, applies proper wind drift correction</li> <li>-Rotates and accelerates to <math>V_Y + 10/-5</math> knots/MPH; maintains <math>V_Y</math> to 1500 feet AGL; maintains coordinated flight; retracts flaps (when appropriate) prior to exceeding <math>V_{FE}</math>; transitions to desired cruise climb commensurate with engine cooling requirements/desired performance</li> <li>-Complies with clearance/departure procedure</li> <li>-Utilizes appropriate checklist</li> </ul>
Short-Field Takeoff	2	<ul style="list-style-type: none"> <li>-Understands short-field operations; accommodates surface conditions</li> <li>-Clears area, obtains clearance, utilizes all available takeoff area, properly positions aircraft for takeoff</li> <li>-Applies brakes while smoothly advancing power to specified run-up RPM; cross checks engine instruments to determine normal operation prior to brake release</li> <li>-Applies remaining power smoothly; maintains directional</li> </ul>

		control, applies proper wind drift correction -Lifts off and accelerates to $V_X + 10/-5$ knots/MPH; establishes proper pitch attitude to maintain speed until obstacles are cleared -Transitions to $V_Y + 10/-5$ knots/MPH or cruise climb (as appropriate); retracts flaps (as appropriate) by $V_{FE}$ -Utilizes appropriate checklist
Soft-Field Takeoff	2	-Understands soft-field operations; accommodates surface conditions -Determines wind direction and properly positions flight controls to accommodate and to maximize lift as quickly as possible -Clears area, obtains clearance, properly positions aircraft for takeoff without stopping; smoothly applies power; cross-checks engine instruments to determine normal operation -Establishes/maintains attitude that will transfer weight from wheels to wings as rapidly as practical; maintains directional control; properly applies wind drift correction -Lifts off at lowest practical airspeed and maintains ground effect while accelerating to $V_X$ or $V_Y$ , as appropriate; maintains $V_X$ or $V_Y + 10/-5$ knots/MPH; maintains $V_X$ or $V_Y$ to 1500 feet AGL; retracts flaps (when appropriate) prior to exceeding $V_{FE}$ ; transitions to desired cruise climb commensurate with engine cooling requirements/desired performance -Complies with clearance/departure procedure -Utilizes appropriate checklist
<b>Four Fundamentals</b>		
Climb	2	-Understands climb performance for RV-Type to be operated -Understands handling qualities (including pitch stability) for best angle, best rate and cruise climbs -Understands proper application of rudder to maintain coordinated flight during all climb operations -Familiar with visibility restrictions during maximum performance climb -Understands engine temperature limits and adjusts climb (when appropriate) to ensure proper cooling air flow -Maintains desired heading $\pm 10^\circ$ -Familiar with techniques for cruise climb altitude adjustment; applies appropriate power/mixture adjustment
Straight and Level Flight	2	-Level-off: applies appropriate lead point, levels at specified altitude $\pm 100$ feet -Establishing cruise condition: understands power settings; trims for desired airspeed; leans mixture for best power or economy; computes fuel flow $\pm 1$ GPH; computes ETA $\pm 5$

		<p>minutes; knows engine manufacturer's maximum recommended cruise power setting</p> <p>-Recognizes turbulent conditions; adjusts speed appropriately</p>
Descent	2	<p>-Descent point: able to compute cruise descent point <math>\pm 1</math> NM; plans descent with sufficient VVI to meet crossing restriction <math>\pm 1</math> NM; understands speed limitations; monitors engine condition; conducts descent check</p> <p>-Actively manages mixture control during descent</p> <p>-Level-off: applies appropriate lead point, levels at specified altitude <math>\pm 100</math> feet</p> <p>-Familiar with techniques for cruise descent altitude adjustment; applies appropriate power/mixture adjustment</p> <p>-Familiar with high descent rates at low speed</p> <p>-Glide: Understands glide performance; able to establish max endurance glide <math>\pm 10</math> MPH; able to establish max range glide <math>\pm 10</math> MPH; knows nominal sink rate for RV-Type to be operated; knows glide ratio for RV-type to be operated; knows power-off glide angle for RV-type to be operated; familiar with prop-stopped glide</p>
Standard Rate Turns	2	<p>-Understands instrument indications for establishing a <math>3^\circ</math> per second turn; able to fly timed turns</p>
Medium Banked Turns	2	<p>-Smoothly establishes <math>30^\circ</math> bank <math>\pm 5^\circ</math>; applies appropriate rudder to coordinate turn with no more than <math>\frac{1}{2}</math> ball-width error; establishes appropriate back pressure to maintain altitude <math>\pm 100</math> feet; computes lead-point for roll out and rolls out <math>\pm 10^\circ</math> of specified heading; maintains airspeed <math>\pm 10</math> knots/MPH throughout</p> <p>-Divides attention between aircraft control, orientation and clearing</p>
<b>Confidence Maneuvers</b>		
$45^\circ$ Banked Steep Turns	2	<p>-Smoothly establishes <math>45^\circ</math> bank <math>\pm 5^\circ</math>; applies appropriate rudder to coordinate turn with no more than <math>\frac{1}{2}</math> ball-width error; establishes appropriate back pressure and power; maintains altitude <math>\pm 100</math> feet; computes lead-point for roll out and rolls out <math>\pm 10^\circ</math> of specified heading; maintains airspeed <math>\pm 10</math> knots/MPH throughout</p> <p>-Divides attention between aircraft control, orientation and clearing</p>
$60^\circ$ Banked Steep Turns	2	<p>-Smoothly establishes <math>60^\circ</math> bank <math>\pm 5^\circ</math>; applies appropriate rudder to coordinate turn with no more than <math>\frac{1}{2}</math> ball-width error; establishes appropriate back pressure and power; maintains altitude <math>\pm 100</math> feet; computes lead-point for roll out and rolls out <math>\pm 10^\circ</math> of specified heading; maintains airspeed <math>\pm</math></p>

		10 knots/MPH throughout -Divides attention between aircraft control, orientation and clearing
Lazy-Eight / Wing-over	1	-Establishes 55-65% cruise condition -Maintains constant pitch and roll rate throughout maneuver using smooth control inputs -Coordinates control inputs -Heading $\pm 15^\circ$ from entry reference at $180^\circ$ points -Airspeed -10 /+20 from entry reference speed -For maximum performance maneuvering: degrees of roll approximately equal to degrees of heading change (i.e., nose slicing through the horizon with $90^\circ$ bank at $90^\circ$ turn point). -Divides attention between aircraft control, orientation, clearing and maintains minimum maneuvering altitude
Chandelle	1	-Establishes 55-65% cruise condition -Simultaneous application of power and smooth pitch and roll inputs to establish $45\text{--}60^\circ$ bank by $45^\circ$ turn point; maintains bank until $135^\circ$ point -Coordinates control inputs -Completes roll out at $180^\circ$ point $\pm 15^\circ$ at speed slightly above stall -Divides attention between aircraft control, orientation, clearing and maintains minimum maneuvering altitude
AOA Recovery	2	-Smoothly retards the throttle to Idle-1500 RPM -Smoothly establishes and maintains $\frac{1}{4}$ to $\frac{1}{2}$ G condition with neutral controls -Coordinates recovery inputs -Avoids excessive airspeed build-up -Reestablishes straight and level flight -Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude
Slow Flight	2	-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 1500 feet AGL) -Properly configures the aircraft -Establishes/maintains airspeed 5 knots/MPH above stall buffet; maintains speed +5/-0 knots/MPH -Accomplishes coordinated straight and level flight, turns, climbs and descents -When appropriate: Maintains specified altitude $\pm 100$ feet; heading $\pm 10^\circ$ ; specified bank angle $\pm 10^\circ$ -Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude

Power-off Stall	2	<ul style="list-style-type: none"> <li>-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 1500 feet AGL)</li> <li>-Maintains coordinated flight and makes smooth control inputs</li> <li>-Recognizes aerodynamic warning/recovers promptly after stall occurs by reducing AOA, increasing power and recovering to straight and level condition; makes minimal control movements and attitude changes during recovery; does not exceed operating limitations for configuration</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Power-on Stall	2	<ul style="list-style-type: none"> <li>-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 1500 feet AGL)</li> <li>-Sets power to 55% or greater</li> <li>-Maintains coordinated flight and makes smooth control inputs</li> <li>-Recognizes aerodynamic warning/recovers promptly after stall occurs by reducing AOA, adjusting power (as appropriate) and recovering to straight and level condition; makes minimal control movements and attitude changes during recovery; does not exceed operating limitations for configuration</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Accelerated Stall	2	<ul style="list-style-type: none"> <li>-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 1500 feet AGL)</li> <li>-Establishes cruise condition at 55-65% power</li> <li>-Smoothly applies coordinated controls to establish 60° bank angle; smooth application of G to cause deceleration while maintaining constant altitude</li> <li>-Recognizes/recovers promptly after stall occurs by reducing AOA, adjusting power (as appropriate) and recovering to straight and level condition; does not exceed operating limitations for configuration</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Nose-High Unusual Attitude	2	<ul style="list-style-type: none"> <li>-Recognizes and confirms an unusual attitude exists</li> <li>-Applies smooth control inputs; maintain awareness of airspeed</li> <li>-Neutralizes aileron and rudder inputs; establishes ¼ to ½ G condition</li> <li>-Adjusts power and bank as necessary to assist pitch and airspeed control; avoids negative G</li> <li>-As the nose approaches the horizon with adequate airspeed,</li> </ul>

		adjusts pitch, bank and power to re-establish straight and level flight
Nose-Low Unusual Attitude	2	<ul style="list-style-type: none"> <li>-Recognizes and confirms an unusual attitude exists</li> <li>-Applies smooth control inputs; maintains awareness of airspeed</li> </ul>
Incipient Spin	1	<ul style="list-style-type: none"> <li>-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 3500 feet AGL)</li> <li>-Makes smooth control inputs</li> <li>-Decelerates power off to a stalled condition, recognizes aerodynamic warning and applies pro-spin controls after the stall is encountered</li> <li>-Maintains pro-spin controls until applying recovery controls</li> <li>-Recovers from nose-low condition without excessive airspeed build-up or engine over-speed</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
<b>Aerobatics</b>		
G Warm-up*	1	<ul style="list-style-type: none"> <li>-Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 150-160 MPH / 65% Power condition</li> <li>-Over-banks and smoothly applies 3 G's for approximately 90° of heading change</li> <li>-Reverses turn direction with an unloaded roll while establishing 150-170 MPH</li> <li>-Smoothly applies 4 G's for approximately 90° of heading change</li> <li>-Manages velocity vector throughout maneuver; avoids excessive speed build-up or accelerated stall</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Acceleration maneuver*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Smoothly establishes ¼ to ½ G condition</li> <li>-Avoids negative G, unintentional engine interruption</li> <li>-Manages velocity vector throughout maneuver; avoids excessive speed build-up</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Basic Roll*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions (in no case lower than 1500 feet AGL)</li> <li>-Establishes 140-170 MPH / 65-75% Power condition</li> </ul>



		<ul style="list-style-type: none"> <li>-Smoothly applies back stick to establish 20-30° nose up</li> <li>-Unloads to neutralize elevator input then applies smooth aileron input in desired direction of roll; maintains sufficient roll rate to ensure return to upright attitude no later than 20-30° nose low</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Loop*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 170-180 MPH / MIL power condition; does not exceed engine red line RPM</li> <li>-Smoothly applies 3-4 G's</li> <li>-Eases back pressure as pitch exceeds 90° nose up, but maintains sufficient pressure to ensure nose continues to track</li> <li>-Apexes inverted at ½ to 1 (positive) G at 70-90 MPH</li> <li>-Reduces power and smoothly increases G through backside of loop to rate nose; avoids excessive speed build-up; avoids accelerated stall</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Split-S*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Manages energy to establish a 10-30° nose up entry condition at 70-90 MPH</li> <li>-Reduces power to idle and smoothly increases G; avoids excessive speed build-up; avoids accelerated stall</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Barrel Roll*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 150-180 MPH / 65-75% condition</li> <li>-Selects suitable reference point; offsets 20-30° using a coordinated turn</li> <li>-Smoothly applies simultaneous back pressure and aileron to establish a 2-3G roll</li> <li>-Maintains adequate roll rate and G to control airspeed throughout the maneuver; adjusts power as necessary</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Immelman*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 170-180 MPH / MIL power condition; does not exceed engine red line RPM</li> <li>-Smoothly applies 3-4 G's</li> </ul>

