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Aviation Solutions and Flight Training

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Test Pilot

Airplane – Single & Multi-Engine Land

Special Preparation Course Syllabus

14 CFR Part 141

Appendix

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Syllabus Instructional Time Table

Lesson Number	Dual Instruction	Ground Instruction
1		2.0
2		2.0
3	1.5	1.0
4	1.5	1.0
5	1.5	1.0
6	1.5	1.0
7	1.5	1.5
8		2.0
9		2.0
10	1.5	1.0
11	1.5	1.0
12	1.5	1.0
13	1.5	1.0
14	1.5	1.5
15		2.0
Totals	15.0 hours	21.0 hours

Preface

This syllabus is a step-by-step lesson plan for the Special Preparation Test Pilot Course and accompanying Certificate. The basic requirements of the Federal Aviation Administration (FAA) Test Pilot Course are presented in 14 CFR Part 141 Appendix K (8) and discussed on the following pages. This syllabus is intended to be supported by the following Reference materials:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

Aeronautical Information Manual

Experimental Aircraft Association (2018) *Flight Test Manual – A Task-Based Approach to Phase I*, Version 1.0

Experimental Aircraft Association (2018) *Flight Test Manual – Test Card Book*, Version 1.0

Federal Aviation Regulations, with emphasis on Part 23 Airworthiness Standards including Appendix A; Part 25 Airworthiness Standards including Appendix H; Part 43 Maintenance and Part 141 including Appendix K Special Preparation Courses and additionally 141.39, 141.45, 141.53 and 141.89 for Maintenance and Quality Assurance.

FAA Advisory Circular 23-8C (dtd 11/16/2011): *Flight Test Guide For Certification of Part 23 Airplanes*

FAA Advisory Circular 43.13-1B (9/8/98, Ch1): *Acceptable Methods, Techniques and Practices – Aircraft Inspection and Repair*

FAA Advisory Circular 43-9C (dtd 5/8/18, Ch2) *Maintenance Records*

FAA Advisory Circular 90-89B (4/27/15) *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*

FAA Advisory Circular 141- 1B (9/12/17) Part 141 *Pilot Schools, Application, Certification and Compliance*

FAA Handbook 8083.1 (1999): *Aircraft Weight and Balance Handbook*

FAA Order 4040.26B (dtd 1/31/2012): Aircraft Certification Service Flight Test Risk Management Program

FAA Order 8110.41 (dtd 7/11/2005): Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

NATC Project Test Plan: *Qualitative Evaluation of the P-51D for the Counterinsurgency Mission* by Yurovich, D.P., April 1990

NATC Project Test Plan: *Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P., December 1989

NATC Project Test Plan: *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., January 1990

REPORT TPS-01R-90 *Technical Report: Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P. January 1990

REPORT TPS-02R-90 *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., March 1990

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 108, Fixed Wing Performance*, September 1992.

Additional reference materials may be acquired by the student in order to further reinforce the topics discussed in this syllabus, but they are not required. Knowledge of calculus is not required, but a nice to have.

All references listed above will be provided electronically in the Academic Assist Package provided for this syllabus.

The following reference books will be used and maintained at Piston2Jet:

Experimental Aircraft Association (2018) *Flight Test Manual – A Task-Based Approach to Phase I*, Version 1.0

Experimental Aircraft Association (2018) *Flight Test Manual – Test Card Book*, Version 1.0

Lowry, J.T. (1999). *Performance of Light Aircraft*. Reston, VA: American Institute of Aeronautics and Astronautics, Inc.

Prerequisites for Enrollment

Before enrolling in this course the student must hold an FAA Commercial Pilot Certificate, Airplane Single (ASEL) and an Instrument Rating. If the student also holds an FAA Commercial Multi Engine Land (MEL) and an Instrument Rating, the student can also execute all or portions of this syllabus flying the Piper PA-23-250 Aztec.

Course Objectives and Grading

The primary objective of this course is to familiarize the student with aeronautical knowledge training on safe piloting and operating practices and procedures for performing maintenance, quality assurance and certification for test flight operations.

The student will be evaluated and graded based on the scale below. Each area of operation, maneuver and knowledge topic will be graded. A passing grade is considered a 3 or higher. All activities must be graded with a 3 or higher before a student can complete the course. At the end of the course the student will partake in a Stage Check with the Chief Instructor, Assistant Chief Instructor or an approved Check Instructor for this course.

