TRC472-F Flight and Navigation Procedures Trainer Type I

Qualification Test Guide

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FNPT Type I information page

FNPT Type I model and serial number	TRC472-F S/N 472F-20051125	
Class of aeroplane being simulated	Single engine, single pilot, propellor aeroplane	
Aerodynamic and engine model data revision	Version 8.40, 13 April 2006	
Avionics equipment system identification	Audio Panel/Marker Beacon	P/N 2692
	NAV/COM1	P/N 2708
	NAV/COM2	P/N 2708
	DME	P/N 2715
	Transponder	P/N 2722
	ADF	P/N 2739
	Autopilot	P/N 2746
	VOR1	P/N 1060
	VOR2	P/N 1077
FNPT Type I manufacturer	TRC Development B.V. Stationsweg 39 4241 XH ARKEL The Netherlands	
Date of FNPT Type I manufacture	2005	
FNPT Type I computer identification	Intel(R) Pentium(R) 4 CPU 3.40 GHz 2.00 GB of RAM	
Visual system	HP vp6121 DLP projector	
	Projection resolution	1024x768 pixels
	Projection dimensions	wxh = 1.3m x 0.75m
	Projection FOV	hxv = 51x30 degrees

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1 Record of revisions

REV NO.	ISSUE DATE	REASON OF REVISION
0	23 August 2007	FIRST ISSUE
1	1 February 2008	Installed new rudder pedal springs New graphs for test 2a3 QTG tests ordered and labelled according to JAR-STD 3A Visual system description incorporated in information page Added engine speed vs. throttle graph in test 2a5 Added statements to tests 2b1 and 2b2 Added flap times test 2b5 Added roll response expected results test 2c2 New Yoke springs installed New graphs for test 2a1 New grapsh for test 2a2 New graphs for test 1c1 New graphs for test 1c2
2	3 December 2008	Installed new yoke and software Renewed all tests and all graphs

2 References and source data

[1] Aerospace Software and Technologies Institute, *Validation Reference Data Report, TRC472-F Flight and Navigation Procedures Trainer Type I*, November 2006.

[2] International Civil Aviation Organization, *Manual of Criteria for the Qualification of Flight Simulators*, Doc. 9625, January 2002.

[3] Joint Aviation Authorities, *Aeroplane Flight & Navigation Procedures Trainers*, Joint Aviation Requirements JAR-STD 3A, June 1999.

[4] Royal Aeronautical Society, *Aeroplane Flight Simulator Evaluation Handbook, International Standards for the Qualification of Aeroplane Flight Simulators*, Third Edition January 2005, ISBN 1 85768 154 1.

[5] Royal Aeronautical Society, *Aeroplane Flight Simulator Evaluation Handbook Volume II, International Standards for the Qualification of Aeroplane Flight Simulators*, First Edition July 1996, ISBN 1 85768 177 0.

3 Terminology and abbreviations

3.1 Terminology

Automatic Testing FSTD testing wherein all stimuli are under computer control.

Basic Instrument Training Device (BITD) A ground based training device which represents the student pilots station of a class of aeroplanes. It may use screen based instrument panels and springloaded flight controls, providing a training platform for at least the procedural aspects of instrument flight.

Breakout The force required at the pilots primary controls to achieve initial movement of the control position.

Closed Loop Testing A test method for which the input stimuli are generated by controllers which drive the FSTD to follow a pre-defined target response.

Computer Controlled Aeroplane An aeroplane where the pilot inputs to the control surfaces are transferred and augmented via computers.

Control Sweep A movement of the appropriate pilots control from neutral to an extreme limit in one direction (Forward, Aft, Right, or Left), a continuous movement back through neutral to the opposite extreme position, and then a return to the neutral position.

Convertible FSTD A FSTD in which hardware and software can be changed so that the FSTD represents more than one model, usually of the same class of aeroplane. The same cockpit shell, computers and necessary peripheral equipment can thus be used in more than one simulation.

Critical Engine Parameter The engine parameter which is the most appropriate measure of propulsive force.

Damping (critical) The CRITICAL DAMPING is that minimum Damping of a second order system such that no overshoot occurs in reaching a steady state value after being displaced from a position of equilibrium and released. This corresponds to a relative Damping ratio of 1.0.

Damping (over-damped) An OVERDAMPED response is that Damping of a second order system such that it has more Damping than is required for Critical Damping, as described above. This corresponds to a relative Damping ratio of more than 1.0.

Damping (under-damped) An UNDERDAMPED response is that Damping of a second order system such that a displacement from the equilibrium position and free release results in one or more overshoots or oscillations before reaching a steady state value. This corresponds to a relative Damping ratio of less than 1.0.

Deadband The amount of movement of the input for a system for which there is no reaction in the output or state of the system observed.

Driven A state where the input stimulus or variable is driven or deposited by automatic means, generally a computer input. The input stimulus or variable may not necessarily be an exact match to the flight test comparison data it is simply driven to certain predetermined values.

Flight and Navigation Procedures Trainer (FNPT) A training device which represents the flight deck/cockpit environment including the assemblage of equipment and computer programmes necessary to represent an aeroplane type or class in flight operations to the extent that the systems appear to function as in an aeroplane. It is in compliance with the minimum standards for a specific FNPT Level of Qualification.

Flight Simulator (Simulator) A full size replica of specific type or make, model and series aeroplane flight deck, including all equipment and computer programmes necessary to represent the aeroplane in ground and flight operations, a visual system providing an out-of-the-flight deck view, and a force cueing motion system. It is in compliance with the minimum standards for Flight Simulator qualification.

Flight Simulation Training Device (FSTD) A training device which is either a Flight Simulator (FS), a Flight Training Device (FTD), a Flight Navigation Procedure Trainer (FNPT) or a Basic Instrument Training Device (BITD).

Flight Test Data Actual aeroplane data obtained by the aeroplane manufacturer (or other supplier of acceptable data) during an aeroplane flight test programme.

Flight Training Device (FTD) A full size replica of an aeroplanes instruments, equipment, panels and controls in an open flight deck area or an enclosed aeroplane flight deck, including the assemblage of equipment and computer software programmes necessary to represent the aeroplane in ground and flight conditions to the extent of the systems installed in the device. It does not require a force cueing motion or visual system. It is in compliance with the minimum standards for a specific FTD Level of Qualification.

Free Response The response of the aeroplane after completion of a control input or disturbance.

Frozen/Locked A state where a variable is held constant with time.

FSTD Data The various types of data used to design, manufacture, test and maintain the FSTD.

FSTD Evaluation A detailed appraisal of a FSTD by the Authority to ascertain whether or not the standard required for a Qualification is met.

FSTD Manufacturer That organisation or enterprise being directly responsible to the Authority for requesting the initial FSTD model qualification.

FSTD Model A defined hardware/software combination which has obtained a qualification. Each FSTD will equate to a specific model and be a serial numbered unit.

FSTD Operator That person, organisation or enterprise directly responsible to the Authority for requesting and maintaining the recurrent qualification of a particular FSTD.

FSTD User The person, organisation or enterprise requesting training credits through the use of a FSTD.

FSTD User Approval The extent to which a qualified FSTD may be used by persons, organisations or enterprises as approved by the Authority. It takes account of aeroplane to FSTD differences and the operating and training ability of the organisation.

FSTD Qualification The technical ability of a FSTD as defined in the compliance document.

Functions Test A quantitative assessment of the operation and performance of a FSTD by a suitably qualified evaluator. The test can include verification of correct operation of controls, instruments, and systems of the simulated aeroplane under normal and non-normal conditions. Functional performance is that operation or performance that can be verified by objective data or other suitable reference material which may not necessarily be Flight Test Data.

Grandfather Rights

(i) The right of an FSTD operator (except a BITD operator) to retain the Qualification Level granted under a previous regulation of a JAA Member State.

(ii) Also the right of an FSTD user (except a BITD user) to retain the training and testing/checking credits which were gained under a previous regulation of a JAA Member State.

Ground Effect The change in aerodynamic characteristics due to modification of the air flow past the aeroplane caused by the presence of the ground.

Hands-off Manoeuvre A test manoeuvre conducted or completed without pilot control inputs.

Hands-on Manoeuvre A test manoeuvre conducted or completed with pilot control inputs as required.

High light Brightness The maximum displayed brightness which satisfies the appropriate brightness test.

Icing Accountability A demonstration of minimum required performance whilst operating in maximum and intermittent maximum icing conditions of the applicable airworthiness requirement.

Integrated Testing Testing of the FSTD such that all aeroplane system models are active and contribute appropriately to the results. None of the aeroplane system models should be substituted with models or other algorithms intended for testing only. This may be accomplished by using controller displacements as the input. These controllers should represent the displacement of the pilots controls and these controls should have been calibrated.

Latency The additional time, beyond that of the basic perceivable response time of the aeroplane due to the response time of the FSTD.

Manual Testing FSTD testing wherein the pilot conducts the test without computer inputs except for initial setup. All modules of the simulation should be active.

Master Qualification Test Guide (MQTG) The Authority approved QTG which incorporates the results of tests witnessed by the Authority. The MQTG serves as the reference for future evaluations.

Non-normal Control A term used in reference to Computer Controlled Aeroplanes. Non-normal Control is the state where one or more of the intended control, augmentation or protection functions are not fully available.

(Note: Specific terms such as ALTERNATE, DIRECT, SECONDARY, BACK UP etc., may be used to define an actual level of degradation)

Objective Test (Objective Testing) A quantitative assessment based on comparison with data.

Power Lever Angle The angle of the pilots primary engine control lever(s) in the cockpit. This may also be referred to as PLA, Throttle, Power Lever and Propeller Lever.

Predicted Data Data derived from sources other than type specific aeroplane flight tests.

Proof-of-Match (POM) A document which shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

Protection Functions Systems functions designed to protect an aeroplane from exceeding its flight and manoeuvre limitations.

Pulse Input An abrupt input to a control followed by an immediate return to the initial position.

Qualification Test Guide (QTG) A document designed to demonstrate that the performance and handling qualities of a FSTD agree within prescribed limits with agreed validation data and that all applicable regulatory requirements have been met. The QTG includes both the agreed validation data and FSTD data used to support the validation.

Reversible Control System A partially powered or unpowered control system in which movement of the control surface will backdrive the pilots control in the cockpit and/or affect its feel characteristics.

Snapshot A presentation of one or more variables at a given instant of time.

Statement of Compliance (SOC) A declaration that specific requirements have been met.

Step Input An abrupt input held at a constant value.

Subjective Test (Subjective Testing) A qualitative assessment based on established standards as interpreted by a suitably qualified person.

Time History A presentation of the change of a variable with respect to time.

Transport Delay The total FSTD system processing time between an input signal from a pilot primary flight control and the instrument response. It is the overall time delay incurred from signal input until output response. It does not include the characteristic delay of the aeroplane simulated.

Upgrade The improvement or enhancement of an FSTD for the purpose of achieving a higher qualification.

Validation Data Data used to prove that the FSTD performance corresponds to that of the (class of) aeroplane.

Validation Flight Test Data Performance, stability and control, and other necessary test parameters electrically or electronically recorded in an aeroplane using a calibrated data acquisition system of sufficient resolution and verified as accurate by the organization performing the test to establish a reference set of relevant parameters to which like STD parameters can be compared.

Validation Test A test by which FSTD parameters can be compared with the relevant Validation Data.

Visual System Response Time The interval from an abrupt control input to the completion of the visual display scan of the first video field containing the resulting different information.

3.2 Abbreviations

AC	Advisory Circular
ACJ	Advisory Circular Joint
ACM	Acceptable Means of Compliance
A_d	Total initial displacement of pilot controller (Initial displacement to final resting amplitude)
AFM	Aeroplane Flight Manual
ADL	Allowable Deficiency List
AGL	Above Ground Level (metres or feet)
Airspeed	Calibrated airspeed unless otherwise specified (knots)
Altitude	Pressure altitude (metres or feet) unless specified otherwise
A_n	Sequential amplitude of overshoot after initial X axis crossing, e.g. $A_1 = 1^{st}$ overshoot
AOA	Angle of Attack (degrees)
ASTI	Aerospace Software and Technologies Institute
Bank	Bank/Roll angle (degrees)
BITD	Basic Instrument Training Device
CAVOK	Ceiling and Visibility OK
CCA	Computer Controlled Aircraft
cd/m^2	candela/metre^2, 3.4263 candela/m^2 = 1 ft-Lambert
cm(s)	centimetre, centimetres
CPL	Commercial Pilot License.
CT&M	Correct Trend and Magnitude
daN	decaNewtons
deg	degree, degrees
DH	Decision Height
distance	distance in Nautical Miles unless specified otherwise
DME	Distance Measuring Equipment
DUT	Delft University of Technology
EASA	European Aviation Safety Agency
EPR	Engine Pressure Ratio
FAA	Federal Aviation Administration (U.S.)
FAR	Federal Air Regulations
FNPT	Flight & Navigation Procedures Training
FSDO	Flight Standard District Office
FSTD	Flight Simulation Training Device
ft	feet, 1 foot = 0.304801 metres
ft-Lambert	foot-Lambert, 1 ft-Lambert = 3.4263 candela/m^2
fuel used	Mass of fuel used (kilos or pounds)
g	Acceleration due to Gravity (metres or feet/sec^2), 1 g = 9.81 m/sec^2 or 32.2 feet/sec^2
G/S	Glideslope
Height	Height above ground = AGL (metres or feet)
IATA	International Airline Transport Association

IEM	Interpretative and Explanatory Material
IFR	Instrument Flight Rules
IOS	Instructor Operating Station
IQTG	International Qualification Test Guide (RAeS Document)
IR	Instrument Rating
ISA	International Standard Atmosphere
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
km	Kilometres 1 km = 0.62137 Statute Miles
kPa	KiloPascal (Kilo Newton/Metres^2). 1 psi = 6.89476 kPa
kts	Knots calibrated airspeed unless otherwise specified, 1 Knot = 0.5148 m/sec or 1.689 ft/sec
lb	pounds
m	Metres, 1 Metre = 3.28083 feet
MCC	Multi-Crew Co-operation
MDA	Minimum Decision Altitude
Medium	Normal operational weight for flight segment
MEL	Minimum Equipment List
min	Minutes
MLG	Main Landing Gear
MPa	MegaPascals [1 psi = 6894.76 pascals]
MQTG	Master Qualification Test Guide
ms	millisecond(s)
N	Normal Control Used in reference to Computer Controlled Aeroplanes
NM	Nautical Mile, 1 Nautical Mile = 6,080 feet = 1852 m
NN	Non-Normal Control Used in reference to Computer Controlled Aeroplane
Nominal	Normal operational weight, configuration, speed, etc., for the flight segment specified
N_1	Engine Low Pressure Rotor revolutions per minute
N_2	Engine High Pressure Rotor revolutions per minute
NWA	Nosewheel Angle (degrees)
n	sequential period of a full cycle of oscillation
OTP	Optional Test Program
PAPI	Precision Approach Path Indicator System
PCATD	Personal Computer-based Aviation Training Device
Pitch	Pitch angle (degrees)
PLA	Power Lever Angle
P_0	Time from pilot controller release until initial X axis crossing (X axis defined by the resting amplitude)
P_1	First full cycle of oscillation after the initial X axis crossing
P_2	Second full cycle of oscillation after the initial X axis crossing
P_n	Sequential period of oscillation
P_f	Impact or Feel Pressure
PLF	Power for Level Flight
psi	pounds per square inch

POI	Principle Operations Inspector
PPL	Private Pilot License
PTT	Part-Task Trainer
QTG	Qualification Test Guide
RAE	Royal Aerospace Establishment
RAeS	Royal Aeronautical Society
REIL	Runway End Identifier Lights
R/C	Rate of Climb (metres/sec or feet/min)
R/D	Rate of Descent (metres/sec or feet/min)
RDR	Reference Data Report
RVR	Runway Visual Range (metres or feet)
s	second(s)
sec(s)	second, seconds
1st Segment	That portion of the takeoff profile from liftoff to gear retraction
2nd Segment	That portion of the takeoff profile from after gear retraction to initial flap/slat retraction
3rd Segment	That portion of the takeoff profile after flap/slat retraction is complete
Sideslip	Sideslip Angle (degrees)
sm	Statute Miles 1 Statute Mile = 5,280 feet = 1609 m
SOC	Statement of Compliance
STOM	Synthetic Trainer Operations Manual
T(A)	Tolerance applied to Amplitude
T(p)	Tolerance applied to period
T/O	Takeoff
TRC	TRC Development b.v. 'The Real Cockpit'
TTI	Training Technology International
T_f	Total time of the flare manoeuvre duration
T_i	Total time from initial throttle movement until a 10% response of a critical engine parameter
T_t	Total time from T_i to a 90% increase or decrease in the power level specified
VASI	Visual Approach Slope Indicator System
VGS	Visual Ground Segment
V_{mca}	Minimum Control Speed (Air)
V_{mcg}	Minimum Control Speed (Ground)
V_{mcl}	Minimum Control Speed (Landing)
V_r	Rotate Speed
V_s	Stall Speed or minimum speed in the stall
VFR	Visual Flight Rules
WAT	Weight, Altitude, Temperature

4 Statements of Compliance

4.1 Introduction

The JAR-STD 3A document for certification prescribes the Minimum Technical Requirements expected from an FNPT I synthetic training device. This section will go through each of the requirements. It will be shown how the TRC472-F described in this document complies with these minimum technical requirements.

4.2 Cockpit Features

JAR-STD 3A:
"*A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated and in which the switches and all the controls will operate as, and represent those in, that aeroplane or class of aeroplane.*"

Below, two pictures show the enclosed cockpit of the TRC472-F simulator and the instructor station, which is located behind the cockpit. Both the cockpit and the instructor station are located within an enclosed room to prevent outside disturbances during flight.

Photograph of the enclosed cockpit of the TRC472-F simulator.

Instructor station next to the enclosure of the simulator cockpit.

4.2.1 Instruments and Systems

JAR-STD 3A:
"Instruments, equipment, panels, primary and secondary flight controls sufficient for the training events to be accomplished [shall] be located in a spatially correct flight deck area."

Modelled after the popular Cessna 172 Skyhawk, all details are precisely reproduced according to the exact dimensions of the original panel and they can be found in exactly the same position. Using gauges modelled after the original, but designed to be driven from a Personal Computer. The TRC472-F is a product out of a complete line of training devices.

The TRC472-F FSTD is equipped with either original or replicated, realistic instruments showing no difference in size and functionality compared to the instruments of the Cessna 172. The instruments are equipped with special servomotors that allow for correct indication. The basic flight instruments are displayed and arranged similarly to instruments in the Cessna 172.