		<ul style="list-style-type: none"> <li>-Eases back pressure to arrive approximately 20-30° nose up, inverted; unloads and smoothly applies aileron to roll back to upright</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Cuban 8*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 170-180 MPH / MIL power condition; does not exceed engine red line RPM</li> <li>-Smoothly applies 3-4 G's</li> <li>-Eases back pressure as pitch exceeds 90° nose up, but maintains sufficient pressure to ensure nose continues to track</li> <li>-Apexes inverted at ½ to 1 (positive) G at 70-90 MPH</li> <li>-Reduces power and smoothly increases G through backside of loop to rate nose to 45° below the horizon (inverted)</li> <li>-Unloaded roll to maintain 45° down line</li> <li>-Initiates smooth pull-out to arrive at initial entry altitude/airspeed</li> <li>-Avoids excessive airspeed build-up; accelerated stall</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
Cloverleaf*	1	<ul style="list-style-type: none"> <li>- Selects appropriate altitude for maneuvering in accordance with training rules and/or local restrictions</li> <li>-Establishes 150-180 MPH / 65-75% condition</li> <li>-Smoothly applies 2-3 G's to achieve 70° pitch</li> <li>-Applies aileron to roll to inverted as nose passes down through horizon</li> <li>-Smooth back pressure to re-establish entry conditions; adjusts power as required</li> <li>-Avoids excessive airspeed build-up; accelerated stall</li> <li>-Divides attention between aircraft control, orientation, clearing, and maintains minimum maneuvering altitude</li> </ul>
<b>Ground Reference Maneuvers</b>		
Turns Around a Point§	1	<ul style="list-style-type: none"> <li>-Selects suitable reference line and establishes cruise condition at 600-1000 feet AGL</li> <li>-Enters maneuver at appropriate distance and applies adequate wind drift correction to track a constant radius turn around the reference point by properly adjusting bank angle</li> <li>- Divides attention between coordinated airplane control, ground track and clearing</li> <li>-Maintains altitude ± 100 feet; airspeed ± 10 knots/MPH</li> </ul>
S-Turns Across a Road§	1	<ul style="list-style-type: none"> <li>-Selects suitable reference line and establishes cruise condition at 600-1000 feet AGL</li> </ul>

		<ul style="list-style-type: none"> <li>-Applies adequate wind-drift correction to track a constant radius turn on each side of the reference line by properly adjusting bank angle</li> <li>-Reverses direction directly over reference line</li> <li>-Divides attention between coordinated airplane control, ground track and clearing</li> <li>-Maintains altitude <math>\pm 100</math> feet; airspeed <math>\pm 10</math> knots/MPH</li> </ul>
Pylon 8's§	1	<ul style="list-style-type: none"> <li>-Determines pivotal altitude</li> <li>-Selects suitable reference points (permits straight/level between points)</li> <li>-Enters at appropriate altitude/airspeed; utilizes 30-45° bank angle at steepest point</li> <li>-Applies corrections: LOS reference line remains on the point</li> <li>-Divides attention between accurate coordinated control, outside visual references and clearing; avoids slips and skids</li> </ul>
1080° Steep Spiral§	1	<ul style="list-style-type: none"> <li>-Selects an altitude sufficient to continue through a series of 3 360° turns</li> <li>-Selects suitable ground reference point</li> <li>-Applies wind drift correction to track a constant radius circle around the reference with a bank angle of <math>\leq 60^\circ</math> at steepest point; maintains airspeed <math>\pm 10</math> knots/MPH</li> <li>--Divides attention between accurate coordinated control, outside visual references and clearing; avoids slips and skids</li> </ul>
<b>Landing</b>		
Emergency Landing	2	<ul style="list-style-type: none"> <li>-Selects appropriate Glide Speed</li> <li>-Selects suitable site for emergency landing</li> <li>-Completes appropriate emergency procedures to effect re-start and/or secure; notifies ATC; squawks 7700</li> <li>-Arrives at High Key position aligned with landing direction +500 / -0 feet of 1500' AGL at a speed <math>\geq 105</math> MPH</li> <li>-Establishes low key 1000' AGL <math>\pm 100'</math> at 105 MPH <math>\pm 10</math> MPH</li> <li>-Arrives at selected landing site with sufficient energy to land</li> </ul>
Descent Check	2	<ul style="list-style-type: none"> <li>-Understands induction system and how to prevent icing/operate alternate air</li> <li>-Utilizes appropriate checklist: basic "GUMPS" flow prior to all descents and landings</li> </ul>
Pattern Operations/ Perch Management	2	<ul style="list-style-type: none"> <li>-Maintains pattern altitude <math>\pm 100</math> feet</li> <li>-Arrives at perch +10/-5 knots/MPH of desired airspeed; maintains throughout final turn</li> <li>-Applies appropriate wind correction to maintain desired ground track</li> <li>-Adjusts perch point for wind conditions</li> </ul>
Low-Approach /	2	<ul style="list-style-type: none"> <li>-Makes timely decision</li> </ul>

Go-Around		<ul style="list-style-type: none"> <li>-Smoothly applies takeoff power; maintains directional control; adjusts pitch for <math>V_X</math> or <math>V_Y</math> climb (as appropriate) +10/-5 knots/MPH to safe altitude; maintains coordinated flight</li> <li>-Adjusts trim; retracts flaps no later than <math>V_{FE}</math></li> <li>-Maneuvers as required to clear traffic/hazards</li> <li>-Applies appropriate wind drift correction</li> <li>-Utilizes appropriate checklist</li> </ul>
Slip	2	<ul style="list-style-type: none"> <li>-Understands proper control inputs to establish a forward and side slip; maintains AOA/airspeed awareness</li> <li>-For the purpose of glide path adjustment during approach to landing: Makes smooth, timely and correct control application during recovery from the slip</li> <li>-For the purpose of cross-wind landing: establishes a forward slip in a timely manner during the transition to landing; maintains desired ground track with longitudinal axis aligned with the landing surface to touchdown</li> </ul>
Normal Landing	2	<ul style="list-style-type: none"> <li>-Considers wind conditions, landing surface, obstructions and selects suitable TDZ</li> <li>-Establishes stabilized final approach; maintains speed of <math>1.3-1.4 V_{S0} \pm 5</math> knots/MPH; applies gust correction</li> <li>-Makes smooth, timely and correct control applications during round out and touchdown</li> <li>-Touches down within first 500 feet of usable surface with no drift/longitudinal axis aligned with landing surface</li> <li>-Maintains cross-wind correction and directional control throughout approach and landing</li> <li>-Complies with approach/clearance procedure</li> <li>-Utilizes appropriate checklist</li> </ul>
180° Power-off Landing	2	<ul style="list-style-type: none"> <li>-Familiar with energy management techniques to accomplish a 180° power-off approach from a 1000 foot AGL low key through touchdown on a suitable landing surface</li> <li>- Considers wind conditions, landing surface, obstructions and selects suitable TDZ</li> <li>-Utilizes appropriate glide speed to transition to final approach speed no slower than <math>1.3 V_{S0}</math></li> <li>-Touches down in normal landing attitude within the first 1/2 of usable surface or at a suitable touchdown point that would allow a full stop landing without application of abnormal braking on the landing surface available with no drift/longitudinal axis aligned with landing surface</li> <li>-Maintains cross-wind correction and directional control throughout approach and landing</li> <li>Complies with approach/clearance procedure</li> <li>-Utilizes appropriate checklist</li> </ul>

Short-Field Landing	2	<ul style="list-style-type: none"> <li>-Considers wind conditions, landing surface, obstructions and selects suitable TDZ</li> <li>-Maintains stabilized approach speed not greater than <math>1.35 V_{SO} + 10/-5</math> knots/MPH</li> <li>-Makes smooth, timely and correct control application during the round out and touchdown</li> <li>-Touches down smoothly at minimum control airspeed at or within 200 feet of planned TDZ with no side drift, minimum float and longitudinal axis aligned with landing path</li> <li>-Maintains cross-wind correction and directional control throughout the approach and landing sequence</li> <li>-Applies brakes and flight controls as necessary to stop in the shortest distance consistent with safety</li> <li>-Utilizes appropriate checklist</li> </ul>
Soft-Field Landing	2	<ul style="list-style-type: none"> <li>-Considers wind conditions, landing surface, obstructions and selects suitable TDZ</li> <li>-Maintains stabilized approach speed not greater than <math>1.35 V_{SO} + 10/-5</math> knots/MPH</li> <li>-Makes smooth, timely and correct control application during the round out and touchdown</li> <li>-Touches down softly with no drift and longitudinal axis aligned with landing path</li> <li>-Maintains cross-wind correction and directional control throughout the approach and landing sequence</li> <li>-Utilizes proper flight controls, speed and power to taxi on the soft surface</li> <li>-Utilizes appropriate checklist</li> </ul>
<b>After Landing</b>		
After landing, parking and securing	2	<ul style="list-style-type: none"> <li>-Maintains directional control</li> <li>-Observes markings/procedures/clearance(s)</li> <li>-Parks in appropriate area; considers safety of airplane, persons and property on the ground</li> <li>-Utilizes appropriate checklist</li> <li>-Familiar with techniques for moving the airplane after shutdown</li> <li>-Conducts post-flight inspection; secures the aircraft</li> </ul>
Servicing	2	<ul style="list-style-type: none"> <li>-Understands how to fuel the aircraft, exhibits ability to properly ground the airplane during refueling operations; understands how to remove, adjust and secure gas caps; exhibits methodology for determining fuel load for less than full tanks; knows location of all fuel drains and is able to drain and inspect fuel from all points</li> <li>-Understands the proper type/weight and how to service oil to the engine sump; able to determine oil level</li> </ul>

Airmanship		
Clearing / Visual Look-out	2	<ul style="list-style-type: none"> <li>-Utilizes proper scanning techniques</li> <li>-Maneuvers as required to ensure flight path is clear of traffic</li> <li>-Maintains situational awareness of other aircraft operating on frequency/sharing the traffic pattern</li> <li>-Understands and applies right of way rules</li> </ul>
Fuel Management	2	<ul style="list-style-type: none"> <li>-Determines fuel requirements and ensures proper fuel load for the conduct of the flight; ensures sufficient fuel reserve at all times</li> <li>-Monitors fuel level throughout the flight</li> <li>-Computes appropriate BINGO fuel</li> <li>-Maintains fuel levels sufficient for lateral balance</li> </ul>
Airmanship	2	<ul style="list-style-type: none"> <li>-Understands aircraft capabilities and limitations</li> <li>-Able to navigate; maintains orientation</li> <li>-Adheres to training rules, procedures and regulations</li> <li>-Utilizes resources effectively</li> <li>-Recognizes fatigue and degraded performance</li> <li>-Manages cockpit workload effectively; prioritizes</li> </ul>
Judgment (ORM/ADM)	2	<ul style="list-style-type: none"> <li>-Identifies risks/hazards, analyzes controls, makes control decisions and monitors results</li> <li>-Understands pilot capabilities: establishes and adheres to personal limitations</li> <li>-Applies appropriate prioritization to ensure safety</li> </ul>
§Ground Reference Maneuvers Optional. *Aerobatics Optional. Note: Aerobatic training may not be practical due to weight and balance limitations.		

**Situational Emergency Procedures Training (SEPT).** Each Block of instruction contains a section of emergency procedures training. A list of possible malfunctions and considerations for discussion are contained in the lesson plans. Each SEPT session should last 1 hour and cover all items listed for discussion. The cockpit of the airplane utilized for training should be used to the maximum extent practical for the conduct of situational emergency procedures training.

**Course Completion Standards.** A minimum of five hours of in-flight instruction is required. All mission elements requiring proficiency will be graded to a minimum standard of 2. Mission elements for which lesson plans specify “practice” or “for purposes of familiarization” will be graded to a minimum standard of 1. Four hours of academic instruction is required. Three one hour sessions of Situational Emergency Procedures Training (SEPT) are required, and all ground, takeoff, in-flight and landing emergencies will be covered. Formal risk management training, a blindfold cockpit check and an open-book written test (corrected to 100%) will be completed.

**Note:** This course of instruction meets all requirements for completion of a biennial flight review in accordance with FAR 61.57.

#### **RV-Type Fuel Considerations**

- Fuel consumption can vary widely from data in the engine operator's manual. Due to variance in construction and power plant size and configurations, it is difficult to establish a baseline ROT that would apply to all RV-type airplanes. Furthermore, even airplanes with nearly identical characteristics can vary in consumption (e.g., carburetor out of adjustment, etc.). It is imperative to obtain accurate fuel consumption data for the airplane flown. If this has not been provided by the builder, it must be obtained through flight test. Fuel flow devices must be properly calibrated to provide accurate information.
- Failure to know the current fuel consumption curves for the airplane operated is just as dangerous as not dipping/checking the tanks in the first place, i.e., the exact amount of fuel on board should be known prior to engine start.
- By FAR 23, the fuel gauges are required to read accurately only when the tanks are completely full OR empty. Although a sound practice for calibrating gauges, keep in mind that FAR 23 does not apply to EAB aircraft, so even this basic assumption cannot be made.
- For a normally aspirated 320 cubic inch engine with a compression ratio of 8.5:1 or less equipped with an aviation carburetor, fuel flow can exceed 13 GPH at high power, with a significant increase in fuel flow at power settings greater than 75% power. For a normally aspirated 360 cubic inch engine with a compression ratio of 8.5:1 or less equipped with an aviation carburetor, fuel flow can exceed 17 GPH at high power, with a significant increase in fuel flow at power settings greater than 75% power. For leaned operation below 70% power, aircraft test and engine manufacturer's data should be consulted to determine nominal fuel flow rates.
- Unusable Fuel. Each RV-type airplane will have a certain amount of unusable fuel. The exact amount can only be determined by testing. If test data is not available for the airplane being operated, it is recommended that it be ASSUMED that a MINIMUM of 1 gallon per side is unusable.
- Fuel Reserve. A minimum 45 minute reserve should be utilized during training operations. Assuming a 1 gallon unusable fuel quantity, O-320 powered airplanes should land with a minimum of 7 gallons on board, and O-360 powered airplanes should land with a minimum of 9 gallons on board (assuming a nominal cruise fuel flow rate of 8 GPH for an O-320 equipped airplane and 10 GPH for an O-360 equipped airplane). Specific values should be computed based on test or manufacturer's data for the airplane to be operated.