Desired Outcomes – Maneuvers and Procedures

Outcome Level	Requirements and Considerations
1 – Describe	<p>Comparable to the Rote level of learning</p> <p>The student demonstrates understanding of the physical characteristics and cognitive elements of the mission and scenario tasks.</p> <p>The instructor provides significant assistance to ensure the successful completion of the task.</p> <p>Although it is not used as a desired outcome for the mission and scenario tasks, a column is provided in the Mission tables for recording this outcome level if the student does not achieve the Explain level.</p>
2 – Explain	<p>Comparable to the Understanding level of learning.</p> <p>The student demonstrates understanding of the underlying concepts and principles of the mission and scenario tasks and the correct methods to perform these tasks.</p> <p>The instructor provides assistance to successfully complete the task.</p> <p>This desired outcome is used when the task is introduced.</p>
3 – Practice	<p>Comparable to the Application level of learning.</p> <p>The student successfully plans and completes the mission and scenario tasks with minimal guidance from the instructor.</p> <p>The instructor provides coaching to assist the student in correcting instructor-identified errors.</p> <p>This desired outcome is used when a task is reviewed in a lesson that occurs after the task was introduced. Task standards change to meet the Practice outcome based on the completion standards for the lesson.</p>
4 – Perform	<p>Comparable to the Correlation level of learning</p> <p>The student demonstrates proficiency in performing the mission and scenario tasks without instructor assistance. At no time is the successful completion of the task in doubt.</p> <p>The student identifies and corrects errors without instructor assistance.</p> <p>This desired outcome is used to signify that the student completes the mission and scenario tasks to the standards outlined in the Test Pilot Syllabus.</p>
5 – Not Observed	The task was not attempted or required during the lesson.

Each lesson shall be conducted with a brief the flight, fly the brief, debrief the flight mentality. An emphasis on professional pilot habit patterns and high-level thinking should be communicated to the student test pilot.

SAMPLE

STAGE 1 - LESSON 1 – GROUND: TEST PILOTING and PERFORMANCE TESTING I

Lesson References:

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992.

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

Recommended Sequence:

Ground Discussion – 2.0 Hours

Lesson Objectives:

The student test pilot will become familiar with the training program and applicable regulations. The student test pilot will be introduced to the responsibilities of a test pilot with respect to leading the project test team, effective test planning to include risk management. Learn test pilot concepts as they relate to fixed wing performance testing of light aircraft. The student will be introduced to the Bootstrap Data Plate (BDP) for each training airplane and to the procedures for taking data relating to normal operations in a single engine airplane. The student will also be introduced to taking data to including normal and short-field takeoff and landing procedures, climbs, descents and level acceleration. The student will also be introduced to the concept of acceptable data by analyzing data tolerances with respect to AC-23-8C.

Pre-Lesson Study Material:

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992.

Discussion Topics:

Why get a test pilot rating?

- Increased technical capability and capacity
- The test pilot is proficient in the required flight skills to obtain accurate data. The

pilot has well developed observation and perception powers to recognize problems and adverse characteristics. The pilot has the ability to analyze test results, understand them, and explain the significance of the findings. To fulfill these expectations, the pilot must possess a sound knowledge of:

- The test aircraft and fixed wing aircraft in general.
- The total mission of the aircraft and the individual tasks required to accomplish the mission.
- Theory and associated test techniques required for qualitative and quantitative testing.
- Specifications relevant to a test program.
- Test Plan Writing including Risk Assessments and Safety procedures.
- Post Flight Daily Reports and Technical Report Writing

Career applications

- Higher level of qualification, increased competitiveness and technical capability in a hiring environment, operation of more complex and higher performance aircraft, moving to a unique level
- Normal operations analytics and evaluation of the testing aircraft as it relates to its designed mission.
- Performance Operations analytics and evaluation with respect to aircraft mission and specifications.

Post-Lesson Review:

Pilots Handbook of Aeronautical Knowledge

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992. Chapters 1, 2, 7, 8, and 9

STAGE 1 - LESSON 2 - GROUND: TEST PILOTING and PERFORMANCE TESTING II

Lesson References:

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992.

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

Recommended Sequence:

Ground Discussion – 2 Hours

Lesson Objectives:

The test pilot under instruction will be introduced to the concept of Performance Testing with a focus on data taking techniques and the mathematics behind data reduction.