1. Wet Compass
   The Wet Compass is an original wet compass extended with electromagnetic controls to override the original magnetic field from the earth.

2. Annunciator Panel (Optional)
   The Annuciator Panel is an optional part which is included with the optional GPS system.

3. VOR 1
   The VOR1 is a replica from the Bendix King xxx and has an adjustable compass ring. The settings of this compass ring is passed on to the flight simulator software.

4. VOR 2
   The VOR1 is a replica from the Bendix King xxx and has an adjustable compass ring. The settings of this compass ring is passed on to the flight simulator software.

5. ADF
   The ADF has a compass ring which can be adjusted by the dial. The settings of this compass ring is passed on to the flight simulator software.

6. Altimeter (Inches or Metric Pressure Scale) The Altimeter has a pointer foor 100 feet, 1000 feet and a disc type pointer for 10.000 feet. The pressure scale can be adjusted using the dial.

7. Vertical Speed Indicator
   A Cessna 172 type VSI

8. Warning Panel
   The warning panel has a switch for Bright, Dim and Test. It has indicators for Low Fuel Left and Fright, Oil Press, Vacuum Left and Right and Volts. The Warning Panel is lighted from behind with bright LEDs

9. Tachometer
   The tachometer scale reaches up to 3500 revolutions, where Color Range Markings at 2100, 2500 and 2600 revolutions.

10. Attitude Indicator
    The Attitude Indicator contains 2 servomotors. The first servomotor controls upward and downward motions. The second servomotor regulates the turning motion. The roll indication is maximum 95 degrees left and 95 degrees right. When during a roll the indicator reaches its maximum mechanical left position, during the completion of the roll it turns very quickly back to the maximum mechanical right position and continous to indicate properly again. Proper indication of the horizon is achieved through a dial which is located centrally underneath the Attitude Indicator.

11. Heading Indicator w. Autopilot heading bug
    The HI comes with a heading bug for use with the Autopilot as delivered in the radio stack. The left dial allows you to indicate the position of the gyro compass. The right dial is used to fix the heading bug on the proper heading (for use with auto pilot). Just as with the actual instrument, this dial needs to be pressed down in order to move the heading bug.

12. Airspeed Indicator
    The AI has indication for up to 200 Knots of airspeed with Color Range Markings for rotation speed and stall speed. The extra temperature indicator and dial are not functionally integrated. Green and yellow areas are available for indication of certain speeds.

13. Turn and Bank Indicator
    The Turn and Bank indicator has indications for a 2 minute turn.

14. Digital Clock
    The DC is a replica of the DAVTRON 830 digital clock and has exactly the same functionality (using Microsoft Flight Simulator software) as the real instrument. Due to additio nal software, functionality normally not available at the DC in the flight simulator has been achieved. See for a full description of the functionality the separate digital clock description chapter.

15. Fuel Indicator (Left and Right)
    The 2 fuel indicator needles give an indication of the fuel in the left and right wing tanks. Using the tank switch, the use of a certain fuel tank can be choosen.

16. EGT / Fuel Flow Indicator
    This indicator show the proper use of the mixture setting and fuel flow.

17. Oil Temp. / Pressure Indic.
    This indicator shows the oil temperature of the engine and the oil pressure on the engine.

18. Suction Gauge/Ammeter
    The suction gauge contains 2 servo driven gauges. Therefore the precision is very high and the needles are exactly to scale. It displays the instrument pressure as simulated and an ampere indicator displays the current used from the alternator to the battery or from the battery to the airplane. The suction gauge shows no difference in size and functionality compared to the suction gauge of the Cessna 172.

19. Cessna style Yoke
    The yoke is a replica of the original Cessna Yoke. Not like most table top yokes, the yoke of the TRC472 can turn over a full 180 degrees and has a total travel (in and out) of 18 centimeters (7") like as in the original Cessna 172. (Most commercially available yokes only have a travel of approx. 9.5 cm./3.7" and can turn approx. 110 degrees maximum).

20. Circuit Breaker Panel
    The circuit breaker panel has simulated circuit breakers which can be controlled by flight simulator software. Since Microsoft Flight Simulator does not support the use of Circuit Breakers, they are not functioning with Microsoft Flight Simulator. The control software and control hardware are able to drive the Circuit Breakers. Therefore, when support for other flight simulator software becomes available.

21. Keyswitch (5 position incl. starter)
    TRC uses an original 5 position keyswitch, with the positions OFF, LEFT, RIGHT, BOTH and START. The start position has a spring return, so realistic start-up procedures as well as pre-flight checks can be carried out realistic.

22. Master Switch (Alt. and Battery)
    Two separate switches are functional as Master Switch.

23. Circuit Breakers
    Realistic working circuit breakers are available on the TRC472 panel. However, they are not supported by Microsoft Flight Simulator 2002/2004. TRC is working on an add-on, which enables the use of the circuit breakers fully. The circuit breakers include

24. Switches Panel
    The fully functional switches on this part of the panel include the Fuel Pump, Bacon lights, Landing Lights, Taxi Lights, Nav., Strobe and Pitot Heat.

25. Avionics Master Switch
    These are the switches to enable the use of the Avionics.

26. Circuit Breakers

27. Realistic working circuit breakers are available on the TRC472 panel. However, they are not supported by Microsoft Flight Simulator 2002/2004. TRC is working on an add-on, which enables the use of the circuit breakers fully. The circuit breakers include

28. Light Regulation
    By turning this knob, the backlight in the instruments can be set to your requirements. It is recommended to turn the light not onto the maximum value when not needed to avoid heat building up.

29. Static Air Switch
    The ON/OFF switch for the static air function.

30. Trim Indicator
    The trim indicator gives an indication of the position of the vertical trim. Adjusting the trim wheel, the indicator will move up and down. For take-off, the indicator should be in the middle position.

31. Trim Wheel
    The trim wheel allows you to change the position of the vertical trim. Adjusting the trim wheel, the trim indicator will move up and down. For take-off, the indicator should be in the middle position. The trim wheel has exactly the number of revolutions as in the real Cessna 172 Skyhawk. This is one of the few instruments, which is not in the original position as in the real aircraft. In a real Cessna 172 Skyhawk, the trim wheel is positioned on a middle console below the panel and has a larger size.

32. Throttle (with Friction Lock)
    The throttle (black knob) has a friction lock, which enables the pilot to tighten the throttle by turning the outside ring clockwise or loosening it anti-clockwise.

33. Mixture (with Leaning)
    The mixture (red knob) has a leaning possibility. By pressing the inner part of the knob, the mixture can be moved inwards or outwards. By turning the outside part of the knob, fine-tuning can be done in combination with the EGT indicator to obtain the best possible fuel use against airspeed.

34. Prop Adjust (optional)
    As an option a Vernier Control for propeller adjust can be ordered or (when the option has been ordered, is already built-in).

35. Flap Indicator
    This indicator shows the position of the flaps. The indicator runs slowly behind the positioning of the flap switch to behave as close as the flap indicator in the real aircraft.

36. Flap Switch
    The flaps switch and can be set at 0, 10, 20 or 30 degrees of flaps.

37. Expansion for 2nd Yoke
    For future expansion, there is already a hole in the panel to allow a second yoke.

38. Tank Switch
    The tankswitch has the positions LEFT, RIGHT and BOTH. This is one of the few instruments, together with the trim wheel, which is not in the original position as in the real aircraft. In a real Cessna 172 Skyhawk, tank switch is normally positioned on the lower part of the middle console below the panel.

39. Fuel Shut Off Switch
    This switch completely shuts off the fuel flow to the aircraft engine. When used during flight, the engine will finally stop.

40. Audio Panel
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

41. NAV/COM1
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

42. NAV/COM2
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

43. Digital DME
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

44. Transponder
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

45. ADF
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

46. Autopilot
    This instrument is part of the radio stack and is fully described in the Navigation Equipment Section.

47. Emergency Transmitter
    Since this switch is not supported in software at all known flight simulator packages, it is not functionally implemented.

4.2.2 Flight Controls

JAR-STD 3A:
"Control forces and control travel shall broadly correspond to that of the replicated aeroplane or class of aeroplane."

The flight controls of the TR472 simulator reproduce the flight controls as can be found in reality. The following describes the flight yoke, the rudder pedals, trim tab and engine controls.

1. Yoke

The Yoke can turn left and right 90 degrees for a total of 180 degrees. The maximum movement in- and out is 170 mm. Due to this wide range of movement, the SimKits Cessna style Yoke behaves very close to the behaviour of the yoke in a real aircraft. The system is made out of metal and quality ABS plastics for the control wheel. The tube is made out of stainless steel and has a fluent travel via nylon bearings. The feels and looks of the Yoke are exactly replicated from the Yoke found in a Cessna 172 and other General Aviation aircraft. The Yoke does not need electrical power.

2. Rudder Pedals

The Rudder Pedals with Proportional Brake System are an exact replica of the rudder pedals found in many aircraft. They are produced from a stainless steel rudder system with die-cast aluminium rudder pedals (original aircraft parts) and a powder coated, 3 mm. thick aluminum case. The proprotional toe brake system allows for usage of the brakes to control the aircraft when on the ground. The rudder pedals can be connected to the CCU or via USB and is recognized under USB as a standard control device by the PC.

3. Flap handle

The Flaps Switch and Indicator is a replica of the original Cessna 172/182 Flaps Switch and Indicator. The Flaps Switch has 4 positions: Flaps Up, Flaps 10 degrees, Flaps 20 degrees and Flaps 30 degrees. The indicator is servo driven and indicates when the Flaps have reached their position.

4. Trim wheel

The Trim Wheel is identical as used in the TRC472 panel and is a smaller version of the original trim wheel as used in a.o. the Cessna 172 Skyhawk. Although smaller, the working is very close to the original trim wheel. 5 turns moves the pointer from "Nose Up" to "Nose Down", just like in a real Cessna 172. The Trim Wheel is produced from high quality, heavy massive plastic and a high quality 5-turn potentiometer is used to send the information to the CCU.

5. Engine controls

The throttle is not a replica, but an original high quality throttle as used in light aircraft. (It is constructed according FAA regulations). The casing (from quality finished aluminum) has Teflon inner liner for low friction. Features stainless steel end fittings, swivel, and end rod. Furnished with FAA-style Black knob. Travel: 3-3/8". The mixture is not a replica, but an original high quality mixture as used in light aircraft. (It is constructed according FAA regulations). The casing (from quality finished aluminum) has

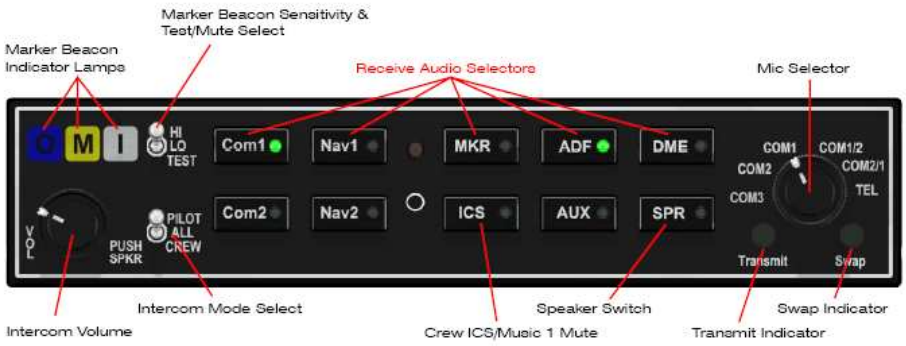
Teflon inner liner for low friction. Features stainless steel end fittings, swivel, and end rod. Furnished with FAA-style Red knob and leaning possibility (fine tuning). Travel: 3-3/8".

4.3 Navigation Equipment

JAR-STd 3A:
"Navigation equipment correspondng to that of the replicated aeroplane or class of aeroplanes, with operation within the tolerances prescribed for the actual airborne equipment. This shall include communication equipment (interphone and air/ground communications systems)."

TRC's Radio Stack RS372 for Flight Simulation is modelled after the popular Bendix King Silver Line Radio Stack, as used a.o. in the Cessna 172 Skyhawk, all details are precisely reproduced extremely close to the exact dimensions of the original radios. Each radio is separately mounted. You can therefore fit the radios in your panel in random order. The RS372 Radio Stack is designed to be driven from a Personal Computer via USB.
The TRC RS372 Radio Stack is a set of modules, which internal construction contains switches, rotary encoders, an LCD Display with driver integrated circuits (where applicable) and Printed Circuit Boards. Each module is connected to the so-called RSC (Radio Stack Controller), an electronics board containing a stand-alone microprocessor. This board is connected to the Personal Computer where the flight simulator software is running on via USB. The firmware (software which runs on the RSC) is downloaded automatically from the PC every time the RSC is powered up. This assures the user of having the latest software version running on the RSC. The interface software, which controls the functionality of the TRC RS372 Radio Stack is running on the background of the Personal Computer where the flight simulator software is running on.

1. Audio Panel



Receiver audio is selected through two momentary and six latched, pushbutton, backlit switches. Com 1 and Com 2 are the momentary switches. The latched function is simulated by the LED which is lighted in the IN position and not lighted in the OUT position. The users can identify which receivers are selected by noting which of the green switch LEDs is illuminated. Push buttons labeled Nav 1, Nav 2, DME, MKR (Marker), ADF, AUX (auxiliary), and SPR (Speaker) are "latched" type switches. When one of these buttons is pressed, it will stay in the "in" position, illustrated by a LED. Press the switch again and it be in the "out" position and remove that receiver from the audio.

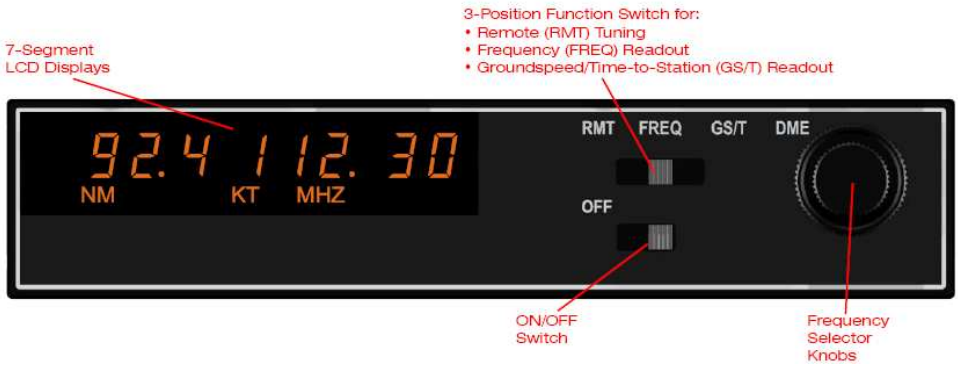
2. NAV/COM1

Rotate the VOL knob clockwise from the OFF position. Select the desired operating frequency in the standby display by rotating the Frequency Select Knobs either clockwise or counterclockwise. A clockwise rotation will increment the previous frequency while a counterclockwise rotation will decrement the previous frequency. The outer knob will change the MHz portion of the standby display. At one band-edge (118 or 136 MHz) the following 1 MHz change will wrap around to the other band-edge. The inner knob will change the kHz portion of the standby display. It will change in increments of 50 kHz

when the knob is pushed in and 25 kHz when the knob is pulled out. The frequency wrap around at the edge of the band is also utilized when incrementing or decrementing the kHz portion of the standby display. To tune the radio to the desired operating frequency, the desired frequency must be entered into the standby display (Figure 5) and then the transfer button must be pushed.

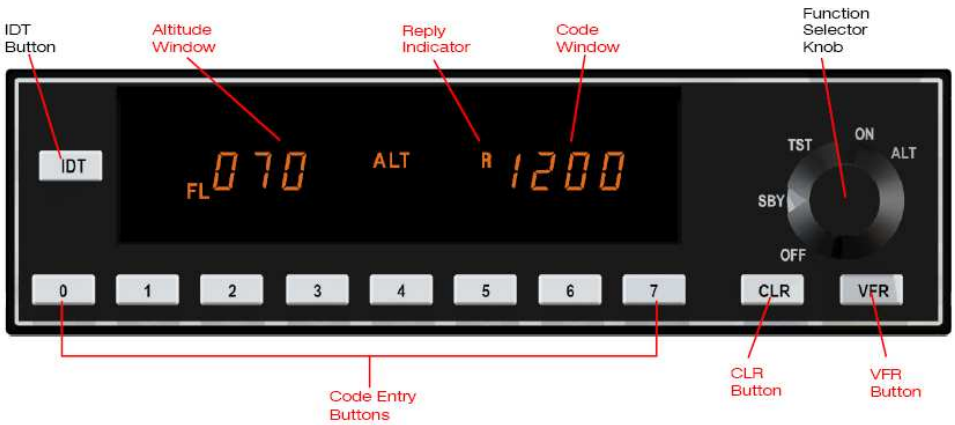
3. NAV/COM2
   See NAV/COM1.

4. Digital DME



The 3-position function switch determines both the information displayed and the channeling source. Place the function switch on Frequency (FREQ). The unit is channeled internally with its own two concentric frequency selection knobs. The smaller of the two knobs has an "in" and an "out" position. When in the "in" position, this smaller knob changes the 0.1 MHz digit (0.0, 0.1, 0.2, etc.). When pulled "out", it changes in 0.05 MHz steps, wrapping around at 0.00 and 0.95 MHz.The outer, larger knob changes the larger digits (1 MHz, 10 MHz). In FREQ mode, the unit will display distance and the selected frequency.

5. Transponder

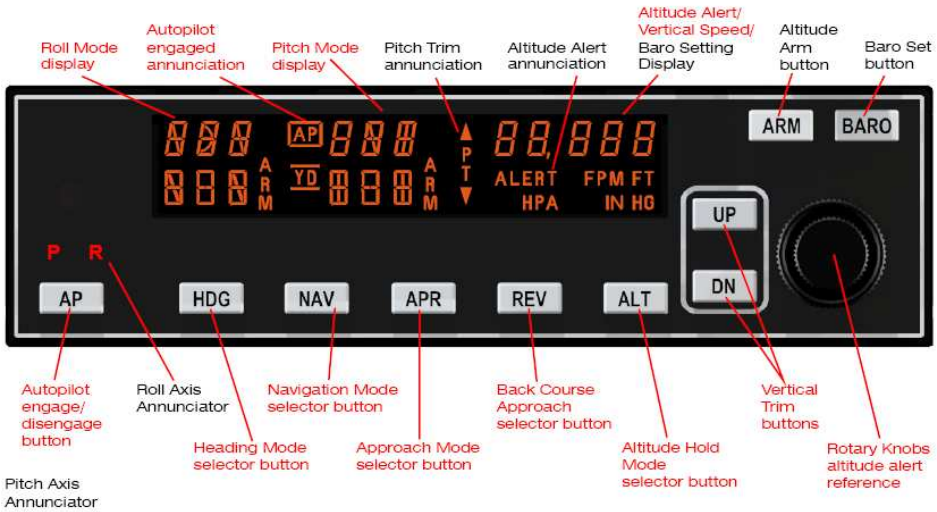


Receiving ground radar interrogations at 1030 MHz, it returns a coded response of pulses to groundbased radar on a frequency of 1090 MHz. As with other Mode A/Mode C transponders, the KT 76C replies with any one of 4,096 codes, which differ in the position and number of pulses transmitted. By "replying" to ground transmissions, the KT 76C enables ATC computers to display aircraft identification, altitude and ground speed on Enroute, Approach or Departure Control radar screens.