# TRAINING RULES

## Weather

- Pattern Only Operations: 1500/3  $\pm$  1 Hour of intended operation.
- Area/Cross-Country Operations: 3000/5  $\pm$  2 Hour of intended operation (along route of flight as well as intended destinations):
  - An alternate will be specified for each stop, regardless of weather forecast.
  - Note: for outer landing field operations during the conduct of local training, the departure/RTB airport is a suitable alternate.
- For Solo/Chase Operations or aircraft not equipped with a gyroscopic artificial horizon (or suitable EFIS): Clearly Defined Horizon.
- For Solo/Chase Operations: Maximum cross-wind component 10 knots.
- For Solo/Chase Operations: Maximum surface wind 15 knots; maximum gust factor 5 knots.
  - Instructor may increase maximum allowable surface wind to 20 knots and gust factor to 10 knots based on student proficiency.
- For Day Operations: Land NLT Official Sunset + 15 minutes.
- For Solo/Chase Operations: Do not land or takeoff on runways within 20° of azimuth of sunrise or sunset within 1 hour of sunrise or sunset (15° elevation). Consider taking off prior to sunrise or immediately after sunset, if necessary.

## Deep Stalls and Spins

- Aircraft loaded within Designer's limits.
- Phase I testing for configuration complete; spins approved in Operating Limitations.
- Loose Items Stowed.
- Planned spins limited to one turn or less.

## Takeoff and Landing

- Minimum runway width: 50' paved; 75' unpaved (N/A for Dual operations).
- Minimum runway length: 2000' (2500' for Solo/Chase Operations).
- Takeoff and Landing Data will be computed; Takeoff Abort and Land NLT points will be Established:
  - Koch Chart will be consulted for DA Effects. A basic Takeoff Safety Factor of 1.33 and Landing Safety Factor of 1.43 will be applied to all operations.
- For operation from turf runways, grass height will not exceed 1/3 wheel diameter.
  - Assume turf runways are wet with dew  $\pm$  1 hour of sunrise.



- For Solo/Chase Operations: No touch and goes on turf runways or any runway shorter than 3000'.
- Touchdown prior to computed Land NLT point for all full-stop landings.
- Initial touchdown must be within 1/3 of usable landing surface for any touch and go.

### **Area**

- Minimum maneuvering altitude: 3000' AGL (may be reduced to 1500' AGL with instructor on board).
- Minimum airspeed (unless performing stalls, slow flight, or aerobatics [including spins]): 80 MPH.
- Maneuvering limits (unless parachutes are worn):  $\pm 30^\circ$  Pitch,  $\pm 60^\circ$  Bank (n/a for spins)
- Smooth control application.
- Minimum G:  $\frac{1}{4}$ .
- Maximum G: Aircraft limits (4-G's desired).
  - Note: assume asymmetric maneuvering reduces G-allowable by 20%.
- Not on a Victor Airway, within the confines of an active VR or IR training route or MOA.
- Minimum planned spin entry altitude: 6000' AGL.
- Ground reference maneuvers: Minimum altitude 800' AGL (1000' AGL desired); Maximum bank angle  $60^\circ$ .
- Minimum altitude: 500' AGL (or higher as required by Regulation).
- Monitor appropriate ATC Frequency.
- For Solo/chase Operations: Recover from stalls and/or slow flight at first sign of buffet, or uncommanded yaw regardless of airspeed.
- Prohibited maneuvers: planned snap rolls, tail slides and negative G maneuvering (including inverted spins)

### **Aerobatics**

- IAW Operating Limitations
- Aircraft loaded IAW designer's limitations for aerobatic flight
- 3000' AGL maneuvering floor
- Parachutes will be worn

### **Pattern Operations**

- A cockpit takeoff check will be completed before beginning all takeoff rolls.
- A GUMPS check will be completed prior to all landings.
- Minimum pattern speed: 80 MPH IAS until in a landing configuration on final approach.

- Add 5 MPH to approach speeds for gusty conditions (or ½ reported gust velocity, whichever is less).
- For non-towered airports, minimum over-flight altitude 500' above specified pattern altitude or 1500' AGL, whichever is less.

### **Fuel**

- Minimum fuel required for takeoff at the beginning of any sortie: 2 hours.
- Minimum fuel: 45 Minutes.
- Planning FF and mission time limits based on actual fuel onboard calculated and understood.

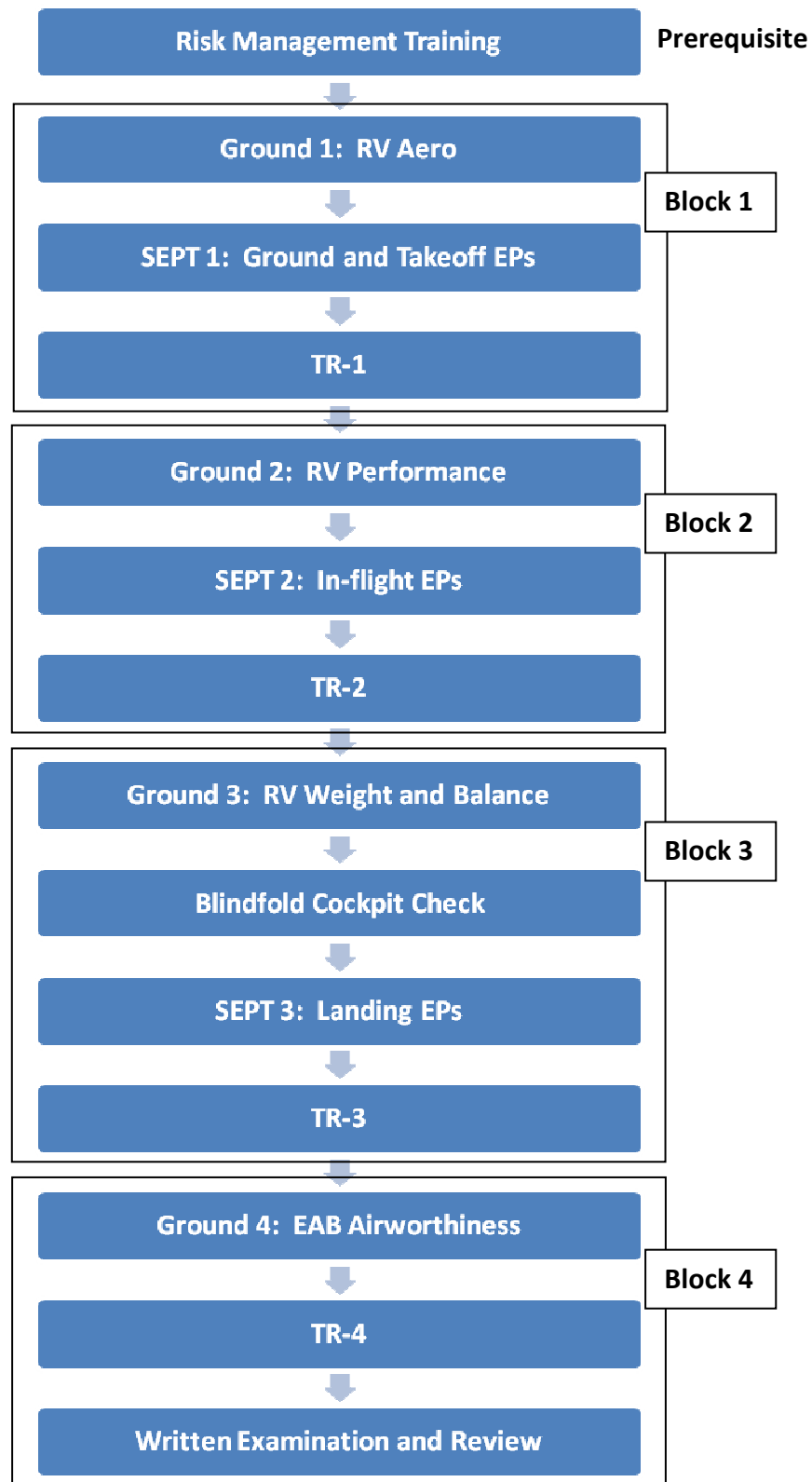
### **Equipment**

- Dual flashlights required for night operations.
- Spare batteries on board for all battery operated equipment.
- For Solo/Chase Operations: Upgrading pilot will carry a cell phone.
- For Solo/Chase Operations: Upgrading pilot will carry a GPS for all non-local (cross-country) operations.
  - Note: For the purposes of this section, outer landing field pattern work does not constitute cross-country operation.

### **Minimum Bail-out Altitude**

- Controlled: NLT 1500' AGL
- Out-of-Control: NLT 2000' AGL

## Syllabus Flow



## **Part 2: Lesson Plans**

## **Operational Risk Management Training**

**Note:** The information in this briefing outline has been adopted from the King Aviation School's "Practical Risk Management" Course and is provided for reference. It is based on discussion contained in Chapter 17 (Aeronautical Decision Making) of the Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25A). Course requirements include formal risk management training if the upgrading pilot has not already completed such training (e.g., military, airlines, etc.). This outline is intended to provide a review for guided discussion, when required. The instructor will review basic risk management principles with the upgrading pilot prior to beginning Block 1 training.

### **Risk 101**

- Risk is insidious
- Unmanaged risk becomes unacceptable
- SURVEILLANCE is the key
  - Look for risk: doesn't jump out at you; but once identified, do something!
- Manage those Risks
  - Usually something simple: get an updated weather brief, service fuel, etc.

### **85% of all mishaps are result of risk management failure**

- Flying training emphasizes physical skill
- We don't really teach risk management
  - We tell stories
  - Establish rules; some are "written in blood"
  - Make up sayings: "3 most useless things in aviation are altitude above you, runway behind you and air in your fuel tanks, etc."
- We learn two ways: from experience or mistakes/situations of others
- Bottom line: we haven't done a good job of teaching risk management as a skill

### **We learn mostly through trial and error**

- We are exposed to risk; if we make it, we evaluate after the fact
  - Not too bad? Risk becomes acceptable BUT IT COULD HAVE JUST BEEN LUCK!
- Bottom line: you get the test first, then the lesson

### **Ugly Facts**

- EXPERIENCE CAN'T PREPARE YOU FOR UNANTICIPATED RISK
- As a rule, pilot's underestimate consequences
  - Risk is vague/indefinite
  - We do a poor job of estimating odds

- Benefits are specific/tangible...e.g., we get there, we land, etc.
- Bottom line: the human animal doesn't do a good job of making decisions when the risks are vague and the benefit is specific

### **We are the enemy**

- Pilot psychology works against us
  - Goal oriented
  - Self-confident
  - Sense of invulnerability
  - Achiever
    - Meets a challenge; effort as required to get the job done; commitment and competence
    - This behavior becomes self-reinforcing! The more successful we are, the more we believe that we really ARE that good. This leads to sense of invulnerability.
- Smart people do dumb things
  - Fact: EVERYONE makes mistakes, even dumb ones
- We get impatient when things don't go as planned
  - Low tolerance for mistakes of others: e.g., ATC, other aircraft in the pattern, etc.
  - You can't control buffoonery, but you CAN CONTROL THE WAY YOU REACT TO IT!
    - Rule #1: It does no good to get angry in the cockpit
- If you're in a hurry, it's probably a good time to slow down
  - Discipline required
    - You need gas as well; it's hard to be patient if the fuel gauge is bumping up against the "E"

### **More Ugly Facts**

- Goal oriented = Risk tolerant
  - Question: Do you HAVE to do this NOW (this hour, today, etc.)?
- Experienced MIGHT = Risk tolerant
  - "I've got 1000 hours of fighter time, I can handle this light plane...even though I've only got three hours of tail wheel time"
- Risk tolerance
  - Distorts risk evaluation
  - Mission accomplishment over risk management
  - Working alone? Much easier to risk your own life; but remember, your family is ALWAYS flying with you!

- WE are the risk, it's how we REACT to external factors that manages risk.
- Experts make as many mistakes as novices; the difference is that experts catch their mistakes.**

### **Risk Mitigation**

- Rules and Regulations help: establish a simple decision matrix
- How do you get help with go / no-go decision?
  - Online resources
  - Fellow pilots
  - Do you have a mentor?
- Basic risk mitigation checklist: PAVE mnemonic
  - Pilot
  - Aircraft
  - enVironment
  - External pressure
- Application: look for risks in each area—if risks pop up in two or more areas, time to think about Plan B...