Pre-Lesson Study Material:

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992

Discussion Topics:

Why performance flight testing?

Aircraft performance generally can be defined as the flight maneuvers an aircraft must execute for successful mission accomplishment. Expected performance parameters must be an integral part of the aircraft design process. Actual aircraft performance characteristics are not always the same as the design or the predicted performance characteristics. Therefore, there is a need for performance flight testing to determine the actual performance.

Review the 9 variables of the Bootstrap Data Plate for all of the P2J aircraft. Provide how glide tests (V_{BG} and Γ_{BG} (the glide angle) provide data necessary to calculate C_{D0} and e ; while climb tests and level speed test (V_x and V_M) establish the slope and intercept for the linearized propeller polar diagram. These four variables are calculated for each configuration of performance interest. Dimensional analysis must be performed to assure variables have the same units resulting in correct calculations.

Discuss the importance of cockpit management, data cards and cockpit resource management. Extra items in the cockpit might be: force gauges, stop watches, excess data cards, video camera, IPAD, and cloth tape measure.

Discuss the need for procedure knowledge and current weight and balance location and fuel total during all data taking events.

Introduce Handling Quality Ratings (HQRs) and method of application.

Introduce and review the importance of post flight data analysis and writing the “daily” as a formal input to the test program report.

Post-Lesson Review:

Pilots Handbook of Aeronautical Knowledge

FAA Advisory Circular 23-8C (dtd 11/16/2011): Flight Test Guide For Certification of Part 23 Airplanes

FAA Order 8110.41, Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992. Chapters 1, 2, 7, 8, and 9

STAGE 1 - LESSON 3 – FLIGHT: PERFORMANCE TESTING I

Recommended Sequence:

Ground Discussion – 1.0 Hours (pre-flight/post-flight debriefing)

Flight – 1.5 Hours

Lesson Objectives:

The student test pilot will become acquainted with the test airplane. The student should learn the attitudes, power settings, and configurations required for the performance of the listed maneuvers and the data gathering techniques that apply to these maneuvers.

Pre-Lesson Study Material:

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. Journal of Aviation/Aerospace Education & Research, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, Flight Test Manual (FTM) No. 108, Fixed Wing Performance, September 1992.

Activity	Grade		Grade
Introduce: Preflight Preparation			
Bootstrap Data Plate for today's test airplane.		Review and annotate atmospheric data for current flight. Enroute and Terminal weather review.	
Review Data Cards for flight.		Review and annotate Weight and Balance.	
Review Flight Performance Test Techniques for flight.		Review calculated preflight takeoff and land data for post flight data comparison.	
Review Cooper-Harper Handling Qualities Rating (HQR) for selected tasks or operations.		Review Qualitative Evaluation (QE) for Cockpit checklists and ground procedures evaluation.	
Introduce: Preflight Procedures			
Preflight Inspection – note special instrumentation on test airplane.		Cockpit Management: force gauge, stop watch, data cards, video recorders, cloth tape measure, if available or required.	
QE review and evaluate all checklists.		Ground Handling: turn radius, controllability, response to inputs, field of view, braking, taxiing with winds, fuel usage: HQRs where appropriate.	
Before Takeoff Check		Review and record current data as briefed.	
Introduce: Safety-Related Operations and Procedures			
Checklist Usage, test procedure checklist and safety checklist as they apply for usage.		Normal and Emergency procedures. Crew Resource Management for all cockpit activities during test flight.	
Positive Exchange of Flight Controls.		Visual Scanning and Collision Avoidance	

Decisions and Conditions to abort test maneuvers: test aircraft problems, weather and/or traffic in the area.			
Introduce: Flight Performance Test Techniques for Takeoff and Inflight			
Takeoff Performance data procedures- takeoff as a dynamic test, reviewed data required and discuss how and when data will be taken/written down.		Constant Airspeed Climbs: Start at V_y and V_x . Add and subtract +/- 5 mph or knots. No tests slower than V_s+5 knots or MPH as appropriate for the airplane.	
Constant Airspeed Descents: Start at V best glide and add or subtract +/- 5 mph or knots. No tests slower than V_s+5 knots or MPH as appropriate for the airplane.		Drag Changes (flaps) for Various Configurations for Constant Airspeed Climbs and Descents.	
Constant Altitude Change of Airspeed- P_s introduction. Rate of acceleration dictates time frame for data sample. Probably every 5 secs for P2J airplanes. Review Data required, test criteria, altimeter to 29.92.			
Introduce: Landing Performance test Techniques			
Need for repeatable landing technique		Maintain fuel reserve necessary to recover in accordance with Piston2Jet SOP and approved TCO.	
Landing as a Dynamic test, review data required		QE flight path stability with approach and landing,	
Introduce: Postflight Procedures			
After Landing		Parking and Securing	
Review the data gathered and the data reduction techniques		Writing the post flight report: "The Daily", from the debrief and data review.	
1 – Describe, 2 – Explain, 3 – Practice, 4 – Perform, 5 – Not Observed			