6. ADF

The active frequency (to which the ADF is tuned) is displayed in the left side of the window at all times. A standby frequency is displayed in the right side when "FRQ" is annunciated. With "FRQ" annunciated, the standby frequency is selected using the frequency select knobs which may be rotated either clockwise or counterclockwise. Pull the small inner knob out to tune 1s. Push the smaller inner knob in to tune 10s. The outer knob tunes the 100s and the 1000s up to 1699. The standby frequency selected may then be put into the active window by pressing the "FRQ" button. The standby and active frequencies will be exchanged (flip-flopped), the new frequency will become active, and the former active frequency will go into standby.

7. Autopilot



1. AUTOPILOT ENGAGE/DISENGAGE (AP) BUTTON - When pushed, engages autopilot if all logic conditions are met. The autopilot will engage in the basic roll (ROL) mode which functions as a wing leveler. When pressed again, will disengage the autopilot. The AP button must be pressed and held for 0.25 seconds to engage the autopilot.
2. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will arm the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on either the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading. Button can also be used to toggle between HDG and ROL modes.
3. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will arm the navigation mode. The mode provides automatic beam capture and tracking of VOR, LOC or GPS as selected for presentation on the HSI or CDI. NAV mode is recommended for enroute navigation tracking. NAV mode may also be used for front course LOC tracking when GS tracking is not desired.
4. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will arm the Approach mode. This mode provides automatic beam capture and tracking of VOR, GPS, LOC, and Glideslope (GS) on an ILS, as selected for presentation on the HSI or CDI. APR mode is recommended for instrument approaches.
5. BACK COURSE APPROACH (REV) MODE SELECTOR BUTTON - When pushed, will arm the Back Course approach mode. This mode functions similarly to the approach mode except that the autopilot response to LOC signals is reversed, and GS is disabled.
6. ALTITUDE HOLD (ALT) MODE SELECT BUTTON - When pushed, will select the Altitude Hold mode. This mode provides tracking of the selected altitude.
7. VERTICAL TRIM (UP/DN) BUTTONS - The action of these buttons is dependent upon the vertical mode present when pressed. If VS mode is active, immediate button strokes will increment the vertical speed commanded either up or down at the rate of 100 ft/min per button press. If ALT mode is active, incremental button strokes will move the altitude hold reference altitude either up or down at 20 feet per press.
8. ALTITUDE HOLD/VERTICAL SPEED DISPLAY In VS hold, displays the commanded vertical speed. In altitude hold, displays the selected reference altitude.

9. PITCH MODE DISPLAY Displays the active and armed pitch modes (VS, ALT, ARM and GS).
10. ROLL MODE DISPLAY Displays the active and armed roll modes (ROL, HDG, NAV ARM, NAV, APR ARM, APR, REV ARM, REV, GS ARM).
11. AUTOPILOT ENGAGED (AP) ANNUNCIATION - Illuminates whenever the autopilot is engaged.

4.4 Sound System

JAR-STD 3A:
"Engine sounds shall be available."

The X-plane simulation environment provides for the aircraft's engine sounds. Sound pitch is dependent on propeller RPM. Wind sounds are audible too, increasing in volume with airspeed. Upon touchdown, tire sounds can be heard. All sounds are generated by the soundcard of the X-plane computer. The sound is made audible with a stereo speaker set and subwoofer located in front of the simulator.

4.5 Aircraft and Atmosphere Modelling

The TRC472-F FSTD is simulated with the X-Plane software package, developed by Austin Meyer.

4.5.1 Airplane

X-Plane reads in the geometric shape of any aircraft and then figures out how that aircraft will fly. It does this by an engineering process called "blade element theory", which involves breaking the aircraft down into many small elements and then finding the forces on each little element many times per second. These forces are then converted into accelerations which are then integrated to velocities and positions.

X-Plane goes through the following steps to propagate the flight:

1: Element Break-Down
Done only once during initialization, X-Plane breaks the wing(s), horizontal stabilizer, vertical stabilizer(s), and propeller(s) (if equipped) down into a finite number of elements. The number of elements is decided by the user in Plane-Maker. Ten elements per side per wing or stabilizer is the maximum, and studies have shown that this provides roll rates and accelerations that are very close to the values that would be found with a much larger number of elements.

2: Velocity Determination
This is done twice per cycle. The aircraft linear and angular velocities, along with the longitudinal, lateral, and vertical arms of each element are considered to find the velocity vector of each

element. Downwash, propwash, and induced angle of attack from lift-augmentation devices are all considered when finding the velocity vector of each element. Propwash is found by looking at the area of each propeller disk, and the thrust of each propeller. Using local air density, X-Plane determines the propwash required for momentum to be conserved. Downwash is found by looking at the aspect ratio, taper ratio, and sweep of the wing, and the horizontal and vertical distance of the "washed surface" (normally the horizontal stabilizer) from the "washing surface" (normally the wing), and then going to an empirical look-up table to get the degrees of downwash generated per coefficient of lift.

3: Coefficient Determination
The airfoil data entered in Part-Maker is 2-dimensional, so X-Plane applies finite wing lift-slope reduction, finite-wing CLmax reduction, finite-wing induced drag, and finite-wing moment reduction appropriate to the aspect ratio, taper ratio, and sweep of the wing, horizontal stabilizer, vertical stabilizer, or propeller blade in question. Compressible flow effects are considered using Prandtl-Glauert, but transonic effects are not simulated other than an empirical mach-divergent drag increase. In supersonic flight, the airfoil is considered to be a diamond shape with the appropriate thickness ratio... pressures behind the shock waves are found on each of the plates in the diamond-shaped airfoil and summed to give the total pressures on the foil element.

4: Force Build-Up
Using the coefficients just determined in step 3, areas determined during step 1, and dynamic pressures (determined separately for each element based on aircraft speed, altitude, temperature, propwash and wing sweep), the forces are found and summed for the entire aircraft. Forces are then divided by the aircraft mass for linear accelerations, and moments of inertia for angular accelerations.

5: Get Back to Work
Go back to step 2 and do the whole thing over again at least 15 times per second.

4.5.2 Atmoshpere

Weather is variable from clear skies and high visibility to thunderstorms with controllable wind, wind shear, turbulence, and microbursts. Rain, snow and clouds are available for instrument flying. Real weather conditions can be downloaded from the internet, allowing you to fly in the actual weather that currently exists.

4.6 Instructor Station

JAR-STD 3A:
"In addition to the flight crew member's stations, suitable viewing arrangements for the instructor [shall be provided. These shall] provide an adequate view of the crew members panels and station."

The instructor station is located right behind the cockpit setup. From the instructor station, it

is possible to have a good, direct view of the pilot and his instruments. The instructor station itself is equipped with a PC that allows control over the simulation at any desired point in time. From this computer, the instructor is able to control the simulated conditions. It is possible, for example, to change weather conditions, freeze flight, set the airplane to another situation, etc.

The layout of the Instructor Station Screen is as follows. The left hand side of the screen contains a number of buttons with which simulation conditions can be altered, such as weather conditions, equipment failures and selection of the airport. The center of the screen is reserved for a map display of the area in which the aircraft is located. The map display can show weather, NDB, VOR, DME, ILS, and airport locations as well as the flown path. It is possible to zoom in or out on the map and to pan the location. The bottom part of the center screen shows the vertical flight profile. On the right hand side of the instructor station screen it is possible to display some of the aircraft instruments in order to monitor the aircraft condition.

4.6.1 Instructor Station Controls

From the instructor station, it is possible to control the following simulation options:

1. Take-off and landing positioning
   On the top, left-hand side of the instructor station screen it is possible to select take-off or

landing positions at final or approach for each available runway of the currently selected airport.

2. Airport selection
   The "Go to Airport" button on the left hand side of the instructor station screen allows the instructor to select any airport available in the database.

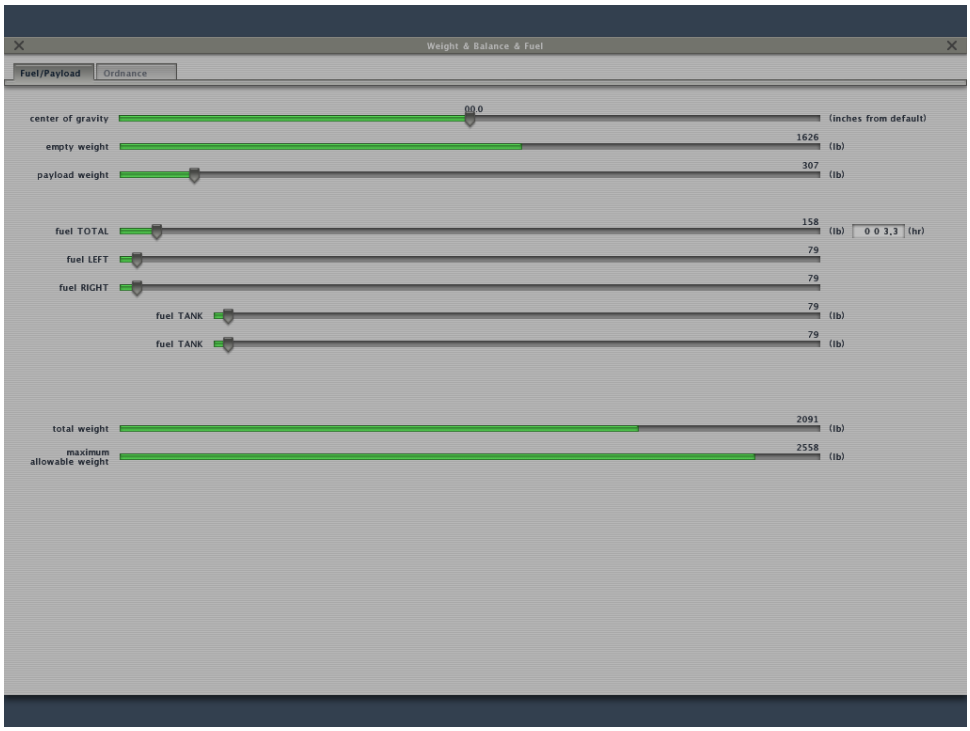
3. Aircraft selection
   The "Load Aircraft" button below the "Go to Airport" button allows the instructor to select a different type of aircraft. Since the TRC472-F is to be certified for a single aircraft model only, this option is not used.

4. Loading and Saving Situations
   To allow for quick starting in several pre-set conditions, flight situations can be saved for later usage. The "Save Situation" and the "Load Situation" buttons can be used to store the current situation or to retrieve a previously stored situation respectively.

5. Local Time
   With the "Set Time" button, local current time can be set to any desired value. Dawn is set at (06:00), Dusk at (17:00) and evening at (19:00). Time will advance in real-time.

6. Weather Control
   The instructor station allows for full control over the weather in the simulation. With the "Set Weather" button a menu is opened from which many different aspects of the weather can be controlled.

7. Weight and Fuel settings Specific weight and fuel conditions can be selected with the "Weight & Fuel" button. A new window is opened that allows for precise control of the aircraft's weight and fuel settings.



8. Equipment Failures
   Below the "Weight and Fuel" button is the "Fail Equipment" button with which instrument or engine failures can be initiated during flight.

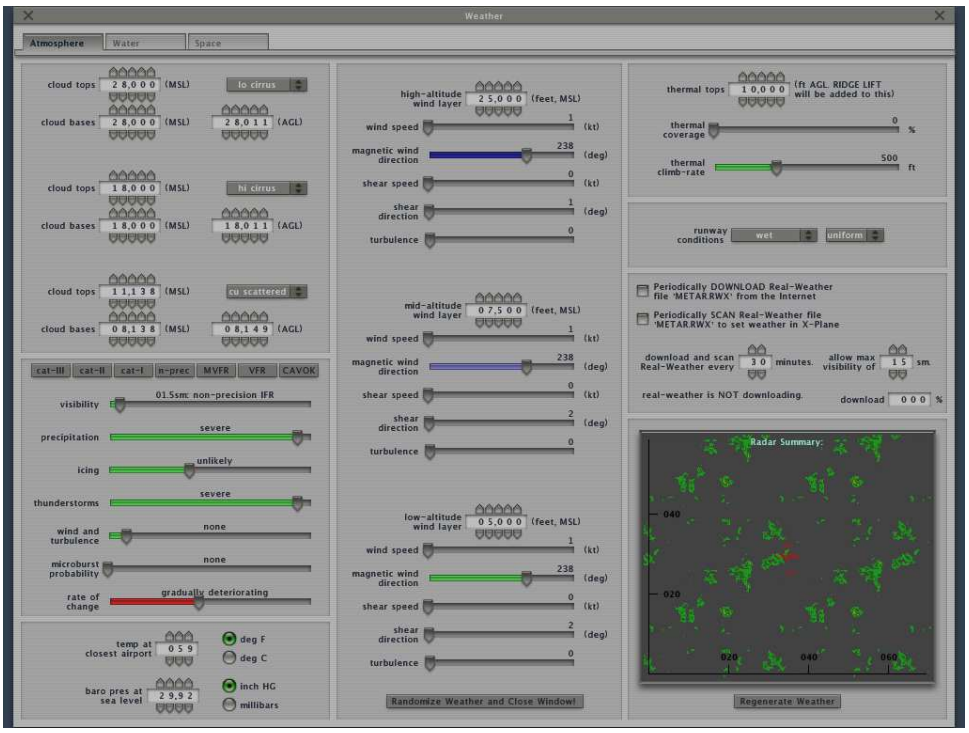
9. Pause and Freeze
   The simulation can be paused and frozen during simulation with the "Pause" and "Freeze-Location" buttons.

4.6.2 Airports

After pressing the "Go To Airport" button on the instructor station screen, a menu appears from which any airport in the airport database can be selected. As soon as an airport is selected the simulation is reset to this location. X-Plane scenery is world-wide. A database of European and North American airports is available.

4.6.3 Weather

Selecting a different weather condition witht the "Weather" button on the main instructor station screen opens up another window with all weather condition options. A great number of conditions can be set, including donwloading current real-weather data from an on-line database.



The following options are available to control weather:

1. Clouds
2. Visibility

3. Precipitation
4. Icing
5. Thunderstorms
6. Wind and Turbulence
7. Microbursts
8. Rate of change of weather
9. Temperature and pressure
10. Runway conditions

4.6.4 System Failures

A great number of system failures can be simulated. Upon pushing the "Fail Equipment" button on the main instuctor station screen, a new window is opened which shows all the options for failing equipment.

The following items can be chosen to malfunction during flight:

1. Instruments
   Instrument failures will cause the instruments to stay in the position they were in when the failure occurred. Vacuum system failures are realistic, complete with gyro tumble as the gyros spin down.

2. Navaids

3. Engine systems, including engine fire
   Engine failures will cause immediate lack of power. Oil pressure failures will cause the engine to slowly lose power and then seize.

4. Hydraulic systems

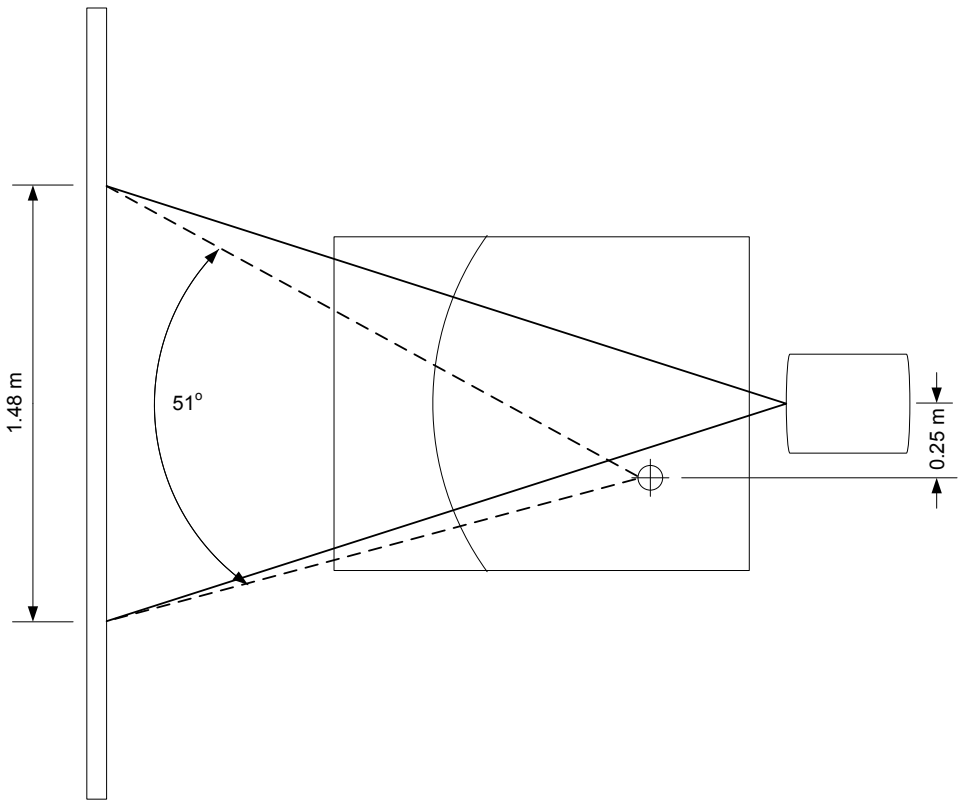
5. Electrical systems

6. Control surfaces
   Control failures will cause the controls to snap to the center position and stay there, simulating cable failure.