### **Psychology**

- Easy to critique others, especially ex post facto
  - Reviewing mishaps helps us “learn from the mistakes of others”
  - Key error/omission/malfunction tends to jump out of a review of a mishap chain, yet a competent aviator failed to note this real-time...
- It's difficult to pick out risk factors real-time for ourselves
  - Need to identify risk and manage
  - Minimums for each category
    - Regulations don't cover every contingency—they are designed to be flexible
    - Personal skill sets/readiness varies from day to day
      - On any given day, every pilot has to establish their own personal minimums

### **Pilot: I'M SAFE**

- Illness
  - How “under the weather” are you?
  - Under pressure to not be the weak link?
- Medication
  - If there is a doubt, there is no doubt: consult AME
- Stress

- For some pilots, flying is stress relief; if you can't decouple stress, don't strap in
- Alcohol
  - 8-hour rule vs. reality
- Fatigue/Food
  - Motor/cognitive skills critically affected by fatigue
- Emotion
  - Rule #1: It does no good to get angry in the cockpit

## **Aircraft**

- Basic Airworthiness and servicing
  - Required inspections complied with
  - Non-scheduled maintenance status?
  - Are you "ramp check" proof?
  - EXACT amount of CLEAN fuel on board
  - EXACT amount of oil in the engine sump
  - Preflight inspection
    - "RVism" Wheel and brake condition: what can you see with the wheel pants installed?
    - Unoccupied cockpit/seat: everything secure?
- Minimum equipment
  - "Old Man" disease: tendency to do more with less, i.e., comfortable accepting a less than perfect airplane
    - That's O.K. and a benefit of experience JUST KNOW THAT BY ACCEPTING MINIMUM EQUIPMENT, YOU'VE FLAGGED ANOTHER RISK CATEGORY
  - Situation dependent
    - Day VFR vs. Night IFR
- Configuration: it's experimental man!
  - Has something been changed? Has it been tested?
  - Sanity check: 43-13 compliant?
    - Mentor? A&P familiar with EAB

## **Environment**

- Biggest factor: WEATHER
  - Different than forecast
- Airfield
  - Runway status/condition
  - Cross-wind
  - Approach aids?



- Airspace
  - TFR?
- Terrain
- Off-station (out base) operations
  - Away from the home 'drome! Have you done your homework?

### **External Pressure**

- Always there in the background: affects EVERYTHING we do
- Causes you to ignore other risk factors: clouds your judgment
- Time pressure
  - Pilots are their own worst enemy; good ones know when it's time to slow down and get their faster
  - Build yourself some room: you can usually recover from "too early"
- Peer pressure
- Mission Accomplishment

### **Pre-flight Decision Time**

- Risk factors are cumulative
  - Insidious
  - If you have issues in two or more areas, flex to Plan B or consider an abort
    - PAVE Categories: Pilot; Aircraft; environment; External Pressure
- Bottom line: This is the math part. Use the "accident chain" analogy, changing one or two things will make a critical difference.

### **Real-time Risk Management: How to monitor risk during flight**

- Utilize all available resources
  - FSS
  - ATC
  - Avionics: XM Weather, etc.
    - Warning: Latency of display! Need to be able to know what you're looking at. View out the window ALWAYS trumps the internet version of reality...
  - Unicom
    - FBO? Someone with a radio on the ground?
  - Wingman: anyone airborne that can help?
- Stick to the plan
  - Planning and preparation are KEY
  - Adding mission elements without malice of forethought and planning is a foul!
- KISS (keep it simple, stupid) works

- Always ask: "Is this the simplest way to accomplish this?" If the answer is "no," time for a simpler plan...

### **"Attention Scan"**

- Is the way you pay attention to consequences, alternatives, reality and external pressure throughout the flight. Analogy: just like a solid instrument cross-check.
- Mnemonic: CARE
- Consequences
  - Dynamic: what's about to happen?
  - Pilot
    - Fatigue/stress increase
    - The pilot that lands is not the same pilot that took off!
  - Aircraft
    - Fuel/mechanical state
  - Environment
    - Weather
  - External pressure
    - "Goal oriented behavior intensifies" means the closer the human animal gets to achieving a mission objective, the greater the tendency to press becomes. Warning sign "I'm almost there..."
- Alternatives
  - What if...runway becomes unusable; weather rolls in; airplane breaks, etc?
  - Here's where contingency planning/thinking pays off
  - No rule says you can't change the game plan; new plan should always be simpler than the old plan
  - Number of alternatives decreases as the flight progresses
- Reality
  - Deal with things as they are, not as you planned
    - Are you as flexible as you think?
    - Does your solution pass the KISS test?
    - Are you pushing too hard NOT to bust a rule?
      - E.g., be on the deck before sundown, etc.
  - Getting upset because someone else's mistake is making your life hard?
  - Good time to apply the "FIDO" principle: forget it and drive on...
- External Pressure
  - Mission accomplishment becomes the over-riding goal: "I gotta' get there..."
    - Tom just landed—the cross-wind can't be that bad...
  - Showing off...are you doing this to impress yourself or someone else?

## **Summary**

- If risk factors affect two groups in PAVE model, consider Plan B or abort
  - PAVE = Pilot; Airplane; environment; External Pressure
- Acid test: Would you do this with an examiner (or your family!) on board?
  - Why risk your own butt!
- Make the effort to understand the consequences of the actions you take
- Bottom Line: If there is a doubt, there is no doubt** (i.e., some mitigating action is required!)

# Block 1

## Ground 1: RV-Type Aerodynamics (1.0 Hours)

### -NO TWO AIRPLANES ARE IDENTICAL / Handling Characteristics Vary

- Construction
  - Rigging / Fairings
- Configuration / Weight
  - Example: Wing landing light effect on stall
- Loading
  - Different airplane with passenger and/or baggage aboard

### -Static Margin (Pitch Stability)

- More pronounced effect with tandem versions: Pitch stability trends towards neutral as RCP and baggage load increases
- All RV's: CG moves aft (decreasing margin) as fuel is burned
  - Tandem: Movement proportional to initial load—if RCP is occupied/baggage carried, shift will be GREATER than if solo
  - Review Weight and Balance information, and determine maximum loads to: A) operate within aerobatic envelope; and B) operate within basic envelope.
- Pilot needs to anticipate neutral control response
  - Pilot needs to be ready to move the stick as required to establish desired attitude and AOA; anticipate over-shoot tendency
  - The key is to monitor pitch RATE when maneuvering and move the stick appropriately
    - Tandem: Can be critical during landing

### -DO NOT EXCEED AFT LIMIT

- Airplane does not become suddenly uncontrollable, however designer's limits ARE NOT CONSERVATIVE—i.e., no margin
- Aerobatics: critical to ensure adequate spin recovery characteristics
  - Aerobatics with passengers? Problematic for most airplanes due to weight restrictions (as well as CG)
- Stick Force Lightening: Gradient linear for a given TAS / CG combination, but:
  - Stick length may be adjusted by builder
  - Stability / margin affected by ATTITUDE
    - Nose-up, low airspeed, high power ( $V_X$  climb) = reduced margin
    - Acrobatics: longitudinal axis nearly vertical = reduced margin
  - Handling improves as speed decreases
    - Heavy stick with forward CG / high speed

- Biggest impact on stick force gradient: CG location
  - Larger variability in Tandem versions
- Maximum Allowable Gross Weight
  - Operation Limitations/Builder specifications vs. designer's limits

#### **-Yaw**

- Positive stability throughout the envelope
  - Excursions (fish tailing) likely in turbulence
- Rudder NOT effective for singular roll control (lift vector placement)
  - Limited dihedral effect to generate roll
- Sufficient volume to be effective post-stall
- Slips: full deflection slips with or without flaps practical
  - No appreciable effect on IAS (wing mounted pitot)
- Effect of gear fairings
  - Destabilizing when installed

#### **-Roll**

- Neutral stability throughout the envelope
- Aileron primary means of controlling roll / lift vector

#### **-Overall Control Harmony: very light ailerons, light rudder, heavier elevator**

#### **-Stalls: straight wing, Frise-type ailerons, no wash-in or wash-out, no stall strips (most airplanes)**

- Power-off: non-event (60 MPH IAS)
  - Notable torque effect at all power settings (including idle)
  - Use rudder to keep the ball centered
  - May have to sacrifice desired attitude or heading control
    - If aileron is used to counter torque at idle, sufficient cross-control will exist at stall to cause a (left) wing drop
  - Nose may or may not drop if full aft stick is held
    - Distinct buffet
    - CG Dependant (More pronounced in Tandem): with forward CG, airplane "nods" and remains controllable post stall; with aft CG airplane remains in stalled condition and may depart (spin) with little warning (will recover quickly, ¼ to ½ turn with neutral controls [ease] with neutral rudder)
  - Aircraft will tend to depart in yaw if deep stall is held
    - First indication of breakdown in directional stability: nose slice
    - Rudder effective to counter slice; heading control not practical
    - More distinct drop with flaps (55 MPH IAS): left roll tendency

- Less buffet than clean stall/Limited aerodynamic warning
- Accelerated: Any attitude/any airspeed
  - AERODYNAMIC WARNING PROPORTIONAL TO G-LOAD
    - Minimal buffet at low G
    - 2.1 G stall @  $\approx 80$  MPH IAS (Pattern speed);  $60^\circ$  bank?
      - 3G @  $\approx 95$
      - 4G @  $\approx 110$
      - 5G @  $\approx 123$
      - 6G @  $\approx 135$  (nominal  $V_A$ )
  - Power on? Same except much higher pitch attitude with lift vector perpendicular to the horizon; more pronounced torque effects
  - AOA or Stall Warning System?

### **-Trim**

- Pitch: Plan design FCP lever--sensitivity proportional to airspeed
  - Cruise: Careful! "Squeeze" the "ball"
  - Good redundant pitch authority at approach/landing speeds
    - Back-up elevator control system?
  - (Tandem) Position of counterweight tip trimmed for landing
    - Solo: Well down
    - Pax/load: closer to neutral
- Roll: No brainer—deflect lever in desired direction of roll to bias stick
  - 6-8 gallon delta before it becomes a factor
- Yaw
  - Fixed tab optimized for 55-75% cruise
    - Only time you're feet on the floor
  - All other conditions: "Step on the ball"
    - Left Rudder most conditions (high speed, low-speed power-off)
    - Right Rudder power-on, high AOA/low speed

### **-"Short" Gear and "Long" Gear**

- Not in full stall condition when three-point
  - Design trade-off for more effective elevator/pitch harmony
  - Airplane must be flown on to the ground
- Great visibility!
- "Tall" gear is an improvement; but still not "FAR 23 full-stall standard"
- Geometry of either type sufficient (generally) for prop clearance during wheel landing, but gear spring characteristics require smooth touchdown technique (tail-low wheel landings offer compromise).

-Three point? OK if tail wheel hits first

### **-Design speed range**

- $V_S$  to  $V_{NE} \approx 4:1$  ratio

-What all this aerodynamic efficiency really means: ANY TIME THE VELOCITY VECTOR IS BELOW THE HORIZON SMOOTH AIRSPEED/G CONTROL IS CRITICAL

-ROT: Nose down = throttle back

-Need to check airspeed before pull-through when inverted

-G-onset is critical for keeping speed under control

-E.g., back side of a loop/split S; unusual attitude or dive recovery

-Also means you've generally got plenty of power available

-Takeoff/Go-around throttle control: torque/P-Factor and yaw...bottom line: smooth, deliberate throttle control required

### **-Loss of Control**

-“Unload for Control” Concept: AOA recovery (stall)

-Establish  $\frac{1}{4}$  to  $\frac{1}{2}$  G condition

-Engine (oil) limitations / fuel starvation (carb)

-Carb float is poor man's aural G-meter!

-Does an inverted oil system work at zero G?

- Stall speed dramatically reduced (zero G = zero  $V_S$ )

-Airplane is ballistic

-Unloaded; airspeed increasing

-Velocity vector on/below horizon

-Roll to recover

-ROT: Degrees nose up (start) = degrees nose low (finish)

-Fuel odor in the cockpit?