Post Lesson Review:

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. Journal of Aviation/Aerospace Education & Research, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

Post-flight review of in-flight data taken for post flight daily report writing

STAGE 2 - LESSON 8 – GROUND: STABILITY AND CONTROL I

Lesson References:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 1, 2, 3, 4 and 5)

Recommended Sequence:

Ground Discussion – 2.0 Hours

Lesson Objectives:

The test pilot under instruction will be introduced to the concepts of Stability and Control Theory and Testing with a primary focus on:

Philosophy of Flying Qualities Testing

Concepts of Stability and Control: Stability and Controllability

Mechanics of Dynamics: The spring-mass damper system, response of a second order system to disturbance, analysis of second order responses and airplane motion.

Longitudinal Flying Qualities: Introduction to Theory; Test Procedures and Techniques – Non maneuvering tasks and maneuvering tasks.

This lecture and Lesson 9 will prepare the test pilot for the flying portion of the S&C portion of the syllabus.

Pre-Lesson Study Material:

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 1, 2, 3, 4 and 5)

Discussion Topics:

Chapter 4 in FTM 103 forms the basis of this lecture and should be reviewed as the primary effort in preparation for this lecture. Review Glossary of Terms for Longitudinal S&C.

Mechanics of Dynamics: The spring-mass damper system, response of a second order system to disturbance, analysis of second order responses and airplane motion.

Longitudinal Flying Qualities: Introduction to Theory; Test Procedures and Techniques – Non maneuvering tasks and maneuvering tasks.

Post-Lesson Review:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 4)

SAMPLE

STAGE 2 - LESSON 9 – GROUND: STABILITY AND CONTROL II

Lesson References:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapter 5)

Recommended Sequence:

Ground Discussion – 2.0 Hours

Lesson Objectives:

The test pilot under instruction will be introduced to the concepts of Stability and Control Theory and Testing with a primary focus on:

Normal Lateral-Directional Stability and Control – Introduction to Theory

Test Procedures and Techniques – Lateral-Directional Flying Qualities

Introduction to Rolling Performance Theory

Introduction to Miscellaneous Lateral-Directional Tests

Pre-Lesson Study Material:

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 5)

Discussion Topics:

Chapter 5 in FTM 103 forms the basis of this lecture and should be reviewed as the primary effort in preparation for this lecture. Review Glossary of Terms for Lateral-Directional and Rolling Performance S&C.

Normal Lateral-Directional Stability and Control – Introduction to Theory

Test Procedures and Techniques – Lateral-Directional Flying Qualities

Introduction to Rolling Performance Theory

Introduction to Miscellaneous Lateral-Directional Tests

Post Lesson Review:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapter 5)

SAMPLE

STAGE 2 - LESSON 10 – FLIGHT: S&C I TESTING Longitudinal Stability I

Lesson References:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapter 4)

Recommended Sequence:

Ground Discussion – 1.0 Hours (pre-flight/post-flight debriefing)

Flight – 1.5 Hours

Lesson Objectives:

The test pilot student will be introduced to longitudinal flying qualities testing and evaluation criteria. This includes introducing the test pilot under instruction to techniques to qualitatively measure the characteristics of the longitudinal flight control system of the test airplane.

Longitudinal flying qualities testing is broken down into nonmaneuvering tasks and maneuvering tasks airborne:

Nonmaneuvering tasks are defined as those tasks during which the transition from one equilibrium flight condition to another is accomplished smoothly and gradually. Nonmaneuvering tasks result in essentially unaccelerated flight conditions. Tasks which can be classified as nonmaneuvering are: take-off, climb, cruise, loiter (hold), glide, descent, approach and wave-off.