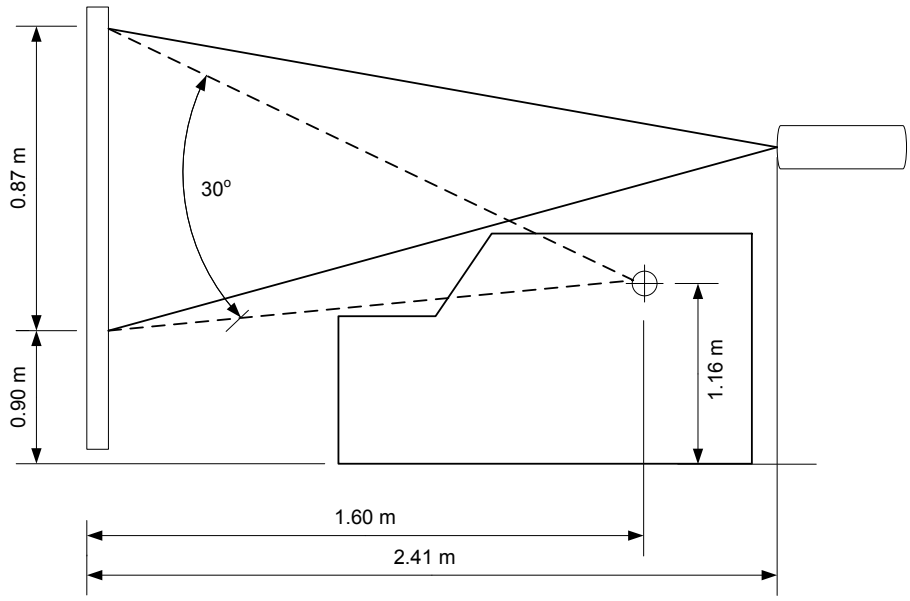
4.7 Visual System

JAR-STD 3A:
"A visual system (night/dusk or day) capable of providing a field-of-view of a minimum of 45 degrees horizontally and 30 degrees vertically, unless restricted by the type of aeroplane, simultaneously for each pilot, including adjustable cloud base and visibility. The visual system need not be collimated but shall be capable of meeting the standards laid down in Part 3 and 4 (Validation, Functions and Subjective Tests - See AMC STD 3A.030). The responses of the visual system and the flight deck instruments to control inputs shall be closely coupled to provide the integration of the necessary cues."

The outside visual is projected with a HP vp6121 DLP projector on a screen in front of the cockpit mockup. Distance from the projector to the projection screen is 2.41m, resulting in a projection of 1.48m wide and 0.87m high. From the cockpit eye-reference point of the pilot, at approximately 1.6m from the projection screen, this results in a horizontal field-of-view of 51 degrees and a vertical field-of-view of 30 degrees (see figure on next page).
Projection resolution of the outside visual is 1024x768 pixels. Refresh rate of the rendered visual is set to have a minimum of at least 25Hz.
It is possible to render many different atmospheric conditions such as day, night, dusk, but also clouds layers, rain, thunderstorms etc.



Top view of the simulator, projector and projection screen



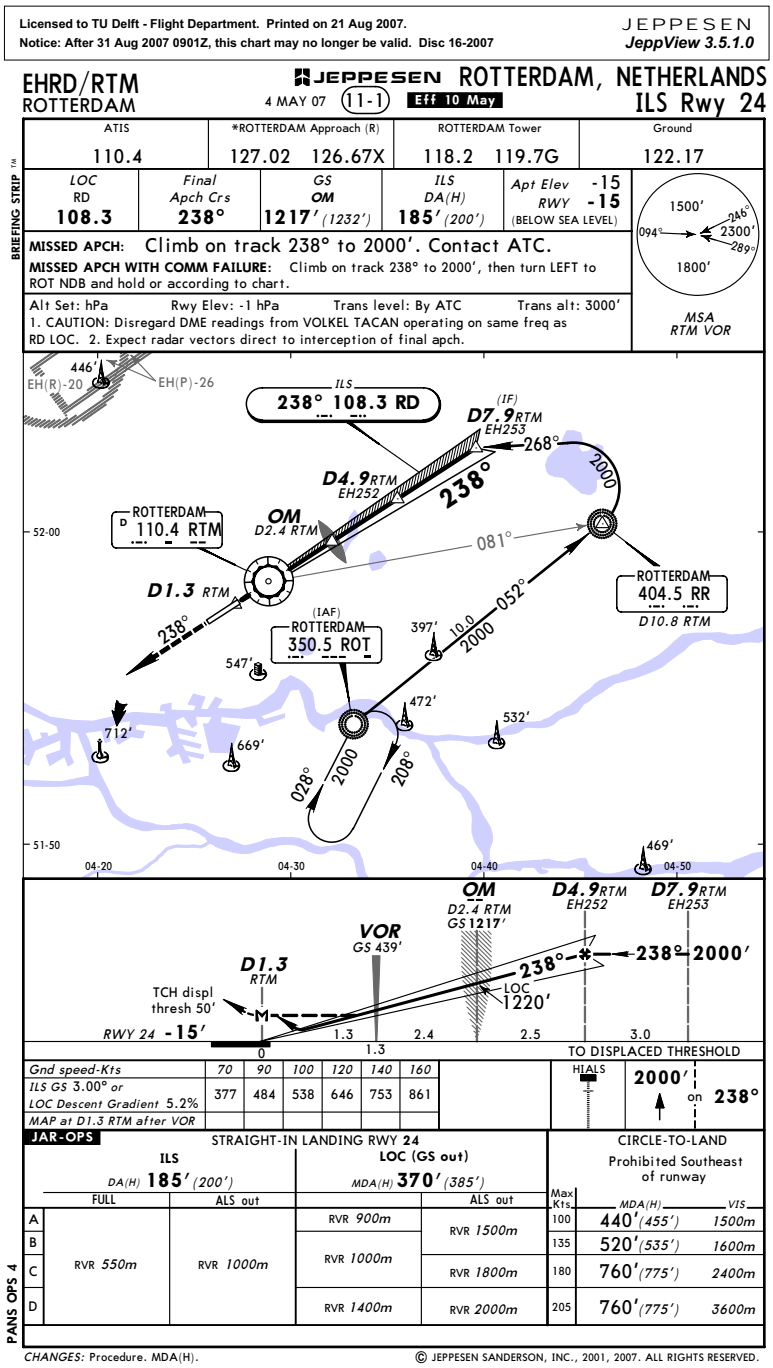
Side view of the simulator, projector and projection screen

4.7.1 Visual Ground Segment

For determination of the visual ground segment (VGS) of the TRC472-F visual, a single-engine piston aircraft, with a fixed tricycle landing gear is considered. Length, width and height of the Cessna 172 Skyhawk, for example, are 8x11x2.5m approximately. Assuming that the distance from the glide slope antenna to the main gear and the distance from the pilot's eye-point to the main gear are smaller than the distance from the front gear to the main gear, the ratio between radio altitude (RA) and gear to gear distance (GGD) is at most:

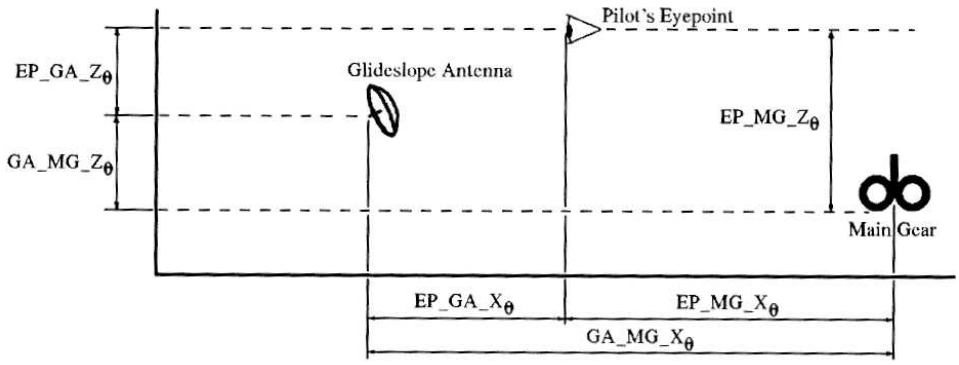
$$\frac{GGD}{RA} * 100\% = \frac{2.1}{30} * 100\% = 7\% \tag{4.1}$$

Thus, the maximum error in VGS is less than 7% when it is assumed that the pilot eye-point and the glide-slope antenna are located at the main gear axis location.
The airfield for which these calculations are done is Rotterdam, the Netherlands, Runway 24. All necessary runway information for the calculation of the VGS can be found in the Jeppensen Chart below. Main parameters for the calculation of the VGS are the ILS glideslope angle $\delta = 3.00$deg and the Glideslope Threshold Crossing Height (THC), which is 50ft or 15m.

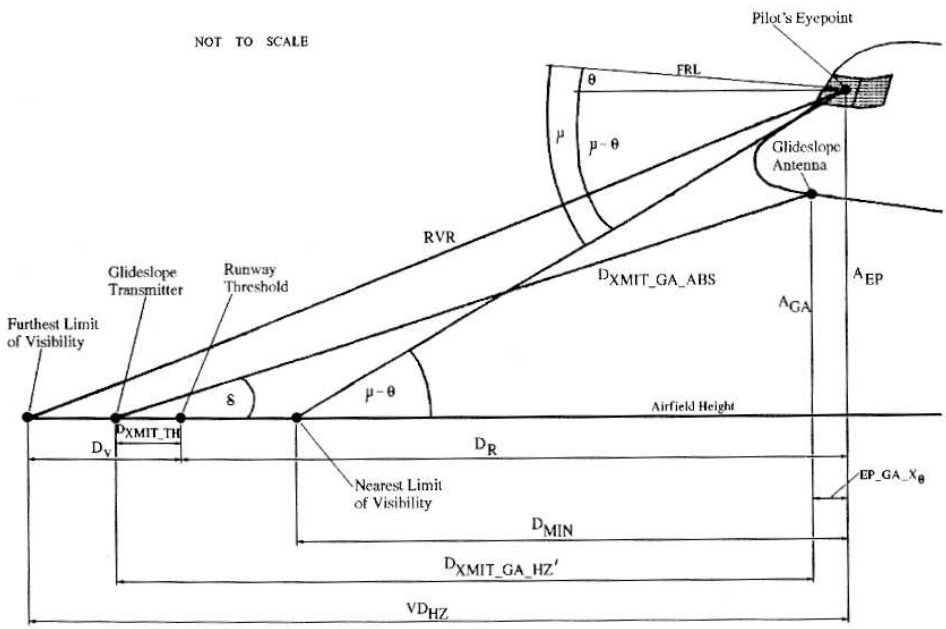


RWY 24 Jeppensen Approach Chart for Rotterdam Airport, the Netherlands

The following calculations are based on the calculations found in [4], though simplified with the above assumptions that glideslope antenna and pilot eye-point are approximately aligned with main gear location, that is $EP_{GA_X\theta} = EP_{MG_X\theta} \cong 0$, see the figure below.



Visual Ground Segment horizontal and vertical distances - pilot/glideslope antenna/main gear.



Visual Ground Segment horizontal and vertical distances - aeroplane to ground.

With the aeroplane on a glideslope with an angle $\delta = 3°$, the horizontal distance from the glideslope antenna to the point where the glideslope intersects the runway centreline is given by:

$$D_{XMIT_GA_HZ} = \frac{A_{GA}}{\tan(\delta)} = \frac{30}{\tan(3)} = 572m \tag{4.2}$$

Using the Threshold Corssing Height (THC), the distance from the glideslope transmitter to the threshold, D_{XMIT_TH} is given by:

$$D_{XMIT_TH} = \frac{TCH}{\tan\delta} = \frac{15}{\tan(3)} = 286m \tag{4.3}$$

With the transmitter at a distance D_{XMIT_TH} from the threshold of the runway, the horizontal distance from the pilot's eye-point to the runway, D_R, is given by:

$$D_R = D_{XMIT_GA_HZ} - D_{XMIT_TH} = 572 - 286 = 286m \tag{4.4}$$

With the Runway Visual Range of 350m, the horizontal distance that will be visible on approach is:

$$VD_{HZ} = \sqrt{RVR^2 + {A_{EP}}^2} = \sqrt{350^2 + 30^2} = 351m \tag{4.5}$$

The distance down the runway that is visible for the given RVR of 350m is:

$$D_V = VD_{HZ} - D_R = 351 - 286 = 65 \tag{4.6}$$

With the cut-off angle μ of 15 degrees at zero pitch, the closest distance that the pilot can see, D_{min}, is:

$$D_{min} = \frac{A_{EP}}{tan(\mu - \theta)} = \frac{30}{tan(15)} = 112m \tag{4.7}$$

The total Visual Ground Segment then is:

$$VGS = VD_{HZ} - D_{min} = 351 - 112 = 239m \tag{4.8}$$

4.7.2 Visual Feature Recognition

Taxiway
Taxiway edge lights are used to outline the edges of taxiways during periods of darkness or restricted visibility conditions. These fixtures emit blue light.

Touchdown Zone Lights (TDZL)
Touchdown zone lights are installed on some precision approach runways to indicate the touchdown zone when landing under adverse visibility conditions. They consist of two rows of transverse light bars disposed symmetrically about the runway centerline. The system consists of steady-burning white lights which start 100 feet beyond the landing threshold and extend to 3,000 feet beyond the landing threshold or to the midpoint of the runway, whichever is less.

Runway Centerline Lighting System (RCLS)
Runway centerline lights are installed on some precision approach runways to facilitate landing under adverse visibility conditions. They are located along the runway centerline and are spaced at 50-foot intervals. When viewed from the landing threshold, the runway centerline lights are white until the last 3,000 feet of the runway. The white lights begin to alternate with red for the next 2,000 feet, and for the last 1,000 feet of the runway, all centerline lights are red.

REIL - Runway End Identifier Lights
REIL's are installed at many airfields to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights located laterally on each side of the runway threshold. REIL's may be either omnidirectional or unidirectional facing the approach area. They are effective for: a. Identification of a runway surrounded by a preponderance of other lighting. b. Identification of a runway which lacks contrast with surrounding terrain. c. Identification of a runway during reduced visibility.

Medium Intensity Runway Lights - MIRL
Runway edge lights are used to outline the edges of runways during periods of darkness or restricted visibility conditions. These light systems are classified according to the intensity or brightness they are capable of producing: they are the High Intensity Runway Lights (HIRL), Medium Intensity Runway Lights (MIRL), and the Low Intensity Runway Lights (LIRL). The HIRL and MIRL systems have variable intensity controls, whereas the LIRL's normally have one intensity setting.

X-plane airport definition files allow for a high degree of detailing the runway information that can be displayed. The following options are available for runways (set in airport definition files, cannot be selected from the simulation control panels or instructor station):
Visual approach path indicator:

1. No visual approach path lighting.
2. VASI (Visual Approach Slope Indicator).
3. PAPI (Precision Approach Path Indicator).
4. Space Shuttle Landing PAPI (steep 20 degree glide path) its use is very rare!

Runway lighting

1. No runway lighting.
2. Runway edge lights (white).
3. Also has REIL (Runway End Identification Lights the flashing strobes at the approach end of the runway.
4. Also has CLL (Center Line Lighting).
5. Also has TDZ (Touch Down Zone) lighting.
6. Only has blue taxiway edge lights (use on taxiways!).

Approach lighting

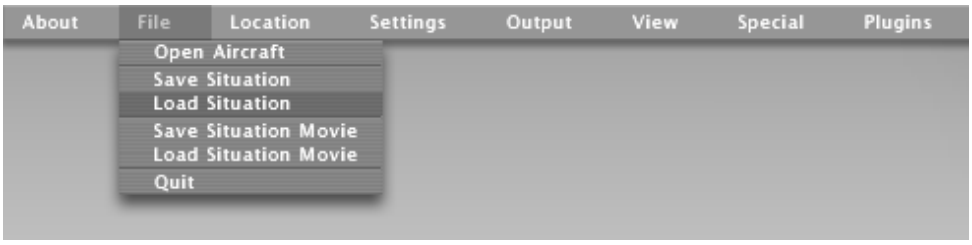
1. No approach lights.
2. SSALS (Simplified short approach light system).
3. SALSF (Short approach light system with sequenced flashing lights).

4. ALSF-I (Approach light system with sequenced flashing lights).
5. ALSF-II (Approach light system with sequenced flashing lights and red side bar lights the last 1000).
6. ODALS (Omni-directional approach light system).
7. Calvert (a British design) category 1.
8. Calvert (a British design) categories 2 and 3.

5 Recording procedures and required equipment for validation tests

1. Select the desired validation test as described in Chapter 6 with the 'up' and 'down' arrows.

2. Make sure the simulation is in the pause mode. Load a saved situation file as described in the manual test procedure.



3. First set the inputs to the given initial conditions as described in the manual test procedure of the selected validation test, e.g. throttle setting = 75.3%. Then press the 'start' button.

4. As soon as the 'start' button is pressed, the simulation continues and parameters will be logged for later evaluation. During the simulation the pilot has to perform the sequence of control inputs as prescribed in the manual test procedure.

5. After the pilot has performed the manual test, the 'stop' button can be pressed. Pressing this button will stop the logging of the data but the actual simulation will only be paused.

6. Use the 'plot' button for plotting the evaluated parameters in the time domain. The graphs can be made as Portable Network Graphics (PNG) or as Encapsulated Postscript (EPS) files. The graphs will be saved in the working directory with an automatically generated name formed by "section number as in QTG" _ "FSTD number" _ "flight condition" _ "evaluated parameter". The logged data will be saved in a Comma Separated Value (CSV) file with an automatically generated name formed by "section number as in QTG" _ "FSTD number" _ "flight condition" _ "criterion name".
When the "Load MQTG results" box is checked, the Master QTG will be shown in the plots as green lines. Parameters with a tolerance will have "tolerance bands" shown in their graph.

7. The elapsed time may be shifted (maximum -5 or +5 seconds) in case of the pilot has started the procedure either too late or too early. Multiples of 0.05 second can be added or subtracted such that the pilot control inputs overlay the reference data from the MQTG. When the 'Shift' box is checked, the timeshifted simulation results will be drawn together with the non-timeshifted results as blue lines in a graph when the 'plot' button is pushed again.

8. The 'Reset' button will re-initialize the Qualification Test panel.

6 Validation tests

6.1 Normal climb engine operating (1a1)

Test objective	To demonstrate that the simulation of engine thrust, aerodynamic drag and atmosphere in a steady state normal climb condition conforms to the class of aeroplane.
Demonstration procedure	Establish a steady climb at nominal climb power with flaps retracted with the engine set to the required climb thrust. Perform the required climb profile and check the rate of climb against the airplane data.
References	[2], [3], [4]

Initial conditions

Climb flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	55	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.027	(-)
FLAP LEVER POSITION	=	0.0	(deg)
FLAP INDICATOR POSITION	=	0.0	(deg)
PITCH CONTROLLER POSITION	=	-11.33	(%)
ROLL CONTROLLER POSITION	=	2.062	(%)
RUDDER PEDAL POSITION	=	-3.273	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	80.4	(kts)
RATE OF CLIMB	=	694	(fpm)
PRESSURE ALTITUDE	=	2016	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	6.5	(deg)
BANK ANGLE	=	4.3	(deg)
ANGLE OF ATTACK	=	2.3	(deg)
SIDESLIP ANGLE	=	-0.4	(deg)
PITCH RATE	=	-0.7	(deg/sec)
ROLL RATE	=	1.4	(deg/sec)
YAW RATE	=	1.0	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2481	(rpm)
EXHAUST GAS TEMPERATURE	=	1215	(deg F)
FUEL FLOW	=	12.1	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.6	(deg)
LEFT AILERON ANGLE	=	0.1	(deg)
RIGHT AILERON ANGLE	=	-0.1	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `601_FSTD_1c1_Climb.sit`. Set all inputs to the values shown here as initial conditions and press 'start'.