-Power: As required

-Idle to reduce yaw effect

-Carbureted engine? Don't be surprised if it quits

-Prop likely to stop if it's light weight (wood)

-Be ready for air-start post recovery

-Starter vs. dive to windmill

### **-Unintentional Spins**

-Airplane resistant to spins unless pro-spin controls are input/held

- Spin resistance proportional to CG location...airplanes more spin prone, less warning with AFT CG (Tandem)
- Neutralizing the controls will always help
  - Auto recovery in ½ turn likely if controls released immediately
- Inertial coupling will occur if you apply anti-yaw rudder with simultaneous forward stick (auto roll).
  - Think of “stick forward” as “ease” or “release back pressure”
- Low Altitude
  - Unintentional spins that occur in the traffic pattern are non-recoverable
    - AOA/Airspeed awareness is critical in the pattern
    - Observe min airspeed / Max AOA limits
    - A 2-G accelerated stall occurs at approximately 80 MPH IAS
    - Skidding turns higher risk than slipping turns
  - Below 2000’ AGL, uncontrolled bailout is not practical.
  - No man’s land: Anti-spin controls NLT 1500’ AGL with PERFECT dive recovery technique: you MIGHT make it; but you are below minimum out-of-control bail-out altitude

**-BOLDFACE**

**-POWER IDLE**

**-CONTROLS NEUTRAL**

- Recovery within 1 to 1 ½ turns no other action

**-RUDDER OPPOSITE YAW**

- Cruciform stick motion
- Tandem/forward CG: Inertial coupling possible
  - Auto roll tendency if rudder deflected
  - Nose tuck past vertical if spin is result of “normal” attitude stall
- If rotation increases, use “other” opposite rudder

**-Altimeter/bail-out cross-check? Must be OUT of the plane NLT 2000AGL for out-of-control**

***-Intentional Spin Characteristics***

- Designer’s viewpoint: not a recreational maneuver
- Pro spin controls must be maintained throughout incipient phase (≈ 2 turns)
  - Expect nose tuck past vertical
- Nose low, high rotation rate: 180-270 deg/sec
  - Full aft stick SLOWS rotation rate



- If stick is allowed to float, expect outside aileron to float up; drive stick off center (opposite spin direction)
- Maintain pro-spin controls until it's time to recover!
- Zero IAS, VVI pegged, 1 G, ball opposite spin (EFIS indications?)
  - 300-500 ft/turn, 2 sec/turn
    - 3000 AGL 6 turns and 12 seconds from impact
    - 1500 AGL 3 turns and 6 seconds from impact
- Recovery requires 1.5 turns and 1000' of altitude
  - Initiate recovery NLT Floor + 1000'
  - More than 7 turns can disorient
- Gee Whiz
  - Power on spins = higher nose attitude / slower rotation rate
  - 10 turn spin + recovery requires  $\approx$  3500' of altitude

#### **-Engine-out Glide Performance: Excellent**

- Max Range glide speed faster than max endurance
  - E<sub>M</sub>: absolute max performance vs. maneuverability...use the "flat" climb curve, i.e., give yourself room for error
- ROT @ 105 IAS:
  - Alt x 2 – 1 NM = no wind estimate (6K' and below)
  - Alt x 2 – 2 NM = no wind estimate (6K' and above)
  - 500 FPM rate of descent
  - 3.5 G's available, 45-60° banked turns practical
  - Tab data in Emergency Checklist?
- VNAV Mode (Garmin)
  - MENU>MENU>SETUP>VNAV
- Nominal 500 feet per 180° of turn
  - 30-40° banks at 105
  - Standard rate turn at 80-85

#### **-Numbers to know by heart**

- > 20° Flaps: 100 MPH IAS
  - Self-limiting if manual!
- Maneuvering Speed:  $\approx$ 135 MPH IAS
- Max L/D: Ballpark V<sub>Y</sub> (Tab Data)
- Max Endurance Glide: Ballpark V<sub>X</sub> (Tab Data)
- Max Cruise except smooth air: 180 MPH IAS
- Rough air? V<sub>A</sub> (135): Slow down to reduce vertical gust effect

- Never exceed: 210 MPH IAS
  - Really a function of EAS (de facto TAS); could get there in cruise descent; safety margin reduced as altitude increases; any buzz—slow down.
  - Need to power back and smoothly transition velocity vector above the horizon. Reduce IAS, resume descent at reduced speed.

## **TR-1: Transition Flight 1 (1.25 Hours + 1.0 Hours Brief + .5 Hours Debrief)**

### **Prerequisites**

1. Risk Management Training
2. Ground 1
3. SEPT 1

### **Briefing**

- Limitations
- Weight and Balance
- Takeoff and Landing Data Computations (TOLD): Safety Factors
- Airworthiness Determination
- Crew Coordination: Emergencies

### **Ground Operations**

- Basic Servicing (May be deferred to post-flight):
  - Fuel
  - Oil
  - Air (Tires)
  - Brake Fluid
- Pre-flight Inspection
  - Use of Checklist: Flow
- Cockpit Management
  - Securing Baggage
  - Securing the unoccupied cockpit for solo operations
  - Strap In / Ergonomics: Use of Cushions; rudder pedal adjustment; design eye height
  - Cockpit Control Familiarization
  - Canopy Operation
  - Emergency Egress: Ground/Bail Out
- Engine Start
  - Use of Checklist
  - Normal Start
  - Hot Start
  - Flooded Start
  - Leaning Mixture for Ground Operation
- Taxi
  - Brake check
  - Tail / Nose Wheel Steering

- Prop Blast and Power Control
- Proper position of Flight Controls
- S-Turns
- Run-up
  - Use of Checklist
  - Positioning Aircraft: Hazards/Cooling
  - Confirming Canopy Security
  - Trim and Flap Setting

### **Takeoff and Departure**

- Normal/Cross-Wind Takeoff
  - Line-up Check
  - Directional Control:
    - Power Application/Torque/P-Factor
    - Raising the Tail/Rotation
  - Engine Power/Pressure Checks During Roll
  - Rotation/Lift Off
- Climb
  - Acceleration: Flap Retraction
  - V<sub>Y</sub> / Cruise Climb
  - Power Adjustment / Temperature Monitoring
- Level-Off
  - Use of Trim
  - Engine Management

### **Fundamentals**

- Straight and Level Flight
  - Visual References
- Pitch Stability Exercise
- Yaw Stability Exercise
- Roll Stability Exercise
- Acceleration/Deceleration
  - Use of Rudder
  - Trim Adjustment
- Standard Rate Turns
  - VR/IR
  - Timed Turn Review
- 30° Banked Turns

- Roll-out Lead Point / Heading Control
- Altitude Control
- Cruise Altitude Climb/Descent Adjustment
  - 1 Inch MAP Per 1000 foot
- Descents
  - Low Speed
  - High Speed: Acceleration Demonstration
  - Computing Descent Point(s) / VVI Required

### **Confidence Maneuvers**

- Steep Turns: 45 and 60° Bank
  - Constant Power (Airspeed Bleed)
  - Constant Airspeed (MIL Power)
    - Roll-out Lead Point / Heading Control
    - Altitude Control
- Slow Flight
  - No-Flap ( $V_{S1} + 5$ )
  - Full-flap ( $V_{S0} + 5$ )
    - Torque Induced Yaw (Go-around) Exercise
- Power-Off Stall
  - AOA Recovery
  - Cross-control (Torque) Demonstration
  - Deep Stall Exercise
- Power-On Stall
  - AOA Recovery
- Lazy- 8

### **Unusual Attitudes (Visual Reference)**

- Nose High; Airspeed Decreasing
- Nose Low; Airspeed Increasing

### **Ground Reference Maneuvers**

- Turns Around a Point

### **Descent/RTB**

- Use of Checklist
- Computing Descent Point / VVI Required

-Engine / Airspeed Management

### **Pattern**

-Pattern Entry

-GUMPS Check

-Perch Management

-Final Turn

-Stabilized Final

-Slip

-Low-Approach and Go-Around

-Closed Pattern

-Runway Drag Exercise

-Full-Stop Landings (TW: 3 point; wheel; tail-low)

- Normal

- Touchdown

- Roll-out Directional Control

- Brake Use

### **After Landing**

-Use of Checklist

-Parking and Securing

- Tie Down

- Control Locks and Covers

- Servicing

## **SEPT 1: Ground and Takeoff Emergency Procedures (1.0 Hours)**

### **EP Basics**

- Maintain aircraft control, analyze the situation, take appropriate action.
- Safer to flying into the ground (crash under control) than to lose control under low energy conditions close to the ground.
- The time to determine when bailing out is appropriate is ON THE GROUND. Minimum bail-out altitudes must be established and adhered to. Based on typical parachute performance, the minimum controlled bailout altitude is 1500 feet AGL, and minimum out-of-control bailout altitude is 2000 feet AGL. These are NO LATER THAN altitudes, occupants must be egressing the airplane by this point. Parachute opening must occur by 1000 feet AGL. Bailout below 1500 feet is not recommended.
- When operating on the ground and during takeoff and landing, the pilot must maintain positive directional control at all times and make allowance for prevailing wind conditions.

### **Ground Emergencies**

- Emergency Ground Egress
- Induction Fire During Start
- No Oil Pressure After Start
- Flooded Engine During Start
- Brake Malfunction
- Fire During Ground Operations
- Loss of Directional Control

### **Takeoff Emergencies**

- Loss of Directional Control
- Abort
- Engine Failure During or Immediately After Takeoff
  - During Takeoff Roll
  - Immediately After Lift-off
  - Below 1500 Feet AGL

## Block 2

### Ground Lesson 2: RV-Type Performance (1.0 Hours)

#### **-NO TWO AIRPLANES ARE IDENTICAL / Performance Varies**

- Engine / Prop / Weight / Empty CG
  - “Light Nose” = O-320 + light-weight prop
  - “Heavy Nose” = O-360 (or more) + constant speed prop
- Primary difference in take-off and landing performance
  - Climb to lesser degree
  - Cruise is cruise, regardless
  - No difference on top end with cruise / constant speed prop
  - Glide: Depends on propeller type/pitch (ROT: 10:1 or better)

#### **-Different airplane with passenger / cargo / density altitude $\Delta$**

#### **-Quality of flight test and data varies**

- Good takeoff and landing data is difficult to measure without proper equipment and test procedures
- Outstanding general performance CAN FOSTER COMPLACENCY

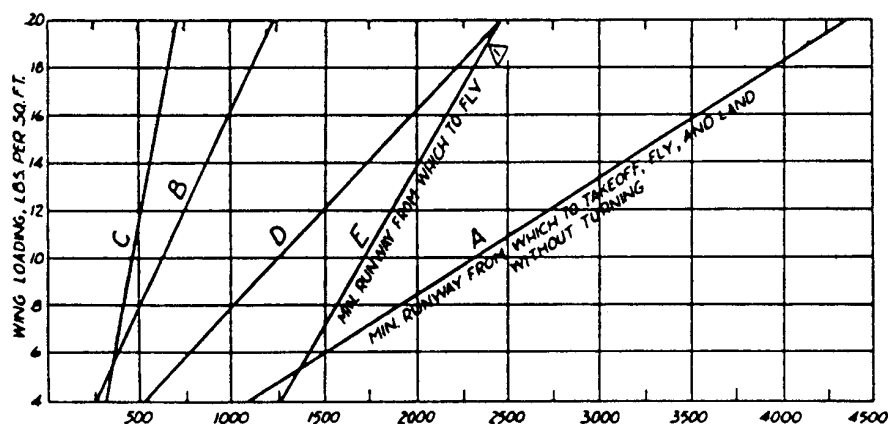
#### **-Example: Van’s Numbers (160 HP RV-4)**

- Prototype / standard conditions / fixed-pitch, wood prop / measured
  - Solo weight data: 1160
    - Real world 965 lb empty weight + 170 lb pilot: 1327 lbs takeoff weight with full fuel
  - RV-4 max allowable gross weight: 1500
- Gross Weight Takeoff
  - Van’s Ground roll distance: 450 feet (measured)
  - AC90-89A estimate: 850 feet (estimate based on wing loading)
    - Minimum Recommended runway: 2000 feet (1:20 climb to 50’)
  - Accelerate/Stop: 1750 feet
  - Take-off/Fly 5 Sec/Land/Stop: 3100 feet
  - “Koch Chart” non-standard density ratio
    - Florida example: Pressure Altitude 300’ MSL / 90°F
      - 30% increase in takeoff distance:
        - Van’s  $\approx$  585 foot ground run
        - AC90-89A  $\approx$  1105 foot ground run
    - Your airplane? Somewhere in that range



-Throttle technique?

-Flap setting?