Maneuvering tasks are defined as those tasks which result in accelerated flight conditions; during maneuvering tasks, transitions from one equilibrium flight condition to another are made quickly, and possibly, somewhat roughly. Tasks which may be included in this category are commercial maneuvers, specifically Chandelles and acrobatics. Acrobatics are not being taught or evaluated in this syllabus.

Activity	Grade		Grade
Introduce: Longitudinal Stability Testing			
Introduce: QE Mechanical Characteristics			
Longitudinal control system-ground tests: control yoke or stick deflection vs tail deflection and control force vs yoke or stick deflection		Breakout forces including friction, freeplay, centering, control system oscillations, longitudinal maneuvering stability: yoke or stick force per G and yoke or stick position per G	
Take off, climb and cruise evaluation		Qualitatively Evaluate pitching moments with configuration changes	
Introduce: Non-Maneuvering Longitudinal Static Stability			
Cruise Configuration (CR)		Power Approach Configuration (PA)	
Variation of yoke or stick force and yoke or stick position with airspeed, trim speed band		Variation of yoke or stick force and yoke or stick position with airspeed	

Maneuvering Static Longitudinal Stability (Wave off for test airplane) - Perform Wave off Maneuver –Yoke or stick force and displacement vs normal acceleration gradient		Flight Path Stability – evaluate flight path angle changes by using pitch control, vice power control.	
Introduce: Maneuvering Static Longitudinal Stability (V_a for test airplane)			
Selected Commercial Maneuvers – Chandelle) Yoke or stick force and displacement vs normal acceleration gradient		Phugoid characteristics in CR, PA and WO configurations. (long period characteristics)	
Trimmability in all configurations- QE assess during flight			
1 – Describe, 2 – Explain, 3 – Practice, 4 – Perform, 5 – Not Observed			

Post-Lesson Review:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997

Post-flight review of in-flight data taken for post flight daily report writing

STAGE 3 - LESSON 15 – GROUND: END OF COURSE & DATA REVIEW

Lesson References:

Airplane Flying Handbook (FAA-H-8083-3B)

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

Aeronautical Information Manual

Experimental Aircraft Association (2018) *Flight Test Manual – A Task-Based Approach to Phase I*, Version 1.0

Experimental Aircraft Association (2018) *Flight Test Manual – Test Card Book*, Version 1.0

Federal Aviation Regulations, with emphasis on Part 23 Airworthiness Standards including Appendix A; Part 25 Airworthiness Standards including Appendix H; Part 43 Maintenance and Part 141 including Appendix K Special Preparation Courses and additionally 141.39, 141.45, 141.53 and 141.89 for Maintenance and Quality Assurance.

FAA Advisory Circular 23-8C (dtd 11/16/2011): *Flight Test Guide For Certification of Part 23 Airplanes*

FAA Advisory Circular 43.13-1B (9/8/98, Ch1): *Acceptable Methods, Techniques and Practices – Aircraft Inspection and Repair*

FAA Advisory Circular 43-9C (dtd 5/8/18, Ch2) *Maintenance Records*

FAA Advisory Circular 90-89B (4/27/15) *Amateur-Built Aircraft and Ultralight Flight Testing Handbook*

FAA Handbook 8083.1 (1999): *Aircraft Weight and Balance Handbook*

FAA Order 4040.26B (dtd 1/31/2012): Aircraft Certification Service Flight Test Risk Management Program

FAA Order 8110.41 (dtd 7/11/2005): Aircraft Certification Service FAA Flight Test Responsibilities, Procedures and Training.

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. *Journal of Aviation/Aerospace Education & Research*, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

NATC Project Test Plan: *Qualitative Evaluation of the P-51D for the Counterinsurgency Mission* by Yurovich, D.P., April 1990

NATC Project Test Plan: *Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P., December 1989

NATC Project Test Plan: *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., January 1990

REPORT TPS-01R-90 *Technical Report: Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P. January 1990

REPORT TPS-02R-90 *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., March 1990

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 108, Fixed Wing Performance*, September 1992.

Recommended Sequence:

Ground Discussion – 2.0 Hours

Lesson Objectives:

The first hour of this lesson will cover the Performance Testing portion of the syllabus.

A review will be conducted of the flight data cards and post flight daily reports.

The second hour of this lesson will cover the Stability & Control portion of the syllabus.

Pre-Lesson Study Material:

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

REPORT TPS-01R-90 *Technical Report: Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P. January 1990

REPORT TPS-02R-90 *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P. March 1990

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 1, 2, 3, 4 and 5)

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 108, Fixed Wing Performance*, September 1992.