Measure the time intervals for the aeroplane to reach an altitude 2200, 2400, 2600, 2800, 3000, 3200, 3400, 3600, 3800 and 4000 feet.

Evaluated parameters

ELEVATOR ANGLE
ENGINE POWER
ENGINE SPEED
EXHAUST GAS TEMPERATURE
FUEL FLOW
INDICATED AIRSPEED
PITCH ANGLE
PITCH CONTROLLER POSITION
PRESSURE ALTITUDE
RATE OF CLIMB
RUDDER ANGLE
THROTTLE SETTING
THRUST

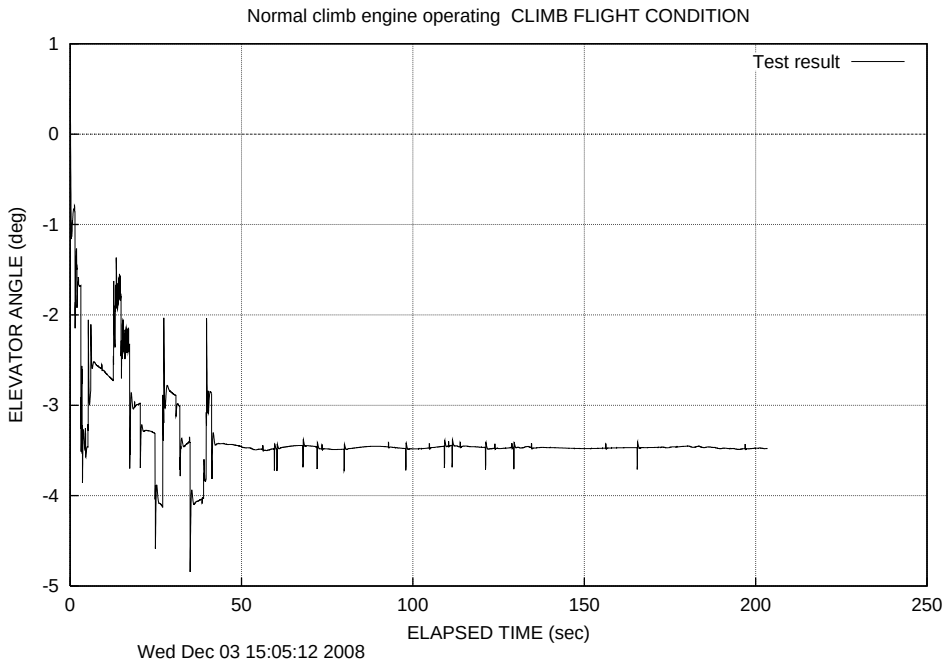
Expected result

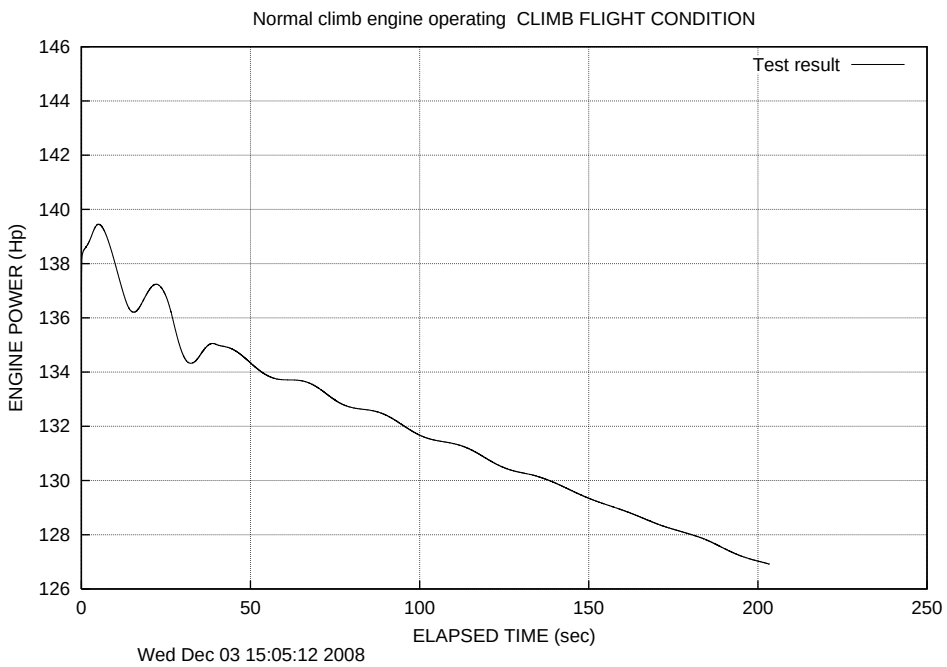
At an indicated airspeed of around 80 kts and the average rate of climb of 700 feet/min, the aeroplane is expected to reach 4000 feet in less than 3 minutes. See section 3.1 of [1]

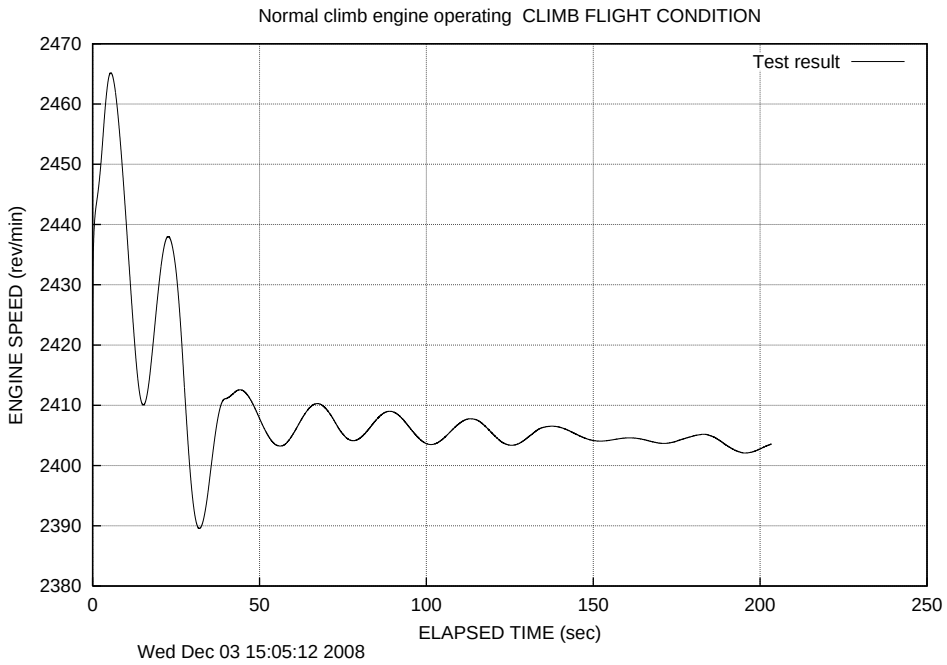
Tolerances

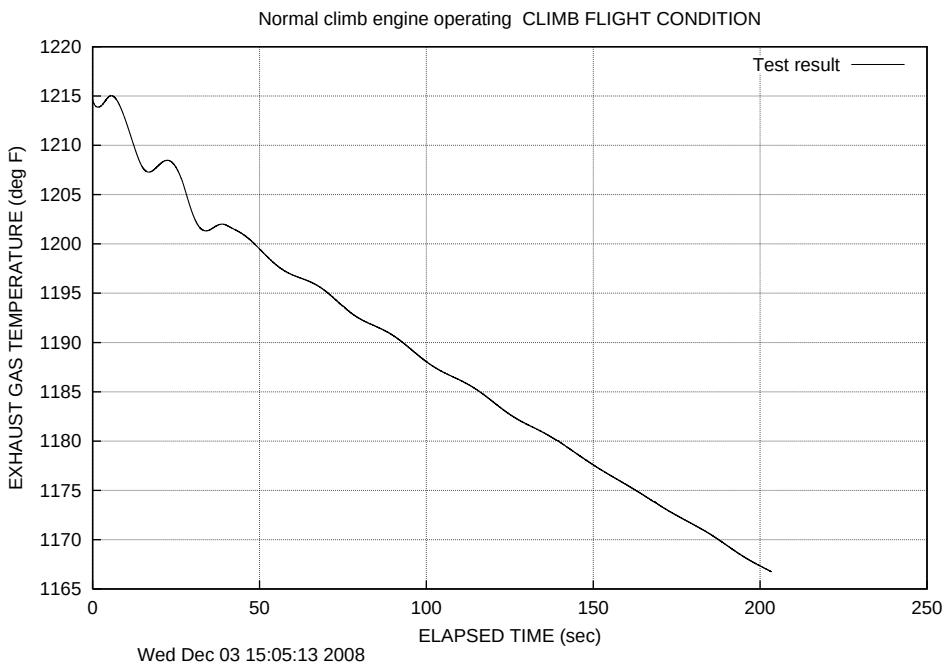
INDICATED AIRSPEED	±3 knots
RATE OF CLIMB	±5% or ±100 feet/min

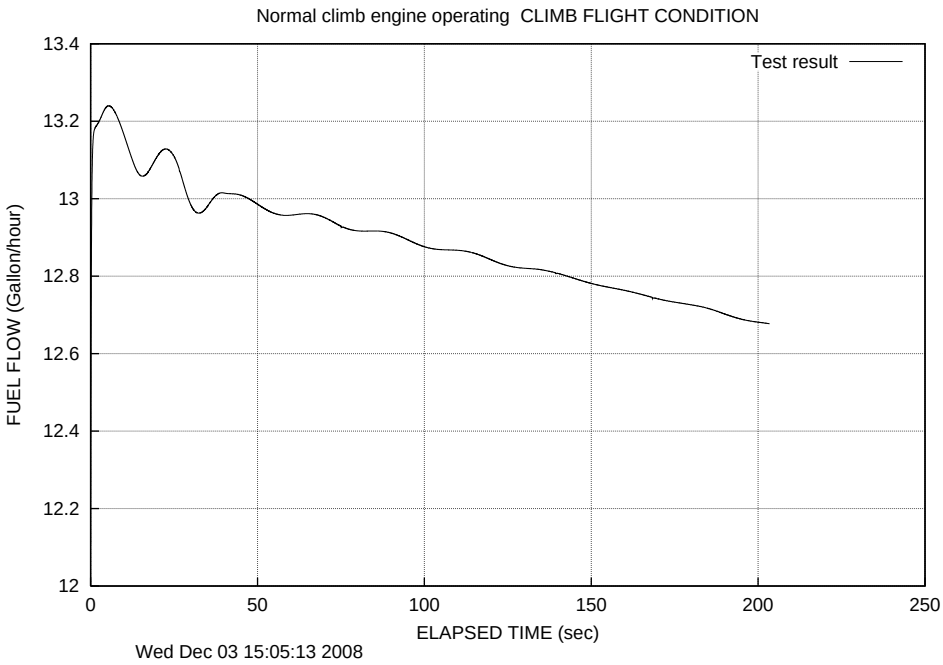
Test result

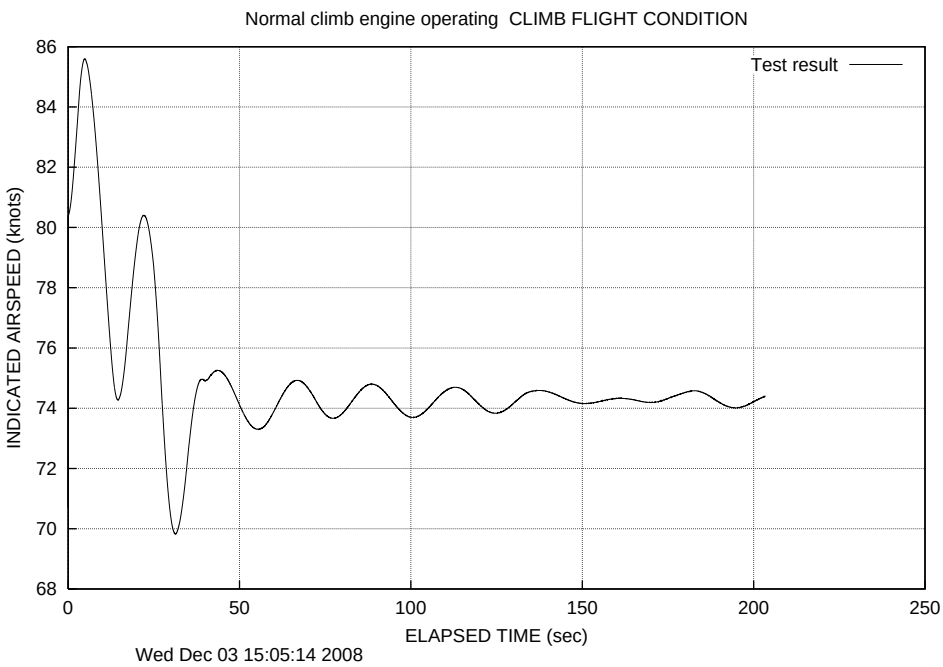

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
1
0
-1
-2
-3
-4
-5
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:12 2008

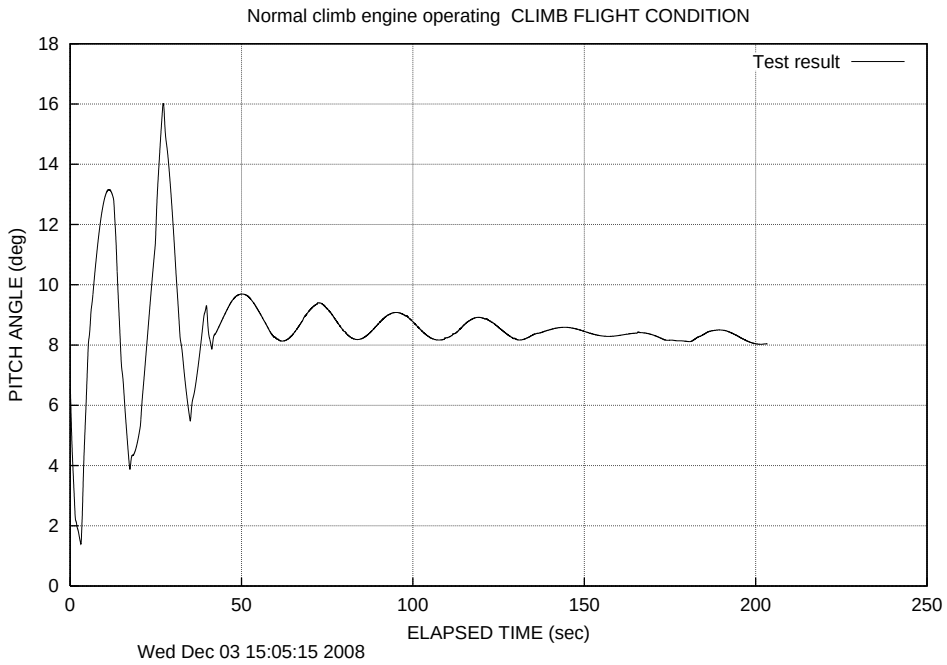

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
146
144
142
140
138
136
134
132
130
128
126
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:12 2008

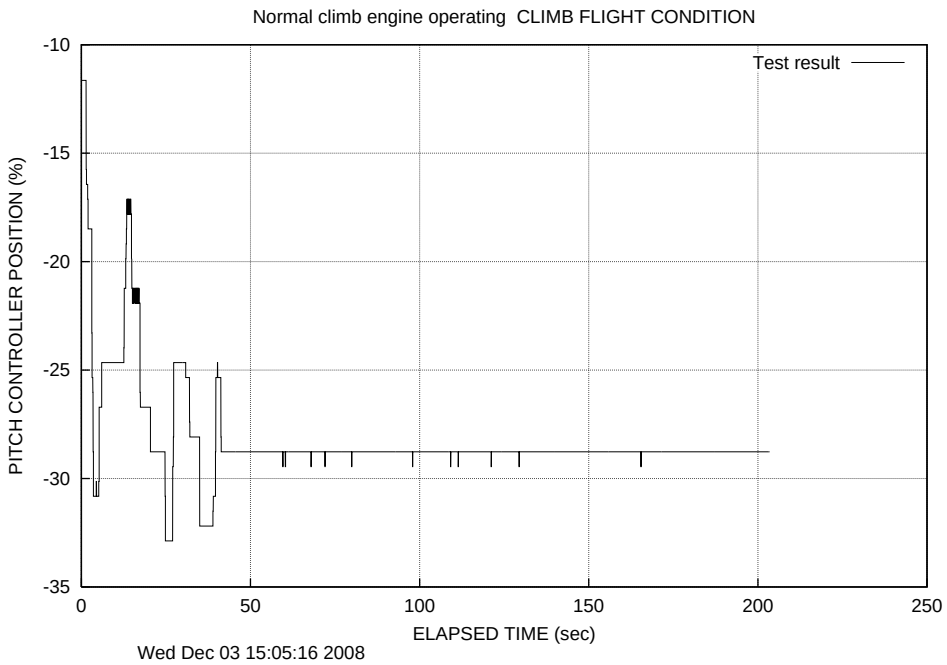

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2470
2460
2450
2440
2430
2420
2410
2400
2390
2380
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:12 2008