- A - Distance to takeoff at minimum smooth lift-off speed, fly for 5 seconds at that speed without climbing, land and stop straight ahead.*
- B - Distance to reach minimum smooth lift-off speed.*
- C - Distance covered in 5 seconds of flight at minimum smooth lift-off speed.*
- D - Distance to stop from minimum smooth lift-off speed (includes air and ground distance).*
- E - Distance to takeoff at slow approach speed and climb thereafter at an angle of 1 in 20 to 50 ft. altitude —this distance will allow most airplanes to accelerate to normal climb speed before crossing end of runway.*

**Figure 2-1: AC90-89A Minimum Recommended Runway Length Chart**

-Climb:

- $V_x$  largely a function of weight: decreases with weight (ball park 80-85 MPH)

- $V_y$  largely a function of altitude: decreases with altitude (ball park 100-120 MPH)

-“Flat” RV climb curve data = fairly consistent performance across a large speed band...LIMFAC on bottom end may be CHT

-Cruise Prop (fixed pitch) ROT at 105-120 IAS (nominal  $V_y$ ):

-Solo / Standard Winter: 1800-2000 FPM

-Solo / Summer: 1200-1500 FPM

-Gross / Standard: 1500-1700 FPM

-Gross / Summer: 1000-1200 FPM

-**Bottom line: Airspeed as required to keep hot cylinder at 400°F or less and oil temperature within limits**

-Constant speed prop: positive effect on takeoff and climb performance

## -Cruise

- Is what it is! Only way to know for sure is to collect data
  - Key: being able to establish a known power setting
    - Tach/MAP required
  - Review charts
    - Manufacturer's Charts/Curves (Operator's Handbook)
    - Airplane charts (if available)
  - No appreciable performance advantage for a constant speed prop over a properly pitched fixed propeller
- Pick a power setting (55-65% sweet spot)
  - Stock O-320 ROT: 7-8 GPH (properly leaned) at altitude (6-10K MSL)
    - LOP if you can get there (GAMI injectors / engine monitor)
  - Stock O-360 ROT: 8-10 GPH (properly leaned at altitude (6-10K MSL)
  - Lycoming recommendation: 65% or less for max engine life
- Fuel flow vs. actual ground speed is all that matters
  - No wind planning numbers?
    - RV-4 Example: 150KIAS / 172MPH
    - 3+30 with 30 minute reserve (450 NM range)
- TAS ROT: add 4 (or 2%) knots / 1000' to IAS
- Power Setting ROT:  $MP + RPM/100 = \% \text{ Power}$ 
  - 45 = 65%** ( $\pm 3$  for each 10% up or down)
    - Example: 22.5" MP + 22(50) RPM = 45 (65% power)
- Can also pull MP/RPM combination off of Lycoming graphic data
  - Right algorithm can turn that into tab data for your airplane
- Cruise Climb/Descent: Airplane is extremely efficient...make 1" MAP per 1000' power adjustments for 300-500 FPM ROC or descent for changing cruise altitude
  - Mixture ROT: If in doubt when adding power, increase mixture
  - Always run full rich/smooth engine when at 75% or higher

## -Descent

- Glide performance: nominal 10:1 ratio or greater
  - Descents take planning
    - Adjust pitch, set airspeed (trim) THEN adjust MP
      - Smooth air ground speed: 3 NM/Min (180 knots)
        - $-3^\circ = 3 \text{ NM per } 1K' \text{ to lose; "DME X } 3"$
      - Rough air ground speed: 2 - 2.5 NM/Min (120-150 knots)
      - Richen mixture as descent progresses; don't be in a rush
    - Instrument Approach:  $GS \times 5 = VVI$  for  $3^\circ$  approach path

- VDP @ HAT/300 in miles from TDZ
- VDP by timing: 10% HAT subtracted from FAF to MAP timing
- 90 Knots, Flaps UP works well
- Visual Stabilized Final: 300' AGL 3K' from TDZ; 6°
- Sufficient energy to reach TDZ power off

#### -Landing

- Normal landing distance  $\approx$  95% of takeoff distance
- Short field landing = back side of the power curve
  - EXPECT float if flying standard 75-80 IAS (1.4  $V_S$ ) power-off approach to three-point
  - Flaps UP to transition weight to the gear
  - Constant speed prop? Whole different animal
- Bottom Line: 2000 foot minimum runway until you're proficient**
  - Proficient? Operating off a short runway still carries increased risk factor...

## **TR-2: Transition Flight 2 (1.25 Hours + 1.0 Hours Brief + .5 Hours Debrief)**

### **Prerequisites**

1. Block 1
2. Ground 2
3. SEPT 2

### **Briefing**

- Limitations
- Weight and Balance
- Takeoff and Landing Data Computations (TOLD): Safety Factors
- Airworthiness Determination
- Crew Coordination: Emergencies

### **Ground Operations**

- Review Basic Servicing (May be deferred to post-flight):
  - Fuel
  - Oil
  - Air (Tires)
  - Brake Fluid
- Pre-flight Inspection
  - Flow
- Cockpit Management
  - Canopy Operation
  - Emergency Egress: Ground/Bail Out
- Engine Start
  - Use of Checklist
  - Normal Start
  - Hot Start
  - Flooded Start
  - Leaning Mixture for Ground Operation
- Taxi
  - Brake check
  - Tail / Nose Wheel Steering
  - Prop Blast and Power Control
  - Proper position of Flight Controls
  - S-Turns
- Run-up

- Use of Checklist
- Positioning Aircraft: Hazards/Cooling
- Confirming Canopy Security
- Trim and Flap Setting

### **Takeoff and Departure**

- Maximum Performance Takeoff ( $V_X$ )
  - Line-up Check
  - Directional Control:
    - Power Application/Torque/P-Factor
    - Raising the Tail/Rotation
  - Engine Power/Pressure Checks During Roll
  - Rotation/Lift Off
- Climb
  - Acceleration: Flap Retraction
  - $V_X$  / High Power Climb
    - Pitch Stability Exercise
  - Engine Monitoring
- Level-Off
  - Use of Trim
  - Engine Management

### **Fundamentals**

- Straight and Level Flight
  - Visual References
- Pitch Stability Exercise
- Yaw Stability Exercise
- Roll Stability Exercise
- Acceleration/Deceleration
  - Use of Rudder
  - Trim Adjustment
- 30° Banked Turns
  - Roll-out Lead Point / Heading Control
  - Altitude Control

### **Confidence Maneuvers**

- Steep Turns: 45 and 60° Bank
  - Constant Power (Airspeed Bleed)

- Constant Airspeed (MIL Power)
  - Roll-out Lead Point / Heading Control
  - Altitude Control
- Slow Flight
  - No-Flap ( $V_{S1} + 5$ )
  - Full-flap ( $V_{S0} + 5$ )
    - Torque Induced Yaw (Go-around) Exercise
- Power-Off Stall
  - Unusual attitude + AOA Recovery
- Power-On Stall
  - Unusual attitude + AOA Recovery
- Lazy- 8
- Incipient Spin
- Go-around Exercise: Power-up/ $V_{MC}$  Yaw Drill

### **Aerobatics**

- G Warm-up
- Basic Roll
- Loop
- Cloverleaf

### **Unusual Attitudes (Visual Reference)**

- Nose High; Airspeed Decreasing
- Nose Low; Airspeed Increasing

### **Ground Reference Maneuvers**

- S-Turns Across a Road

### **Descent/RTB**

- Use of Checklist
- Computing Descent Point / VVI Required
- Engine / Airspeed Management

### **Emergency Landing Pattern**

- High Key
- Low Key
- Final Turn

- Final
- TDZ Management

### **Pattern**

- Pattern Entry
- GUMPS Check
- Perch Management
- Final Turn
- Stabilized Final
- Slip
- Low-Approach and Go-Around
- Closed Pattern
- Runway Drag Exercise
- Full-Stop Landings (TW: 3 point; wheel; tail-low)
  - Normal
  - Touchdown
  - Roll-out Directional Control
  - Brake Use

### **After Landing**

- Use of Checklist
- Parking and Securing
  - Tie Down
  - Control Locks and Covers
  - Servicing

## **SEPT 2: In-Flight Emergency Procedures (1.0 Hours)**

### **In-flight Emergencies**

- Electrical Malfunction
  - Low Amperage
  - High Amperage
- Electrical Fire
  - VMC Fire Extinguished
  - IMC / Night Fire Extinguished
- Oil System Malfunction
- Engine Malfunction
  - Engine Failure / Loss of Power
  - Engine Fire
- Pitot / Static Malfunction
- Induction Icing
- Controllability Check
- Canopy Loss During Flight
- Cockpit Ventilation / Heat Malfunction
- Fuel Leak
- Fuel Transfer Malfunction
- EFIS Malfunction
- Flight Control Malfunction
- Trim Malfunction
- Flap Malfunction
- Glide Performance
  - Altitude Lost in Gliding Turn
  - Glide Chart
- Out-of-Control
  - Spins
- Bail-out
- Passenger Incapacitation
- Emergency Descent



## Block 3

### Ground Lesson 3: RV-Type Weight and Balance (1.0 Hours)

#### -RV-Types are load sensitive

- Need to observe design limits
- Stability and handling characteristics vary with load

#### -Different airplane with pax and baggage

- Bottom line: you need to know gross weight and where CG is & understand what that means for handling and performance

#### -Definitions

- Empty weight: Does it include oil (likely)? Unusable fuel (unlikely)?
- Gross weight = empty + pilot/pax/baggage + gas
  - High weight = decreased performance; increased stall speed; reduced G-available
  - Maximum gross: designated by builder / specified in operating limitations
  - Van's Numbers Table 2-1

Table 2-1: RV-Type Basic Weight and Balance Design Limits					
Type	Maximum Allowable Gross Weight	Maximum Aerobatic Gross Weight	Forward CG Limit	Aerobatic CG Limit	Aft CG Limit
RV-4	1500 LBS	1375 LBS	68.7	75.9	77.4
RV-6	1600 LBS	1375 LBS	68.7	75.3	76.8
RV-6A	1650 LBS	1375 LBS	68.7	75.3	76.8
RV-7	1800 LBS	1600 LBS	78.7	84.5	86.82
RV-7A	1800 LBS	1600 LBS	78.7	84.5	86.82
RV-8	1800 LBS	1600 LBS*	78.7	85.3	86.82
RV-8A	1800 LBS	1600 LBS*	78.7	85.3	86.82
*1550 LBS if not equipped with the -1 wing. All CG limits inches aft of Datum. Datum for RV-4/6(A) is 60" ahead of the leading edge of the wing, and 70" ahead of the LE for RV-7(A)/8(A).					

- Aerobatic gross: max weight that 6 G's is available
- Aerobatics with passengers? It depends...likely not so much

#### -Useful Load: It Depends!

- Huge variation in airplane empty weights
- Designer's empty weight vs. reality: You must have specific data for your plane
  - 100 lbs (+) "overweight" is not uncommon

- How old/reliable is the data?
- Not the builder?
- How good is your data? Did YOU weight it?
- Warning sign: Both main gear weights identical

Table 2-2: RV-Type Useful Load with Full Fuel					
Type	Fuel Capacity (Gallons)	Fuel Weight	Nominal Empty Weight*	Aerobatic Useful Load Full Fuel	Maximum Gross Useful Load Full Fuel
RV-4	32	192	915	268 lbs	493 lbs
RV-6	38	228	965	182 lbs	407 lbs
RV-6A			1015	132 lbs	407 lbs
RV-7	42	252	1061	287 lbs	487 lbs
RV-7A			1114	234 lbs	434 lbs
RV-8			1067	281 lbs	481 lbs
RV-8A			1120	228 lbs	428 lbs
Nominal empty weight based on Van’s data. Actual empty weight varies considerably. RV-8/A aerobatic gross weight limit reduced to 1550 lbs if -1 wing not fitted; numbers in this Table reflect -1 wing limits.					

#### **-CG range: front and back limit of CG measured in inches or percent of MAC**

- Basic limits vs. aerobatic aft limit (RV-4 example, 58" chord, datum 60" forward of wing leading edge [all moments positive]):
  - Forward limit is always 68.7" aft of datum (15% chord point)
  - Aft limit for normal flight 77.4" aft of datum (30% chord point)
  - Aerobatic aft limit 75.9" aft of datum (27.5% chord point)

#### **-Stability Considerations**

- Forward CG
  - Heavy stick
    - lbs/G
    - More aft stick for landing
  - Improved stall/spin resistance & recovery
    - Higher stall speed
  - Higher trim drag (reduced top speed)
  - Increased pitch stability
  - Overall: more stable and safe; less fun to fly
- Aft CG
  - Lighter stick
    - Less stick for landing
    - PIO?

- Less pitch stability
- Lower trim drag
- Decreased departure susceptibility
  - Stall/Spin recovery slower; requires more positive control input
- Aerobatic limit is there for a reason: assume no margin
- Preserves reasonable stall/spin recovery characteristics / increased likelihood of unintentional stalls (handling error)
- No intentional spins with CG aft of aerobatic limit
- Overall: less stable; more fun to fly
  - Van: CG's in aft half of range optimize handling harmony
    - Sweet spot: RV-4 example 72.3 to 75.9"
- Exceeding aft limit is dangerous
  - Control reversal possible

### **-CG Shift During Flight**

- CG moves aft as fuel is burned
  - “Most aft” at landing weight / BINGO / flame-out
- May be possible to be in limits for takeoff and out of limits for landing
  - Heavy passenger + baggage = worst-case

### **Math**

- Weight X Arm = Moment
- “Arm” is distance from “datum”
  - Example: RV-4 datum 60” ahead of wing leading edge
- “Ground truth” data in airframe log
  - Need sufficient data aboard to compute condition
    - Must be dated
  - Did you build or buy?
    - New-to-you RV-type should be re-weighed
    - Leveling datum? Van’s Builder’s Manual...

### **-Arms**

- Pilot
- Pax (tandem)
- Fuel: CG moves aft as fuel is burned
- Baggage area(s)
- Daily computations:
  - Most forward / most aft (worst-case comparison)
  - Tabular data for your airplane?
  - Garmin X96 weight and balance page?
    - Program with data for your airplane

-Easy way to calculate CG every time you fly

**-Compartment structural design limits**

-Cockpits: RV-4 example, 240 lbs each

-Baggage compartment: RV-4 example, 100 lbs

-Still need to compute actual weight/balance

### **Blindfold Cockpit Check (.25 Hours)**

-Upon completion of TR-2 and prior to TR-3, the instructor will conduct a blindfold cockpit check. The upgrading pilot will be required to locate all cockpit controls, switches and critical circuit breakers by feel.