Discussion Topics:

Performance

A review of the completed Bootstrap Data Plate for the tested airplane, with review of the five primary BDP items: Wing Reference Area, Wing Aspect Ratio, Rated MSL Torque, Altitude drop off parameter and propeller diameter.

A review of the four variables calculated from performance testing data collected during the syllabus: Parasite drag coefficient, airplane efficiency factor propeller polar slope and propeller intercept. The test pilot student will also review of dimensional analysis for each the variables in the BDP of the airplane for consistency and correctness.

A review of data taken during the Performance phase should also be compared to existing data from the POH. How does our data compare to Takeoff and Landing as compared to the POH and atmospheric data on the test days?

How does the calculated airspeed climbs compare to V_y and V_x of the given airplane? What were the calculations for the angle of climb for V_y and V_x ? How does the angle of climb vary with variations of testing speeds around V_y and V_x ?

How does the calculated $V_{BESTGLIDE}$ compare to the POH number for the airplane. What was the calculation for the angle of descent for $V_{BESTGLIDE}$? How does the angle of descent vary with glide speed test points?

What is the quantitative and qualitative assessment of level speed runs? Is there data supporting evaluation of Ps, energy addition rate of the test airplane?

What conclusions does the test pilot student have for HQR ratings?

What conclusions does the test pilot student have for flight path stability with the approaches and landings during the Performance phase of the syllabus?

What are the overall impressions from the test pilot student on this phase of instruction?

Stability & Control

Longitudinal Stability

A review of the Mechanical Characteristics of the Longitudinal flight control system characteristics. What are the assessments with regards to: BO+F, freeplay, centering, control systems oscillations, yoke or stick force per G, and yoke or stick position per G?

Review all HQRs assigned during the S&C Phase and how the student test pilot assessed their impact on the mission of the aircraft.

Review the yoke/stick forces during maneuvering and evaluations by the student test pilot.

What was the assessment of trimmability in aspects of flight in this phase of testing?

What were the phugoid long period characteristics of the airplane in cruise and powered approach configurations?

Lateral-Directional

A review of the Mechanical Characteristics of the Lateral and Directional flight control system characteristics. What are the assessments with regards to: BO+F, freeplay, centering, control systems oscillations, yoke or stick force per G, and yoke or stick position per G?

What can be concluded from our steady heading sideslips with respect to directional stability, dihedral effect and sideforce characteristics?

What was the evaluation of the spiral stability in cruise and power approach configurations?

Review all HQRs assigned during the S&C Phase and how the student test pilot assessed their impact on the mission of the aircraft.

What can we conclude about the roll mode from our testing with respect to damping, frequency and roll to yaw (ϕ/β) ratio. Is the concept of roll mode time constant understood?

What are the overall impressions from the test pilot student on this phase of instruction?

Post-Lesson Review:

Airplane Flying Handbook (FAA-H-8083-3B)

Lowry, J. T. (1995). The Bootstrap Approach to Predicting Airplane Flight Performance. Journal of Aviation/Aerospace Education & Research, 6(1). <https://doi.org/10.15394/jaaer.1995.1167>

Pilots Handbook of Aeronautical Knowledge (FAA-H-8083-25B)

NASA TN D-5153 Copper Harper Handling Qualities Rating (HQR) Scale, April 1969

NATC Flight Report NATC-3760/5

NATC Project Test Plan: *Qualitative Evaluation of the P-51D for the Counterinsurgency Mission* by Yurovich, D.P., April 1990

NATC Project Test Plan: *Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P., December 1989

NATC Project Test Plan: *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., January 1990

REPORT TPS-01R-90 *Technical Report: Evaluation of the Longitudinal Static Stability Characteristics of the T-38 Airplane for the Advanced Trainer Mission* by Yurovich, D.P. January 1990

REPORT TPS-02R-90 *Technical Report: Evaluation of the Lateral-Directional Flying Qualities of the TA-4J Airplane for the Advanced Trainer Mission* by Yurovich, D.P., March 1990

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 103, Fixed Wing Stability and Control – Theory and Flight Test Techniques*, January 1997 (Chapters 4 and 5)

U.S. Naval Test Pilot School, *Flight Test Manual (FTM) No. 108, Fixed Wing Performance*, September 1992.