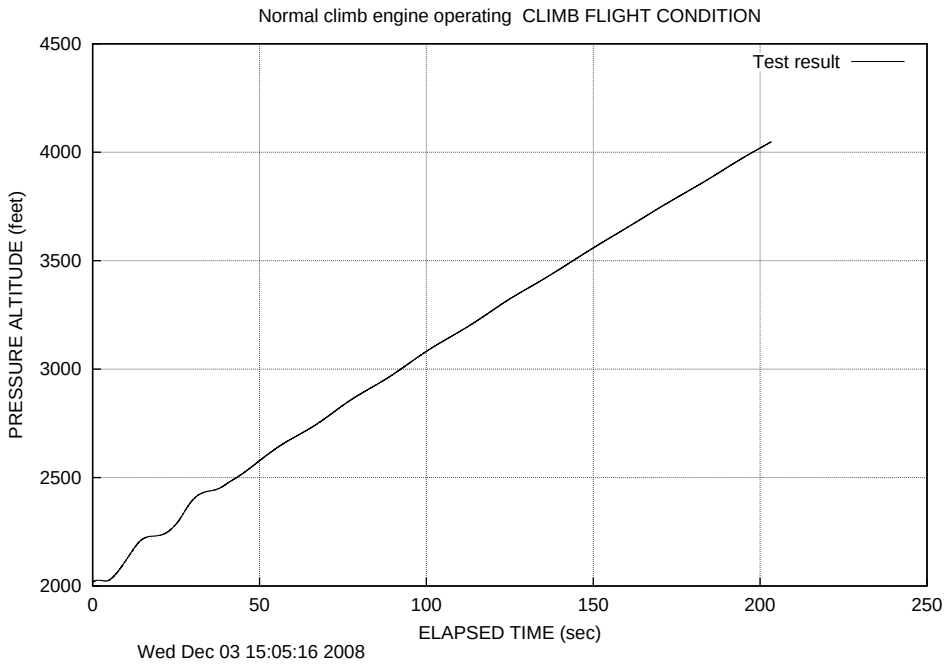

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
EXHAUST GAS TEMPERATURE (deg F)
1220
1215
1210
1205
1200
1195
1190
1185
1180
1175
1170
1165
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:13 2008

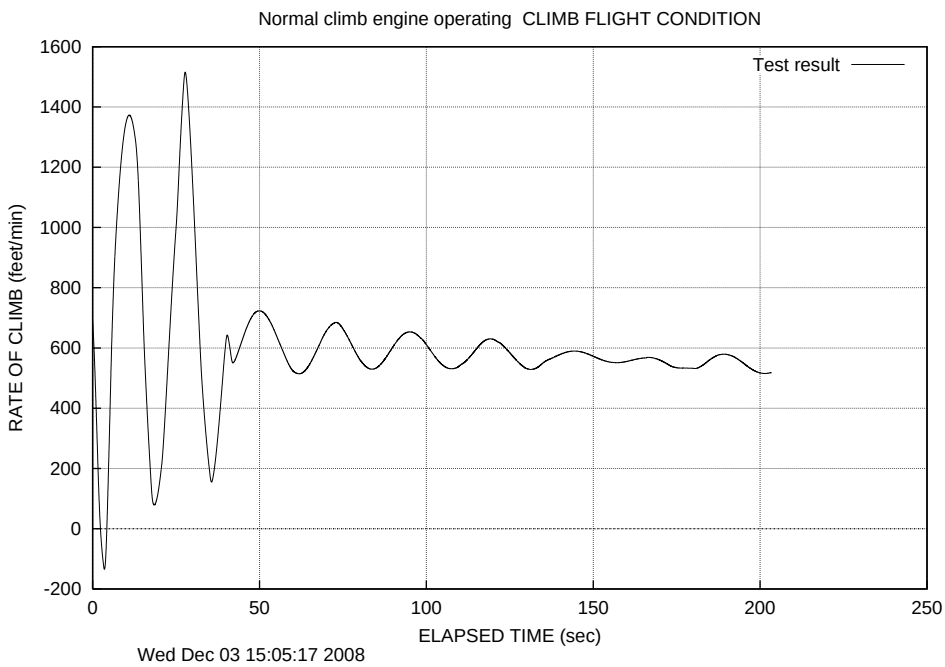

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
13.4
13.2
13
12.8
12.6
12.4
12.2
12
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:13 2008

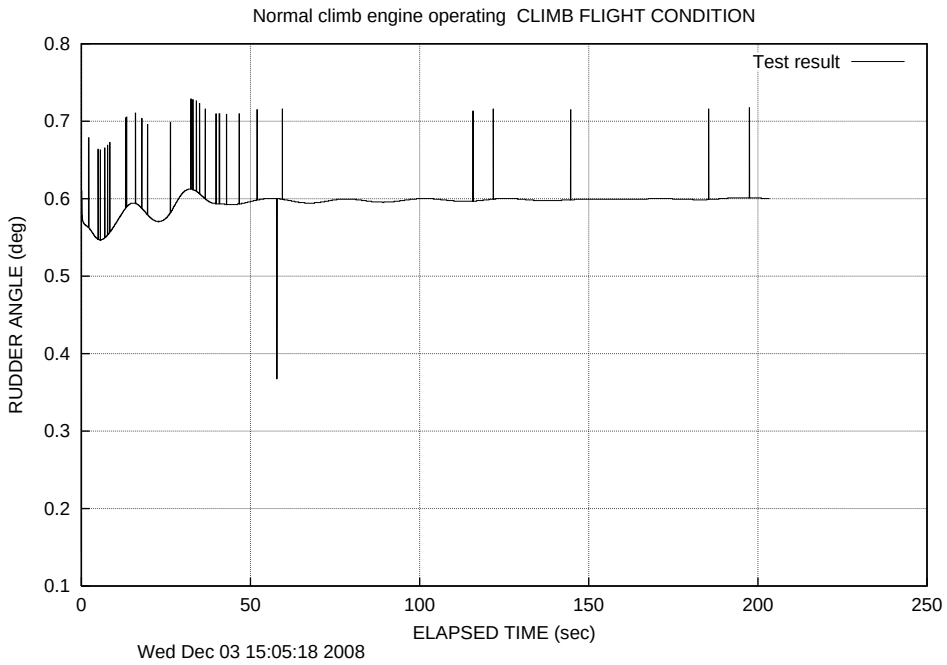

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
86
84
82
80
78
76
74
72
70
68
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:14 2008

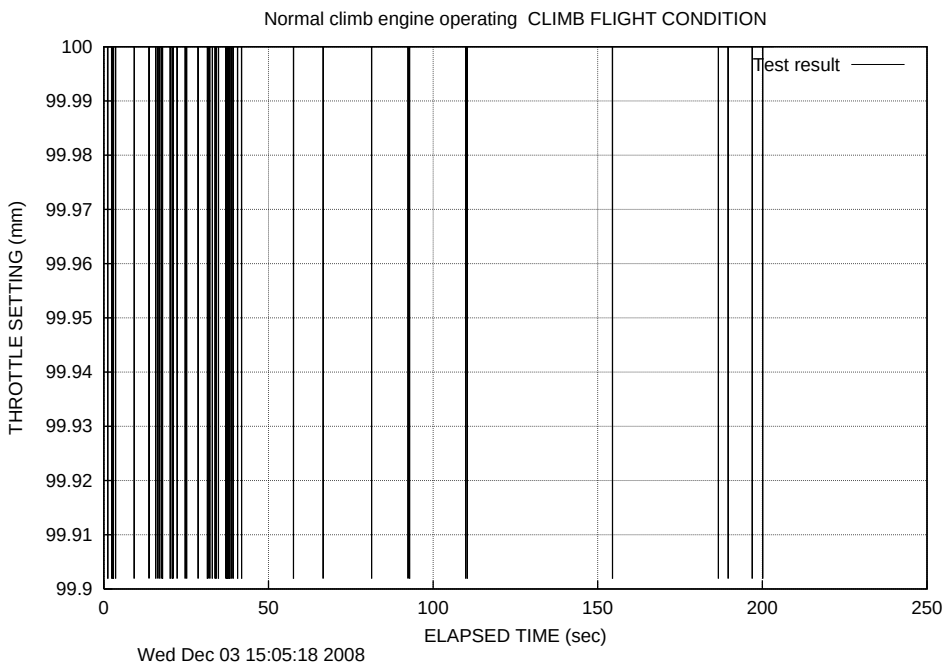

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:05:15 2008
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250

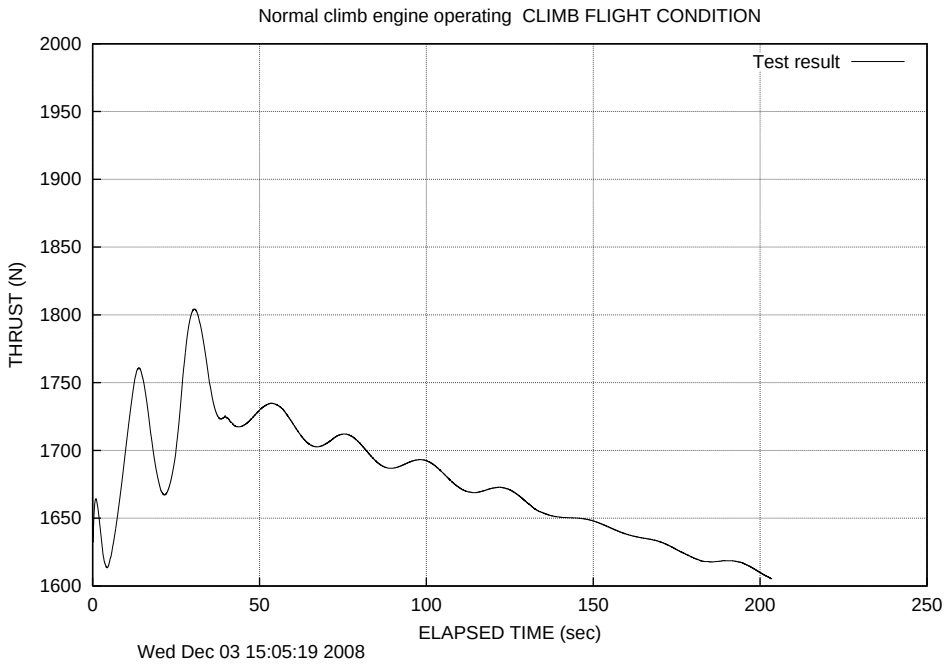

Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
ELAPSED TIME (sec)
Wed Dec 03 15:05:16 2008
-10
-15
-20
-25
-30
-35
0
50
100
150
200
250


Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4500
4000
3500
3000
2500
2000
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:16 2008


Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
1600
1400
1200
1000
800
600
400
200
0
-200
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:17 2008


Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:18 2008


Normal climb engine operating CLIMB FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
100
99.99
99.98
99.97
99.96
99.95
99.94
99.93
99.92
99.91
99.9
0
50
100
150
200
250
ELAPSED TIME (sec)
Wed Dec 03 15:05:18 2008



Source data	Section 3.1 of [1]
Comparison of results	The climb from 2300 feet to 3700 feet was reached in (164.3-26.3) = 138.0 seconds. The average rate of climb of this segment is $60 \times (3700 - 2300)/138.0 = 609$ feet/min with an average indicated airspeed of 74.4 kts.
These results show compliance with the obtained flight test data and are adopted as validation data.	

6.2 Stall warning actuation (1b1)

Test objective	To demonstrate that the simulation of longitudinal control power, lift, pitching moment and stall warning indications conform to the class of aeroplane.
Demonstration procedure	Conduct a wings-level stall entry at or near idle power using longitudinal trim to achieve a steady rate of deceleration until reaching the minimum speed before initiating recovery.
References	[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	35.59	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.023	(-)
FLAP LEVER POSITION	=	10.0	(deg)
FLAP INDICATOR POSITION	=	10.0	(deg)
PITCH CONTROLLER POSITION	=	-6.000	(%)
ROLL CONTROLLER POSITION	=	1.031	(%)
RUDDER PEDAL POSITION	=	-4,727	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	72.2	(kts)
RATE OF CLIMB	=	388	(fpm)
PRESSURE ALTITUDE	=	3060	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	5.7	(deg)
BANK ANGLE	=	-4.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	0.7	(deg)
PITCH RATE	=	1.2	(deg/sec)
ROLL RATE	=	-0.3	(deg/sec)
YAW RATE	=	-0.9	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	997	(rpm)
EXHAUST GAS TEMPERATURE	=	1101	(deg F)
FUEL FLOW	=	8.20	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.0	(deg)
LEFT AILERON ANGLE	=	0.6	(deg)
RIGHT AILERON ANGLE	=	-0.6	(deg)
RUDDER ANGLE	=	0.8	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH

SWITCH FUEL CUTOFF	=	OFF	

Initial conditions

Climb flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	27.07	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.023	(-)
FLAP LEVER POSITION	=	0.0	(deg)
FLAP INDICATOR POSITION	=	0.0	(deg)
PITCH CONTROLLER POSITION	=	-9.333	(%)
ROLL CONTROLLER POSITION	=	0.0	(%)
RUDDER PEDAL POSITION	=	10.55	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.7	(kts)
RATE OF CLIMB	=	-257	(fpm)
PRESSURE ALTITUDE	=	2051	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.0	(deg)
BANK ANGLE	=	-6.6	(deg)

ANGLE OF ATTACK	=	3.9	(deg)
SIDESLIP ANGLE	=	-1.1	(deg)
PITCH RATE	=	-1.5	(deg/sec)
ROLL RATE	=	-2.2	(deg/sec)
YAW RATE	=	-2.3	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	1918	(rpm)
EXHAUST GAS TEMPERATURE	=	1077	(deg F)
FUEL FLOW	=	7.28	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-3.2	(deg)
LEFT AILERON ANGLE	=	0.4	(deg)
RIGHT AILERON ANGLE	=	-0.4	(deg)
RUDDER ANGLE	=	-1.6	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `614_FSTD_2c8_Approach.sit` or `614_FSTD_2c8_Climb.sit` for the Approach or Climb flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Approach flight condition:

Starting after 5 seconds with the throttle setting at the initial trim condition:
1. Pull the throttle to the idle position. Use pitch controller position to hold the initial altitude. Use the Yoke in roll position to remain wings-level.
2. After the stall warning has gone off, push the throttle to its initial trim condition and stop recording 5 seconds after the recovery has been initiated.

Climb flight condition:

Starting after 5 seconds with the throttle setting at the initial trim condition:
1. Pull the throttle to the idle position. Use pitch controller position to hold the initial attitude angle. Use the Yoke in roll position to remain wings-level.
2. After the stall warning has gone off, push the throttle to its initial trim condition and stop recording 5 seconds after the recovery has been initiated.

Evaluated parameters

ANGLE OF ATTACK
BANK ANGLE
ELEVATOR ANGLE
ELEVATOR TRIM TAB ANGLE
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED
NORMAL LOADFACTOR
PITCH ANGLE
PITCH CONTROLLER FORCE
PITCH CONTROLLER POSITION
PITCH RATE
PRESSURE ALTITUDE
RUDDER ANGLE
STALL WARNING ACTUATION

Expected results

Indicated airspeed at stall warning actuation is expected to be 51 kts under approach flight conditions and 57 kts under climb flight conditions. See section 3.14 of [1].

Tolerances

BANK ANGLE	±2°
INDICATED AIRSPEED	±3 kts

Test result

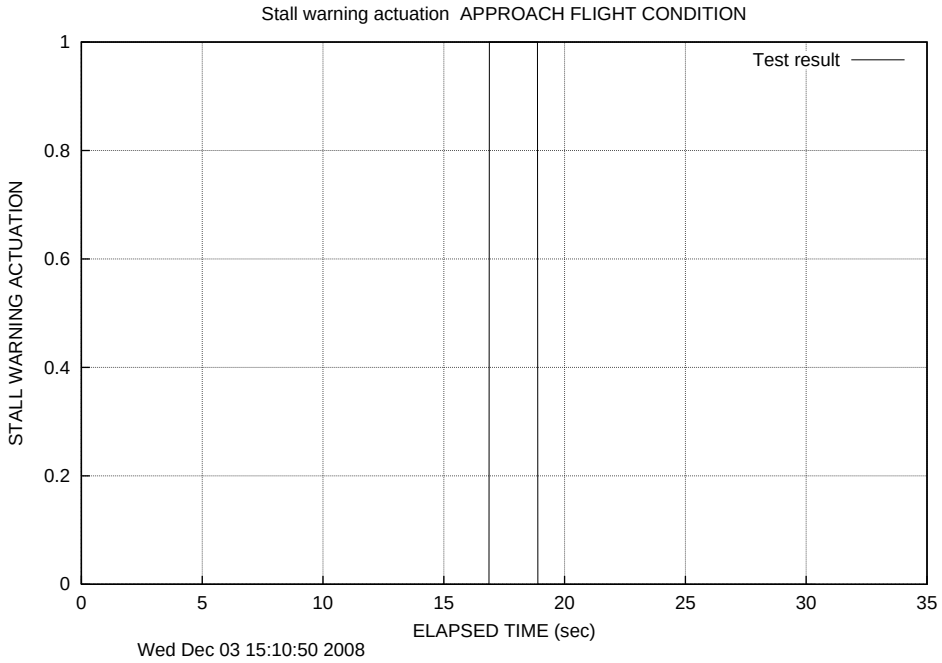
Approach flight condition:

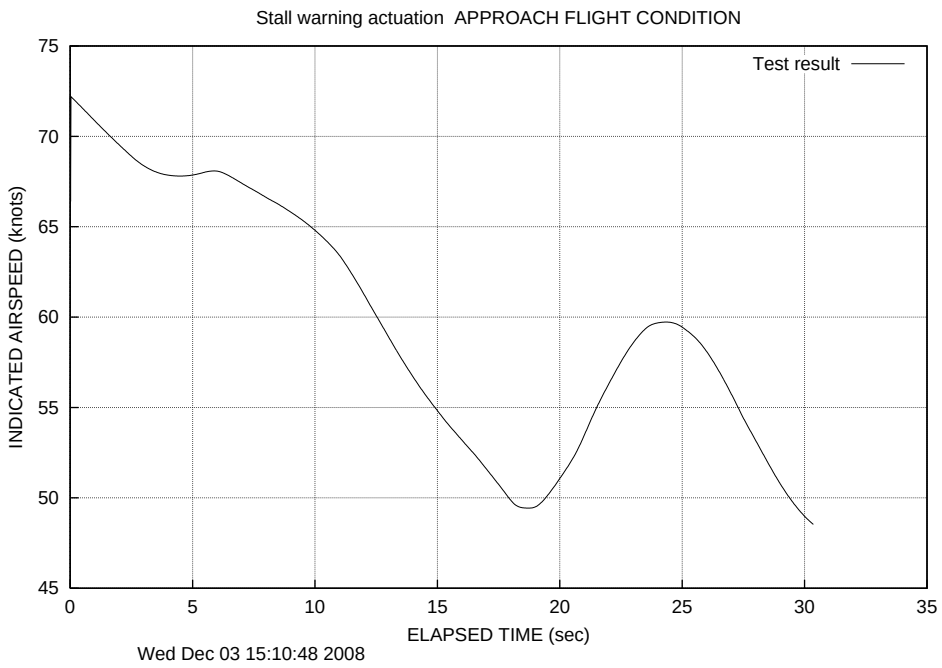
STALL WARNING SPEED (kts)	WING FLAP ANGLE (deg)	BANK ANGLE (deg)
51	10	0.0