## **TR-3: Transition Flight 3 (1.25 Hours + .75 Hours Brief + .5 Hours Debrief)**

### **Prerequisites**

1. Block 2
2. Ground 3
3. SEPT-3

### **Briefing**

- Limitations
- Weight and Balance
- Takeoff and Landing Data Computations (TOLD): Safety Factors
- Crew Coordination: Emergencies

### **Ground Operations**

- Pre-flight Inspection
  - Flow
- Cockpit Management
  - Emergency Egress: Ground/Bail Out
- Engine Start
  - Use of Checklist
  - Leaning Mixture for Ground Operation
- Taxi
  - Brake check
  - Tail / Nose Wheel Steering
- Run-up
  - Use of Checklist
  - Positioning Aircraft: Hazards/Cooling
  - Confirming Canopy Security
  - Trim and Flap Setting

### **Takeoff and Departure**

- Maximum Performance Takeoff ( $V_X$ )
  - Line-up Check
  - Directional Control:
    - Power Application/Torque/P-Factor
    - Raising the Tail/Rotation
  - Engine Power/Pressure Checks During Roll

- Rotation/Lift Off
- Climb
  - Acceleration: Flap Retraction
  - $V_X$  / High Power Climb
  - Engine Monitoring
- Level-Off
  - Use of Trim
  - Engine Management

### **Confidence Maneuvers**

- Steep Turns: 45 and 60° Bank
  - Constant Power (Airspeed Bleed)
  - Constant Airspeed (MIL Power)
    - Roll-out Lead Point / Heading Control
    - Altitude Control
- Slow Flight
  - No-Flap ( $V_{S1} + 5$ )
  - Full-flap ( $V_{S0} + 5$ )
    - Torque Induced Yaw (Go-around) Exercise
- Power-Off Stall
  - Unusual attitude + AOA Recovery
- Power-On Stall
  - Unusual attitude + AOA Recovery
- Lazy- 8
- Incipient Spin
- Chandelle

### **Aerobatics**

- G Warm-up
- Loop
- Barrel Roll
- Immelman

### **Unusual Attitudes (Visual Reference)**

- Nose High; Airspeed Decreasing
- Nose Low; Airspeed Increasing

### **Descent/RTB**

- Use of Checklist
- Computing Descent Point / VVI Required
- Engine / Airspeed Management

### **Emergency Landing Pattern**

- High Key
- Low Key
- Final Turn
- Final
- TDZ Management

### **Pattern**

- Pattern Entry
- GUMPS Check
- Perch Management
- Final Turn
- Stabilized Final
- Slip
- Low-Approach and Go-Around
- Closed Pattern
- Full-Stop Landings (TW: 3 point; wheel; tail-low)
  - Normal/Short/soft field
  - Touchdown
  - Roll-out Directional Control
  - Brake Use

### **After Landing**

- Use of Checklist
- Parking and Securing



### **SEPT 3: Landing Emergency Procedures (1.0 Hours)**

#### **Landing Emergencies**

- Landing With Known Flat tire
- Emergency Landing Pattern
  - High Key
  - Low Key
  - Final turn
  - Touchdown
- Airspeed Indicator Failure
- Ditching

## Block 4

### Ground Lesson 4: EAB Airworthiness Determination (1.0 Hours)

**-Big Picture: Pilot determines airworthiness / Owner responsible for maintenance**

**-Pilot “airworthiness”**

- Certificate on person
- ORIGINAL, valid medical on person
  - Can’t be a copy (ramp check)
- Currency
  - Logs: Not required to be carried in the aircraft
  - Check ride / Competency check / biennial flight review
    - Check-ride in lieu of
    - Tail wheel endorsement
  - Required day / night recency of experience
    - Tail wheel takeoffs and landings must be to a full-stop
  - May be required to submit documentation ex post facto if ramp checked

**-Paperwork**

- A** Special Airworthiness Certificate (Pink)
    - Available and DISPLAYED IN COCKPIT
      - N-number must match data plate / markings
      - Only valid when OPERATING LIMITATIONS are aboard
  - R** Registration Certificate
    - Temporary? Pink, 120 day limitation
    - Expiration date?
  - R** Radio Station License
    - Only required for flight outside of CONUS
      - Canada/Bahamas/Mexico/Etc.
      - FCC Form 605 / Schedule C to Apply
    - If station license required, then restricted radio telephone operator’s permit is required
  - O** Operating Limitations
    - Part of airworthiness certificate for experimental aircraft
    - Letter issued by FSDO to original builder
  - W** Weight and Balance Data
    - Must be **DATED and CURRENT**
      - Can be a photo copy of airframe log
- Compass correction card?

- Most recent VOR check?
- Altimeter / pitot static check (24 months)?
- Transponder check (24 months)?
- ELT batteries (ramp check item)
  - “D” cells in ELT: Batteries must have expiration date stamped
  - Additional battery in instrument panel remote actuator switch
  - Decel (G) switch check
  - Recorded in log books / sticker?
- Placards:
  - Experimental
  - Passenger Warning

**-“Condition” check vs. “Annual”**

- Experimental (homebuilt) aircraft require a condition check
  - Not “annual”
  - Can be performed by any A&P or original builder if issued repairman’s certificate
    - AI is NOT required / there is no type certificate to comply with
  - Due at the end of the 12<sup>th</sup> month
  - Builder can develop checklist
    - Do you have one?

**-FAR 43 (Maintenance) DOES NOT APPLY TO EXPERIMENTAL AIRCRAFT, sort of...**

- FAR 91.319(e) Operating Limitations
- FAR 43, Appendix D: General guidance for condition inspection
- All maintenance “IAW AC 43-13”
  - 43-13 forms baseline for accepted maintenance practice, use it!
- ANYONE can turn a wrench on an experimental aircraft
  - Normal logging required
- Only an A&P, AI or original builder (with repairman’s certificate) can sign condition inspection

**-Certification and Modification**

- FAR 21.191 governs certification of experimental aircraft
- FAA guidance in order 8130.2F
- “Phase I” is initial testing in restricted area
- “Phase II” is “normal ops” for experimental aircraft
- Modification
  - Major Change?

- May require FSDO interpretation
- Minor change definition: "...one that has no appreciable effect on the weight, balance, structural strength, reliability, operation characteristics, or other characteristics affecting the airworthiness..."
- Major change example: propeller swap
  - "5 hours in the box" with FSDO letter required
- Some FAA maintenance inspectors are NOT familiar with homebuilt / experimental certification
  - Do your homework so you can issue the answer!

## **TR-4: Transition Flight 4 (1.25 Hours + .75 Hours Brief + .5 Hours Debrief)**

### **Prerequisites**

1. All SEPT Training Complete
2. Block 3
3. Ground 4

### **Briefing**

- Limitations
- Weight and Balance
- Takeoff and Landing Data Computations (TOLD): Safety Factors
- Crew Coordination: Emergencies

### **Ground Operations**

- Pre-flight Inspection
  - Flow
- Cockpit Management
  - Emergency Egress: Ground/Bail Out
- Engine Start
  - Use of Checklist
  - Leaning Mixture for Ground Operation
- Taxi
  - Brake check
  - Tail / Nose Wheel Steering
- Run-up
  - Use of Checklist
  - Positioning Aircraft: Hazards/Cooling
  - Confirming Canopy Security
  - Trim and Flap Setting

### **Takeoff and Departure**

- High Density Altitude, Heavy Weight Takeoff
  - Line-up Check
  - Directional Control:
    - Power Application/Torque/P-Factor
    - Raising the Tail/Rotation
  - Engine Power/Pressure Checks During Roll

- Rotation/Lift Off
- Climb
  - Acceleration: Flap Retraction
  - $V_Y$  Best Rate Climb
  - Engine Monitoring
- Level-Off
  - Use of Trim
  - Engine Management

### **Confidence Maneuvers**

- Steep Turns: 45 and 60° Bank
  - Constant Power (Airspeed Bleed)
  - Constant Airspeed (MIL Power)
    - Roll-out Lead Point / Heading Control
    - Altitude Control
- Slow Flight
  - No-Flap ( $V_{S1} + 5$ )
  - Full-flap ( $V_{S0} + 5$ )
    - Torque Induced Yaw (Go-around) Exercise
- Power-Off Stall
  - Unusual attitude + AOA Recovery
- Power-On Stall
  - Unusual attitude + AOA Recovery
- Lazy- 8
- Incipient Spin

### **Aerobatics**

- G Warm-up
- Split-S
- Hammerhead
- Cuban 8

### **Unusual Attitudes (Visual Reference)**

- Nose High; Airspeed Decreasing
- Nose Low; Airspeed Increasing

### **Descent/RTB**

- Use of Checklist
- Computing Descent Point / VVI Required
- Engine / Airspeed Management

### **Simulated Flame-out (SFO)**

- High Key
- Low Key
- Final Turn
- Final
- TDZ Management

### **Pattern**

- Pattern Entry
- GUMPS Check
- Perch Management
- Final Turn
- Stabilized Final
- Slip
- Low-Approach and Go-Around
- Closed Pattern
- Full-Stop Landings (TW: 3 point; wheel; tail-low)
  - Normal/Short/soft field
  - Touchdown
  - Roll-out Directional Control
  - Brake Use

### **After Landing**

- Use of Checklist
- Parking and Securing

## Written Exam and Review

**Note:** This is intended to be an open-book exam, corrected to 100%. It should be administered to the upgrading pilot upon successful completion of TR-4. Answers should conform to the RV-type to be operated in the field (i.e., at the conclusion of training). This may or may not be the airplane utilized for transition training. Not all questions may be applicable to all airplanes, therefore the instructor will need to determine applicability. Additional questions or study areas may be developed/assigned at the instructor's discretion.

1. According to Operating Limitations issued by the FAA, the maximum allowable gross weight for the RV-type to be operated is \_\_\_\_\_ lbs. The designer's recommend maximum gross weight for this type is \_\_\_\_\_ lbs. Explain why these two numbers may be different:  
  
\_\_\_\_\_  
\_\_\_\_\_

2. The maximum allowable weight for aerobatics is:
  - a. Determined by structural limits of the airplane and specified in the builder's manual
  - b. Determined by the builder and specified in the Operating Limitations issued by the FAA
  - c. Varies as a function of maximum G-allowable
  - d. Is not specified
3. True or False. FAR Part 43 delineates maintenance requirements for Experimental-Amateur Built (EAB) aircraft.
4. The stick force gradient (lbs of pull required per G) for the typical RV-type airplane is a function of:
  - a. Pitch attitude (in degrees)
  - b. Airspeed
  - c. CG Location
  - d. Constant under all flight conditions
5. The CG is referenced from a datum located \_\_\_\_\_ inches ahead of the leading edge of the wing. This location was chosen to ensure that all computed moments are positive / negative (choose one).
6. The AEROBATIC CG limits are \_\_\_\_\_% MAC (\_\_\_\_\_inches aft of datum) to \_\_\_\_\_% MAC (\_\_\_\_\_inches aft of datum).



7. The aft CG limit for all operations is \_\_\_\_\_% MAC (\_\_\_\_\_ inches aft of datum).
8. RV-type airplanes are equipped with:
  - a. Split flaps
  - b. Fowler flaps
  - c. Plain flaps
9. True or False. Airworthiness Directives may apply to components (including engines) utilized in EAB aircraft.
10. Total fuel capacity is \_\_\_\_\_ gallons ( \_\_\_\_\_ gallons per side).
11. Usable fuel is \_\_\_\_\_ gallons.
12. Using the minimum recommended runway length chart in AC90-89A, determine the distance required to takeoff at minimum smooth lift-off speed, fly for 5 seconds at that speed without climbing and landing and stopping straight ahead at maximum allowable gross takeoff weight listed in the Operating Specifications: \_\_\_\_\_ feet.
13. Using a Koch Chart, adjust the answer obtained in Question #12 for an airport pressure altitude of 4000 feet at 85°F.
14. For normal operation of a Lycoming O-320 or O-360, above what power setting should engine leaning not be attempted:
  - a. 65%
  - b. 75%
  - c. 80%
  - d. 85%
15. Using the engine operator's manual, checklist or pilot's information manual compute expected fuel flow for a 65% cruise condition at 8500 feet MSL: \_\_\_\_\_ GPH.
16. Using the engine operator's manual, checklist or pilot's information manual, compute expected fuel flow for a 75% cruise condition at 3000 feet MSL: \_\_\_\_\_ GPH.
17. CG moves forward / aft (choose one) as fuel is burned. This effect is lesser / greater (choose one) in tandem aircraft with a rear seat passenger.
18. Maximum demonstrated cross-wind component for RV-type airplanes is:
  - a. 15 knots
  - b. 17 knots
  - c. 20 knots
  - d. Not specified

19. True or False: No attempt should be made to restart a secured engine after a fire.
20. The glide ratio for RV-type to be operated is \_\_\_\_:1. This translates to \_\_\_\_NM glide per 1000' of available altitude.
21. Maximum RANGE glide speed is \_\_\_\_\_ MPH / knots.
22. True or False. Phase I Operating Limitations may apply for test periods after major modification.
23. Who may perform maintenance on an EAB aircraft?
- a. Anyone
  - b. A certified Air Frame and Powerplant Mechanic
  - c. The builder
  - d. All of the above
24. RV-type aircraft exhibit \_\_\_\_\_ lateral stability.
- a. Negative
  - b. Neutral
  - c. Positive
25. \_\_\_\_\_ stability ( \_\_\_\_\_ ) has the most critical effect on aircraft performance.
- a. Lateral (roll)
  - b. Directional (yaw)
  - c. Longitudinal (pitch)
26. What is the approximate ratio of  $V_{NE}$  to  $V_S$  for RV-type aircraft:
- a. 3:1
  - b. 4:1
  - c. 5:1
  - d. 6:1
27. The airfoil section utilized in the RV-4/6/7 and -8 stalls at \_\_\_\_\_ to \_\_\_\_\_ degrees angle of attack.
28. True or False. Indicated stall speed increases with and increase in gross weight.
29. A 2G accelerated stall occurs at approximately \_\_\_\_\_ knots / MPH.
30. True or False. A slip (insufficient rudder in a turn) is more likely than a skid (excessive rudder in a turn) to cause a spin in the event critical angle of attack is unintentionally exceeded when maneuvering.