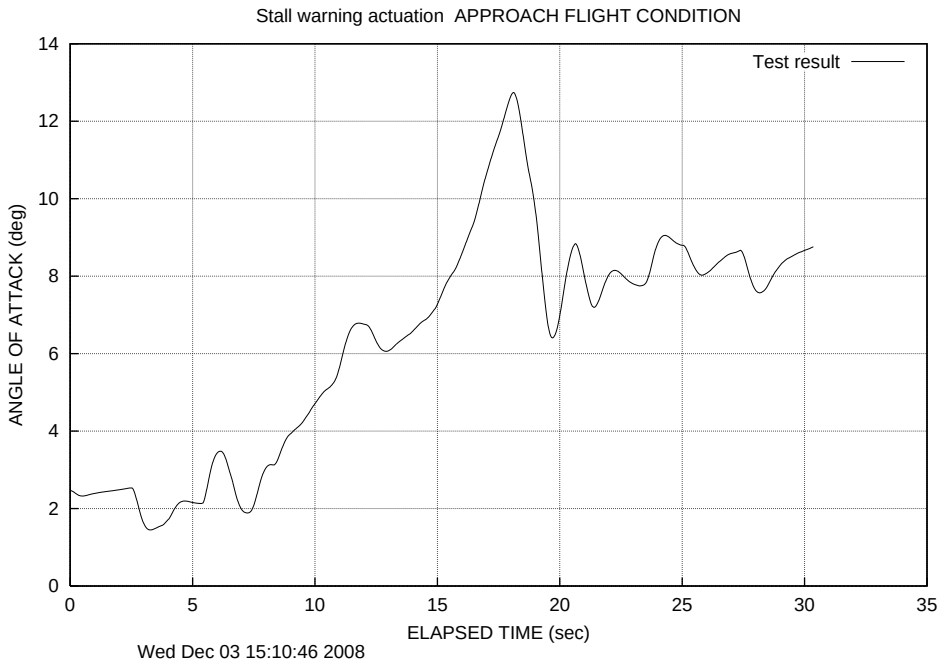
Climb flight condition:

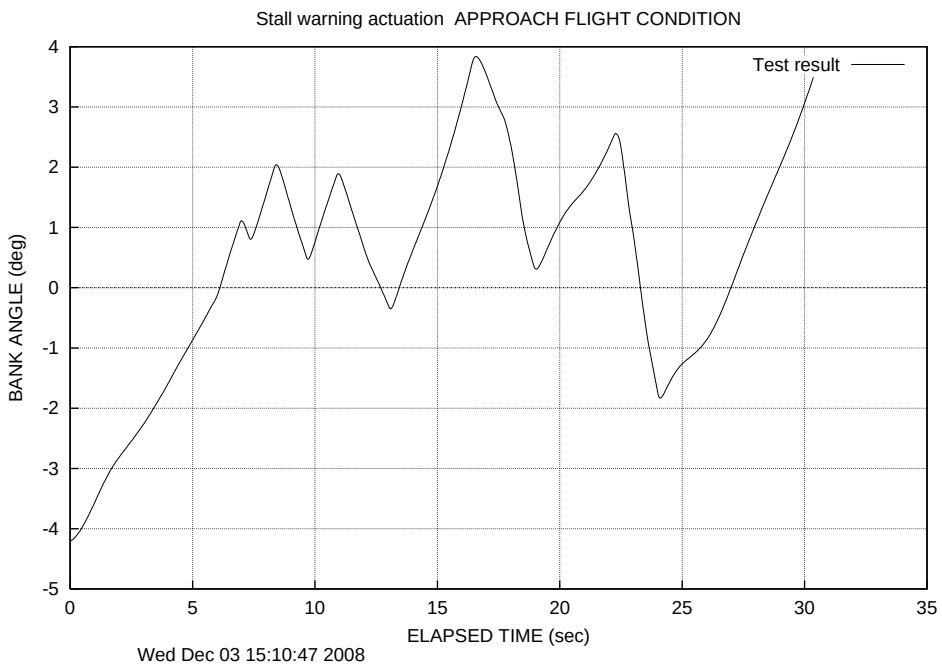
STALL WARNING SPEED (kts)	WING FLAP ANGLE (deg)	BANK ANGLE (deg)
57	0	0.0

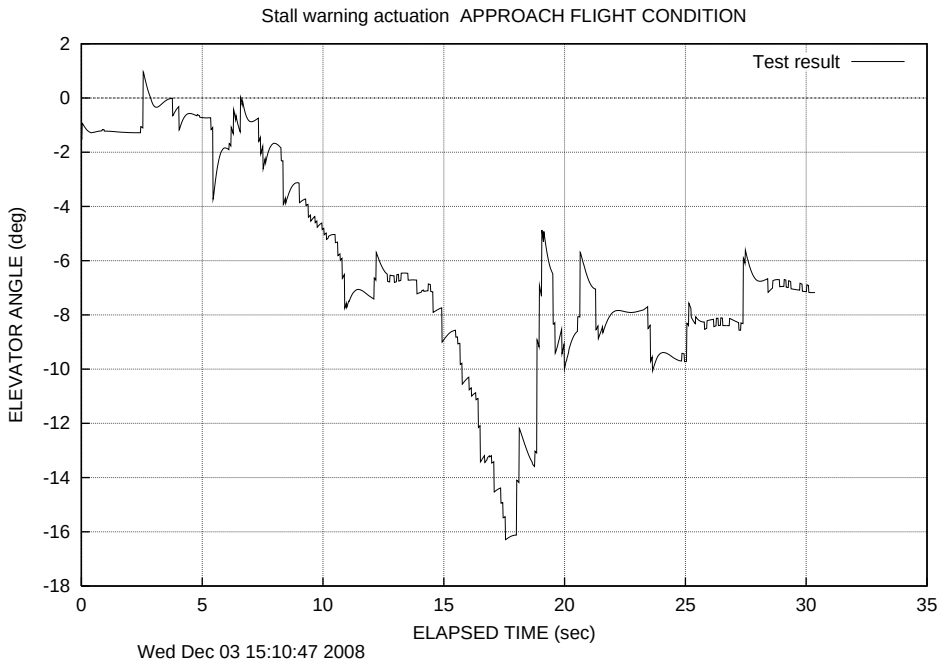
Approach flight condition:

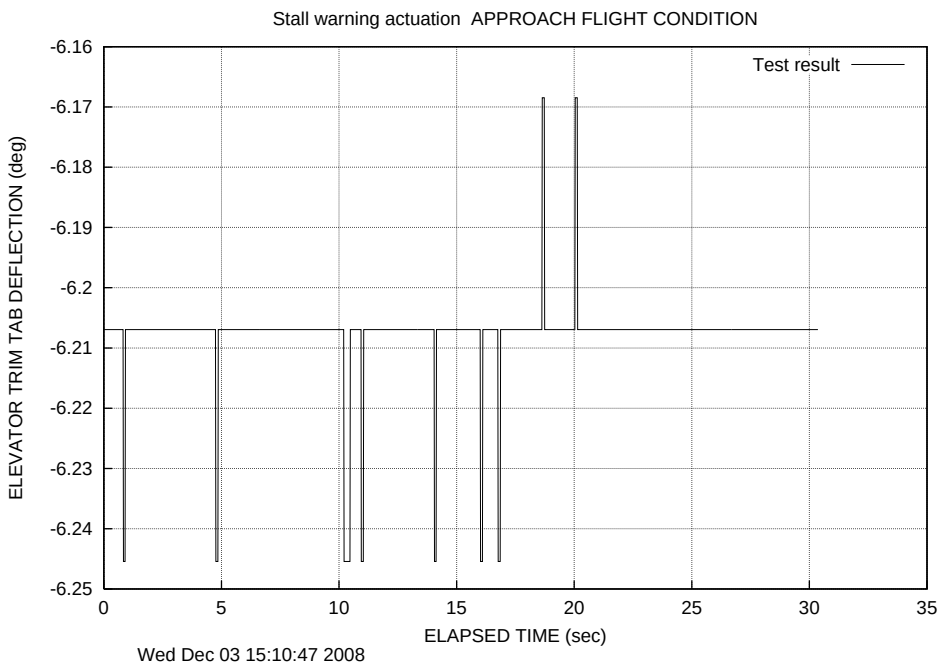


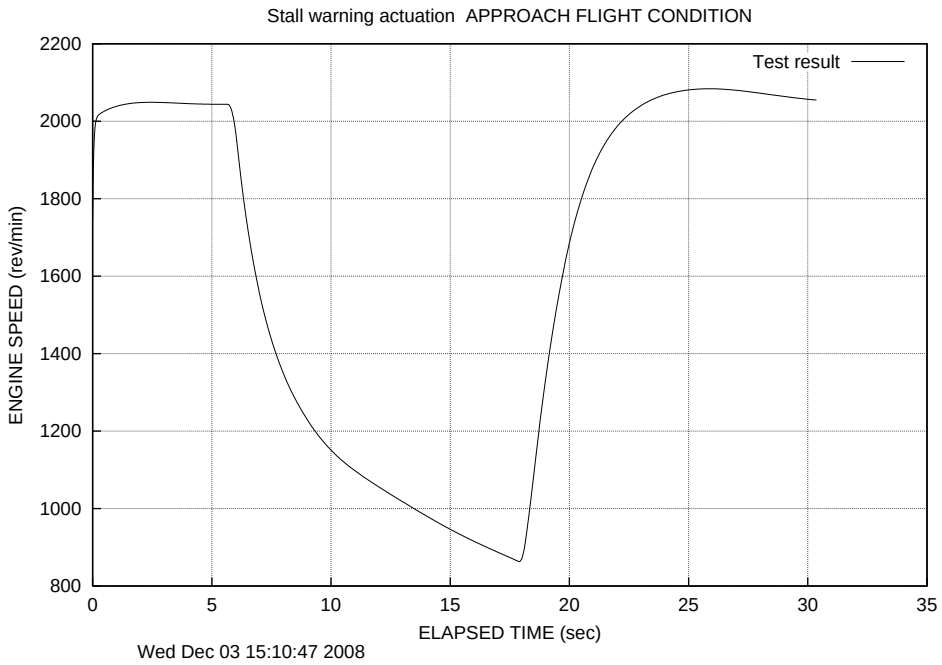


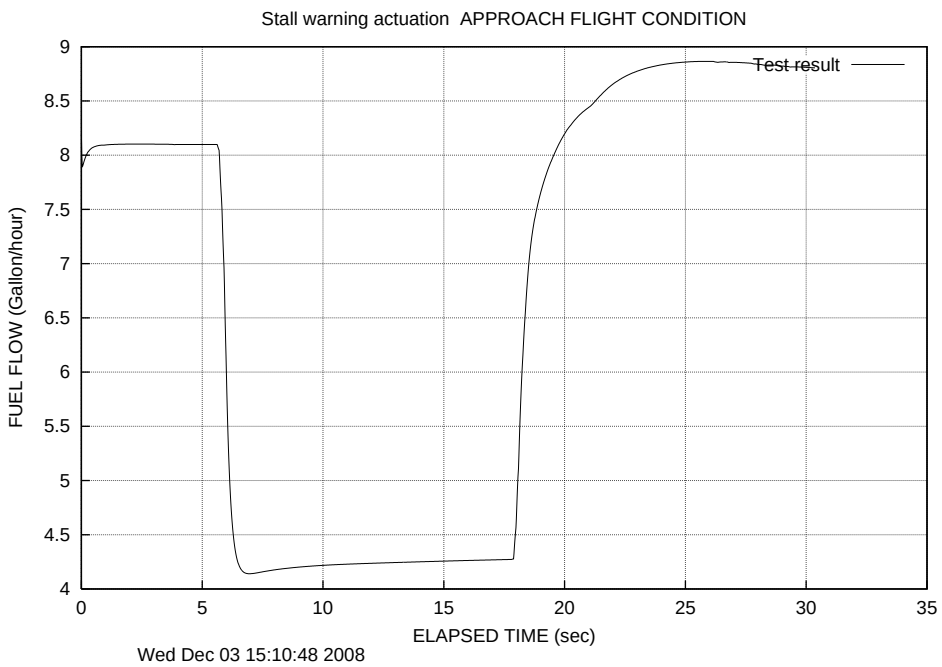

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:10:46 2008
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30
35

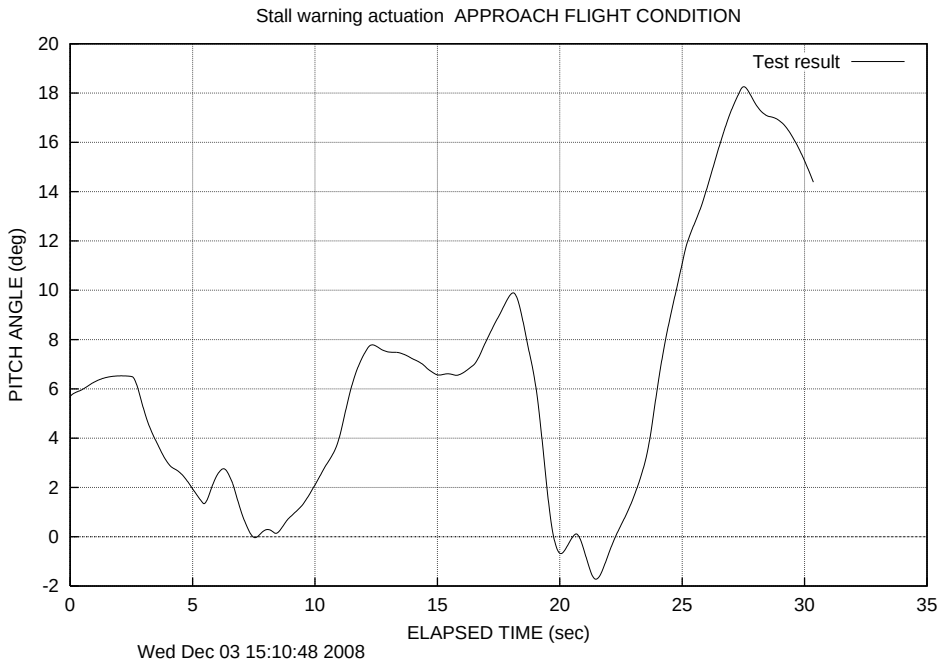

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:10:47 2008
4
3
2
1
0
-1
-2
-3
-4
-5
0
5
10
15
20
25
30
35

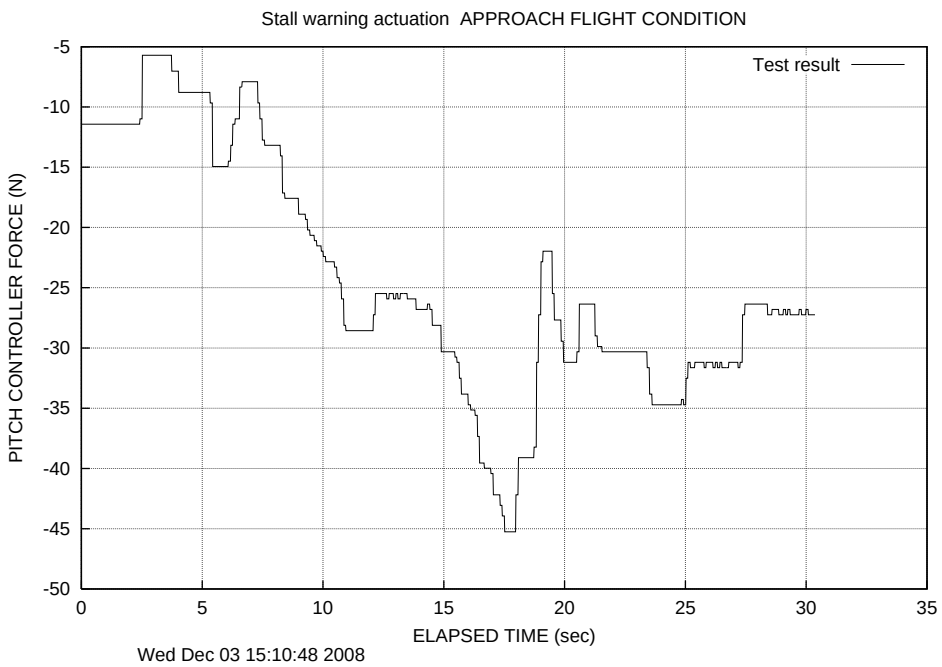

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:47 2008

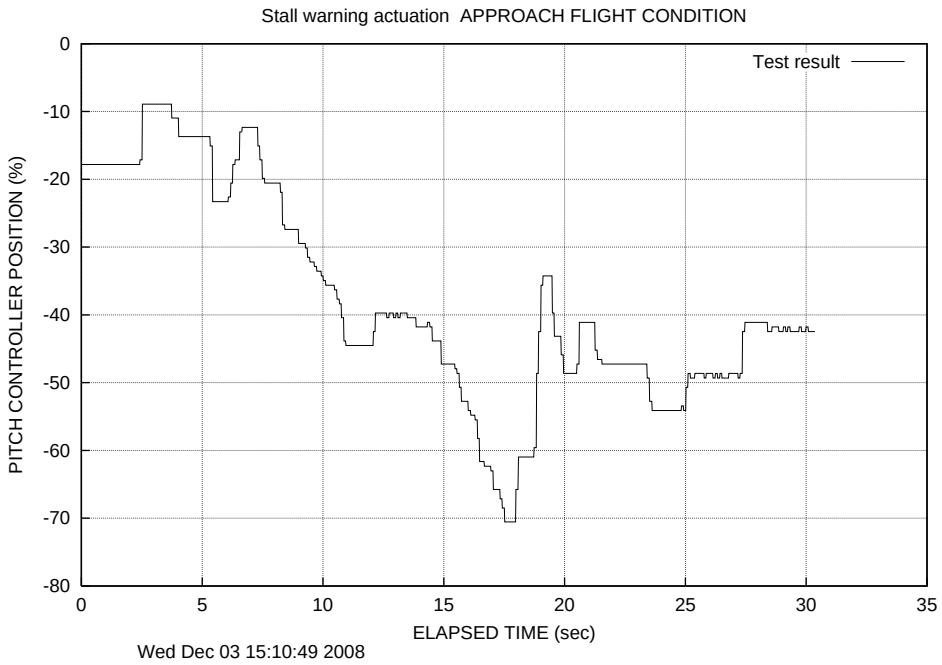

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-6.16
-6.17
-6.18
-6.19
-6.2
-6.21
-6.22
-6.23
-6.24
-6.25
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:47 2008