31. Minimum out-of-control bail-out altitude is \_\_\_\_\_ feet AGL.
32. Maximum allowable engine RPM is \_\_\_\_\_.
33. Minimum fuel pressure is \_\_\_\_\_.
34.  $V_{S1}$  (stall speed, flaps up) is \_\_\_\_\_ knots / MPH IAS at maximum gross weight.
35. True or False. IAS for  $V_X$  (best angle of climb speed) decreases as gross weight decreases.
36. Normal tire pressure is \_\_\_\_\_ to \_\_\_\_\_ PSI.
37. True or False. Ash-less dispersant and mineral oil may be mixed.
38. Spins greater than \_\_\_\_\_ turns may result in pilot disorientation.
39. True or False. The indicated airspeed associated with  $V_{NE}$  decreases with altitude.
40. Carson's number is an airspeed associated with maximum fuel efficiency. IAS for Carson's number for the RV-Type aircraft is approximately:
- a. 100 MPH
  - b. 120 MPH
  - c. 95 Knots
  - d. 150 Knots
41.  $L/D_{MAX}$  represents the point of maximum endurance, and if holding is required and fuel is critical, holding should be performed at  $L/D_{MAX}$ . The speed for  $L/D_{MAX}$  is \_\_\_\_\_ knots / MPH.
42. Manifold pressure changes \_\_\_\_\_ inches per 1000 feet of altitude change.
43. True or False. An increase in touchdown speed has a greater effect on landing roll distance than does an increase in landing weight.
44. Assuming the engine is equipped with a carburetor, the pilot should be aware that ice can form in the venturi with outside temperatures between \_\_\_\_\_°F and \_\_\_\_\_°F and is most likely to form in the \_\_\_\_\_ to \_\_\_\_\_ degree F range. Relative humidity may be as low as \_\_\_\_\_ to \_\_\_\_\_%.
45. True or False. Visible moisture must be present for carburetor ice to form.
46. True or False. Use of the throttle controlled accelerator pump on carbureted engines may increase the chance of induction fire during start.
47. RV-4 and -6 tail wheel equipped airplanes may suffer from landing gear shimmy during deceleration following landing. The factor MOST LIKELY to influence shimmy is:

- a. Outside air temperature
  - b. Tire pressure
  - c. Type of surface (hard or soft)
  - d. Out of balance wheels
48. True or False. The best technique to counter wheel shimmy is light brake application.
49. Assuming the RV-Type airplane is equipped with a manifold pressure gauge and tachometer, what combination of RPM and MP would produce approximately 65% power?
- a. 2400 RPM/21" MAP
  - b. 2200 RPM/26" MAP
  - c. 2150 RPM/20.5" MAP
  - d. 2500 RPM/23" MAP
50. Recommend minimum oil quantity for a local 1 hour flight is \_\_\_\_\_ qts.
51. Maximum oil capacity is \_\_\_\_\_ qts.
52. 100LL Aviation gasoline weighs \_\_\_\_\_ lbs per gallon. The arm of the fuel tanks used to compute actual weight and balance is \_\_\_\_\_ inches.
53. Maximum allowable baggage capacity is \_\_\_\_\_ lbs (assuming gross weight and CG are within limitations).
54. Maximum recommend cylinder head temperature for a typical Lycoming O-320/-360 installation is \_\_\_\_\_ degrees F for maximum engine life.
55. Maximum oil pressure limit is \_\_\_\_\_ PSI.
56. You are on a cross-country stop-over and servicing the airplane. During your last oil change, you serviced the airplane with Aeroshell 100 AD oil. The FBO you are at only has Phillips multi-weight AD oil available. Can you top off with this oil to continue on to your destination? Yes / No (choose one).
57. Which portion of the Federal Aviation Regulations specifies the maintenance REQUIRED for EAB aircraft?
- a. FAR 43
  - b. FAR 23
  - c. FAR 25
  - d. FAR 91
58. Which portion of the Federal Aviation Regulations specifies accepted methods and techniques to be utilized for aircraft repair and maintenance?

- a. FAR 43
- b. FAR 23
- c. FAR 25
- d. FAR 91

59. True or False. Asymmetric G limitations are not specified by the designer.
60. Maximum cruise speed for normal operation ( $V_{NO}$ /top of the green arc) is \_\_\_\_\_ knots / MPH.
61. Lycoming defines a minor engine over-speed as \_\_\_\_\_% or less of rated maximum RPM for a period not to exceed \_\_\_\_\_seconds.
62. The maximum speed at which FULL flaps may be extended is \_\_\_\_\_ knots / MPH.
63. True or False. Passengers must be briefed on the experimental nature of the airplane before flight.
64. For a typical emergency parachute, fastest chute opening occurs at \_\_\_\_\_ MPH. \_\_\_\_\_ to \_\_\_\_\_ seconds is required for a full chute; and generally \_\_\_\_\_ to \_\_\_\_\_ feet will be lost during deployment at terminal velocity for the opening sequence to occur. Pack opening should occur no later than \_\_\_\_\_ feet AGL to ensure a fully-deployed chute prior to landing.
65. A fuel asymmetry of more than \_\_\_\_\_ gallons will require the use of aileron trim (if equipped).
66. Which primary flight instrument(s) utilize(s) pitot and static pressure?
- a. Altimeter
  - b. Turn and Bank
  - c. VVI
  - d. Airspeed Indicator
67. (RV-4 only) True or False. The most common cause of canopy loss in flight is the pilot failing to properly secure the canopy before takeoff.
68. True or False. At speeds above  $V_A$ , pilot-induced over-G is not possible, because aerodynamic limits (stall) will occur before reaching structural limits.
69. True or False. If you are performing a cruise descent at a speed in excess of  $V_{NO}$  but less than  $V_{NE}$  (i.e., in the yellow arc), and encounter a vertical gust (turbulence) of sufficient magnitude, it is possible to exceed aircraft structural limits and cause permanent deformation of the structure.

70. What best defines velocity vector?
- The direction in which lift is acting
  - A point roughly 90 degrees to the angle of attack
  - The direction in which the airplane is moving, but not necessarily pointing
  - The direction in which the airplane is pointing
71. When loaded within aerobatic limitations specified by Van's aircraft, what are the G-limits of the airplane? +\_\_\_\_\_G's to -\_\_\_\_\_G's. What are the G limitations at maximum allowable gross weight? +\_\_\_\_\_G's to -\_\_\_\_\_G's.
72. Asymmetric maneuvering is defined as simultaneous control inputs in two (or more) axis, e.g., rolling and pulling simultaneously. As a rule of thumb, asymmetric maneuvering reduces allowable G by \_\_\_\_\_%.
73. (Tandem types only) True or False. When approaching for landing in a solo configuration, it is typical to use nearly full nose-up trim capability. This trim force must be trimmed out in the event a go-around is performed or balked landing occurs.
74. True or False. No significant yawing motion will occur if the throttle is advanced rapidly during go-around at low airspeed at high angle of attack.
75. RV-Type aircraft exhibit:
- Neutral longitudinal static stability
  - Positive longitudinal static stability
  - Negative longitudinal dynamic stability
  - Positive dynamic stability about the longitudinal axis
76. Which design characteristic DOES NOT contribute to lateral stability in RV-Type airplanes?
- Dihedral
  - Proper distribution of weight
  - Keel effect
  - Lateral CG offset
77. True or False. Unless power, pitch control and G-loading are properly modulated; all RV-Type aircraft are capable of rapid acceleration to dangerously high airspeeds when the velocity vector is below the horizon.
78. (RV-4/-6) True or False. The Whitman style landing gear is very tolerant of early forward stick application during a wheel landing.
79. For operations from high elevation airports, Lycoming recommends ground leaning for smoothness prior to takeoff when field elevation exceeds \_\_\_\_\_ feet MSL.

80. Lycoming stipulates that detonation margin is reduced when leaning at power settings above \_\_\_\_%.
81. What is the primary danger when operating in excess of maximum allowable gross weight?
- a. Decreased critical angle of attack
  - b. Decreased stall speed
  - c. Reduced structural margin
  - d. High landing speed
82. For normally aspirated Lycoming power plants, 75% power can be maintained up to what approximate altitude?
- a. 10,000-11,000 feet MSL
  - b. 6500 feet MSL
  - c. 7000-8000 feet MSL
  - d. 7000-8000 feet AGL
83. When operating off a turf runway, it's recommended that grass height not exceed:
- a. 1/3 wheel diameter
  - b. 1/2 wheel diameter
  - c. 1 wheel diameter
  - d. Not specified
84. True or False. RV-type cruise climb performance is relatively consistent over a broad band of airspeeds.
85. The factor that determines at what point an airplane may encounter hydroplaning when landing on a wet runway is:
- a. Depth of water
  - b. Touchdown speed
  - c. Tread depth
  - d. Tire pressure
86. (IFR Only). In the event an RV-type airplane encounters structural icing conditions, the portions of the airframe most likely to make ice first are:
- a. The pitot tube and leading edge of the horizontal stabilizer
  - b. The base of the canopy
  - c. The leading edge of the wings
  - d. The landing gear
87. True or False. For Lycoming power plants, the engine is warm enough for takeoff when the throttle can be opened smoothly and the engine does not hesitate, surge or run roughly.

88. What limitations are associated with starter operation? Crank time should be limited to \_\_\_\_\_ seconds; with a \_\_\_\_\_ second cool-down between attempts. This cycle may be repeated up to \_\_\_\_\_ times.
89. Recommended approach speed for RV-type aircraft is:
- a.  $1.2 V_S$
  - b.  $1.3 V_S$
  - c.  $1.3-1.4 V_S$
  - d. Not specified
90. Which RV-type airplane primary control surface is cable activated:
- a. The ailerons
  - b. The elevator
  - c. The ailerons and rudder
  - d. The rudder
91. True or False. Compared to most typical production light aircraft, RV-type aircraft stall power-on at relatively low pitch angles.
92. (Tail wheel Only) True or False. After landing, a ground loop is more likely to occur during the roll-out/deceleration phase.
93. What is maximum allowable cylinder head temperature? \_\_\_\_\_ degrees F.
94. True or False. RV-type airplanes equipped with a wooden propeller should have the propeller bolts inspected, re-torqued and properly safety wired on a regular basis.
95. Where can the pilot find weight and balance information for the RV-type airplane to be operated?
- a. In the builder's manual
  - b. In the pilot's operating manual
  - c. In the pilot's information manual
  - d. In the cockpit
96. True or False. You did not build your RV-type aircraft, but purchased it from the builder. Only an A&P mechanic may perform maintenance on the aircraft.
97. True or False. A well executed water landing normal involves less deceleration violence than a poor tree landing or a touchdown on extremely rough terrain.



98. Concerning stall recovery characteristics, if an inadvertent stall occurs, RV-type aircraft (when loaded within design limits and rigged in accordance with instructions in the builder's manual) require \_\_\_\_\_ to resume flying.
- A simple unload/release of back-pressure
  - Full-forward stick
  - Maximum power
  - A combination of maximum power and forward stick
99. You are the third owner of an RV-type aircraft originally completed in the mid 1990's. You wish to review service bulletins for the type. Where do you find designer's service bulletins?
- In the FAA database
  - By requesting them from the local FSDO
  - On-line at Van's Aircraft web site
  - By calling the technical support phone number at Van's Aircraft
  - C or D above
100. Regarding your third-hand, mid 90's vintage RV-type, it came with very little documentation other than the minimum required by FARs. You should consider:
- Purchasing a set of preview plans for the type (including the builder's manual) from Van's Aircraft
  - Reviewing type-specific forum discussion on-line on vansairforce.net
  - Joining the local EAA chapter and/or contacting an EAA Flight Advisor
  - All of the above
101. True or False. It is possible to derive specific performance information for the RV-type to be operated without flight test.
102. List the documents the **MUST** be carried on-board the aircraft at all times for operation within the United States:
- \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_
103. True or False. The airframe maintenance log need not be carried in the aircraft.
104. True or False. When loaded within design limits and rigged in accordance with instructions in the builder's manual, RV-type aircraft exhibit good post-stall directional control capability.

105. For the purpose of an overhead type emergency landing pattern, “low key” is defined as:
- a. A point directly above the planned TDZ from which a descending spiral can be flown without use of power to landing
  - b. A point 180 degrees abeam the planned TDZ from which a gliding turn can be flown without use of power to landing
  - c. Final roll-out point, from which a 5-6 degree glide path can be maintained to the desired TDZ without use of power
  - d. Any point from which sufficient altitude and airspeed exist in combination to allow a gliding descent to a desired TDZ without use of power