Stall warning actuation APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2200
2000
1800
1600
1400
1200
1000
800
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:47 2008

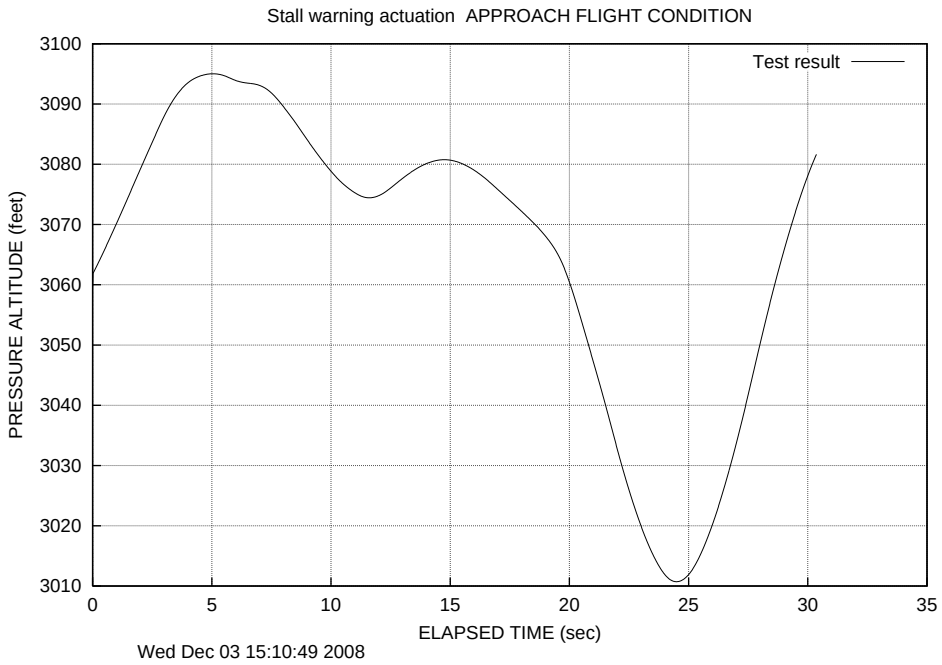

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:48 2008

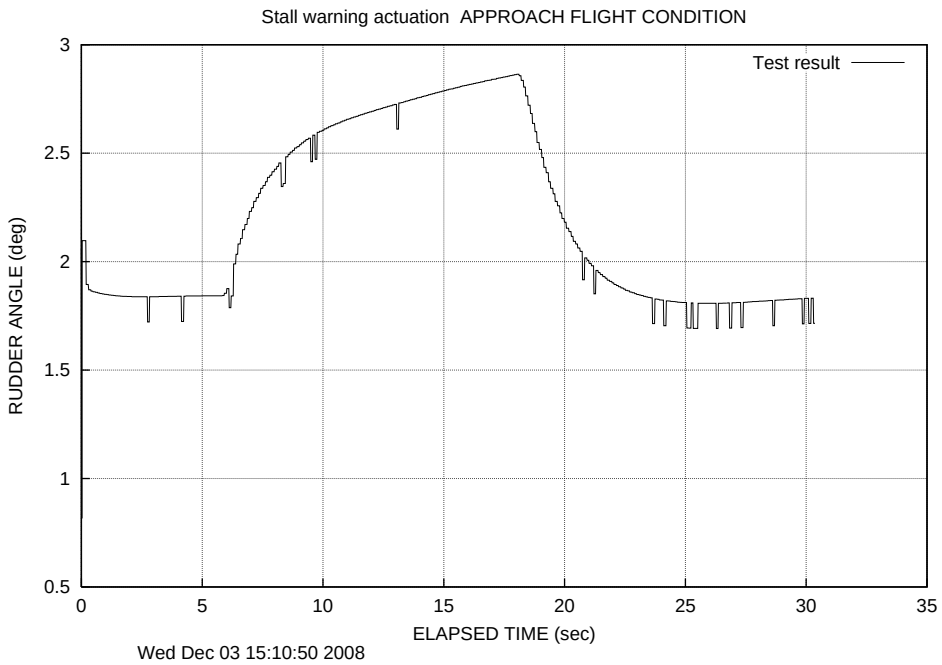

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:10:48 2008


Stall warning actuation APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER FORCE (N)
ELAPSED TIME (sec)
Wed Dec 03 15:10:48 2008

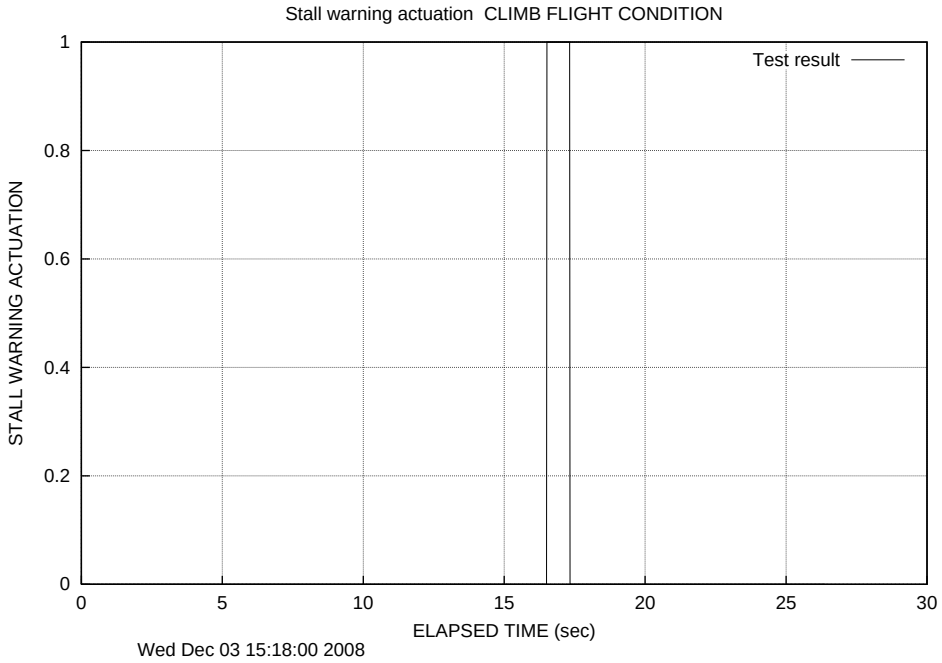

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
0
-10
-20
-30
-40
-50
-60
-70
-80
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:49 2008

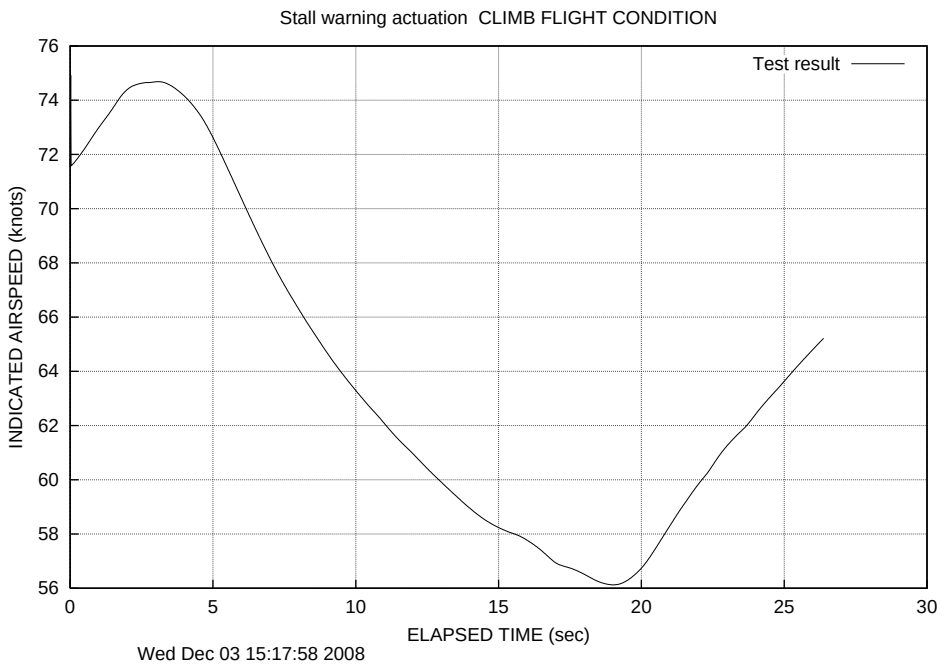
Stall warning actuation APPROACH FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
8
6
4
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:49 2008

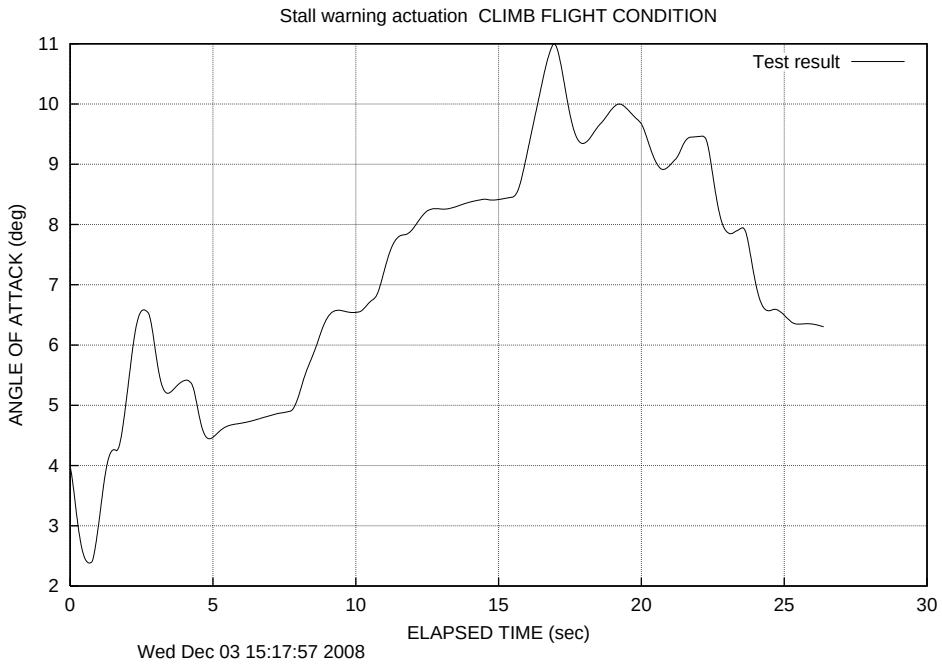

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3100
3090
3080
3070
3060
3050
3040
3030
3020
3010
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:49 2008

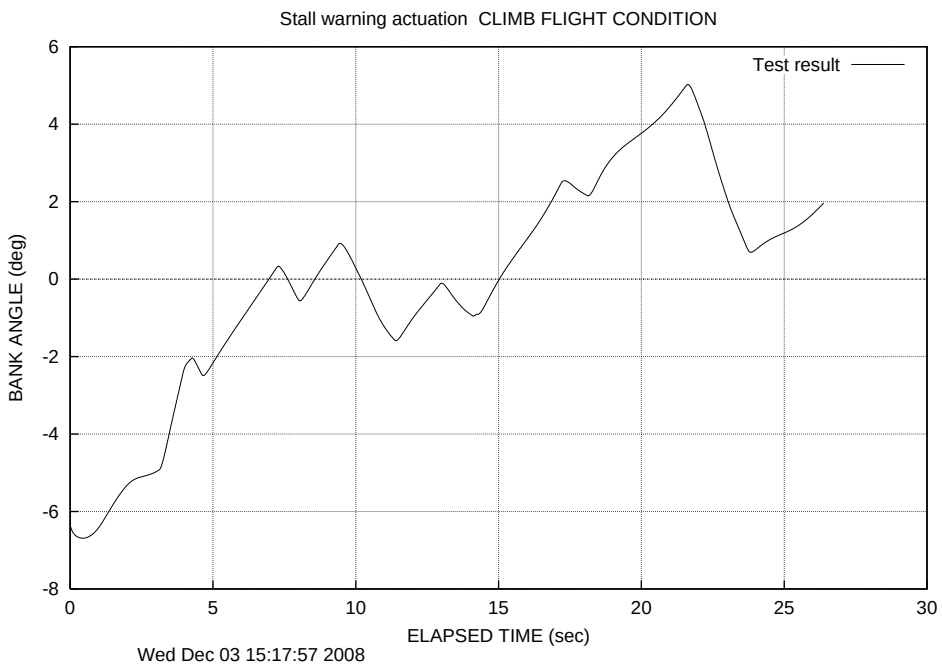

Stall warning actuation APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
3
2.5
2
1.5
1
0.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:10:50 2008

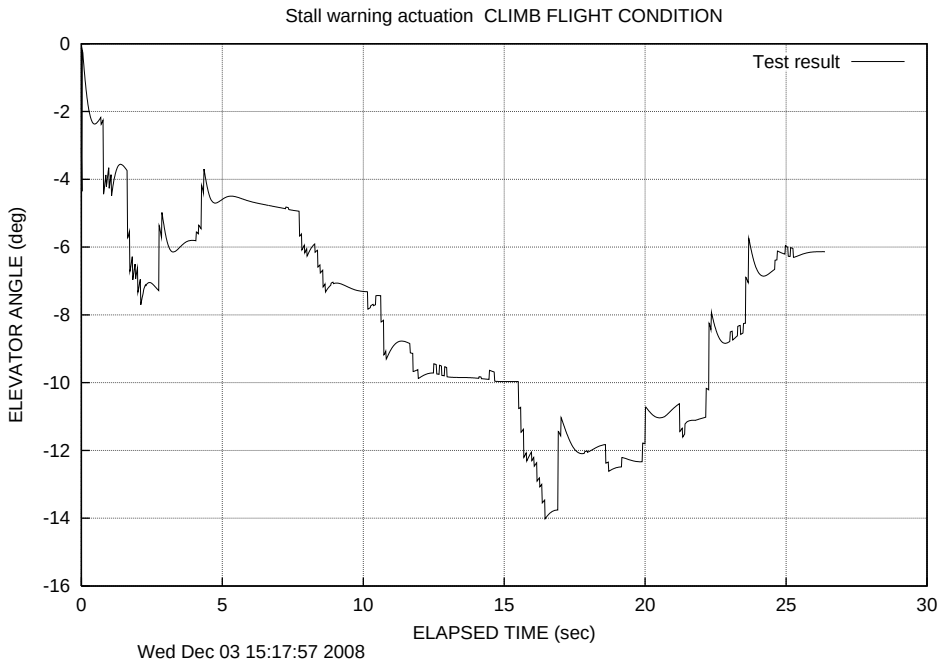
Climb flight condition:

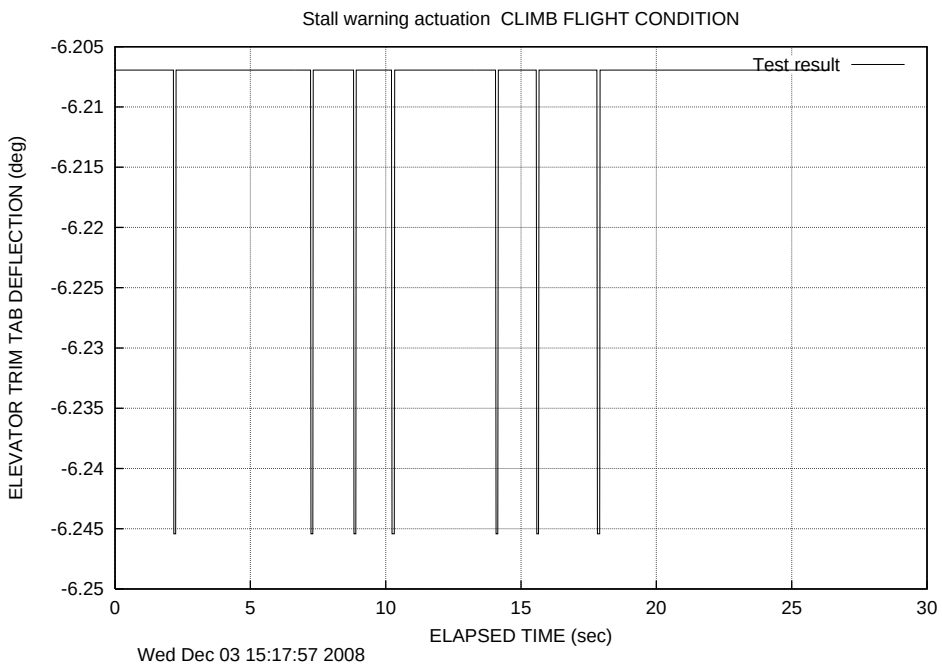


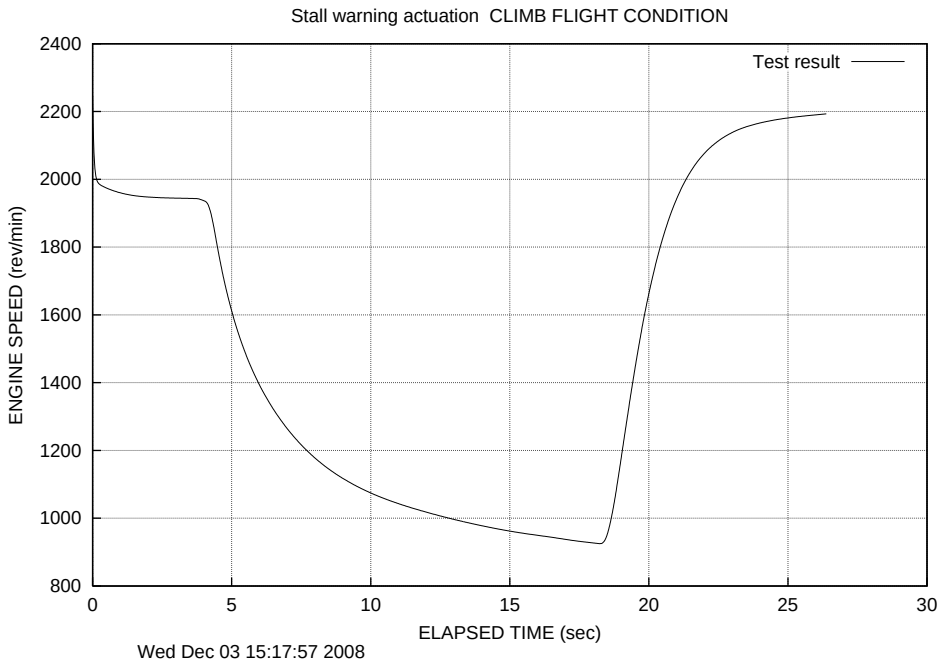


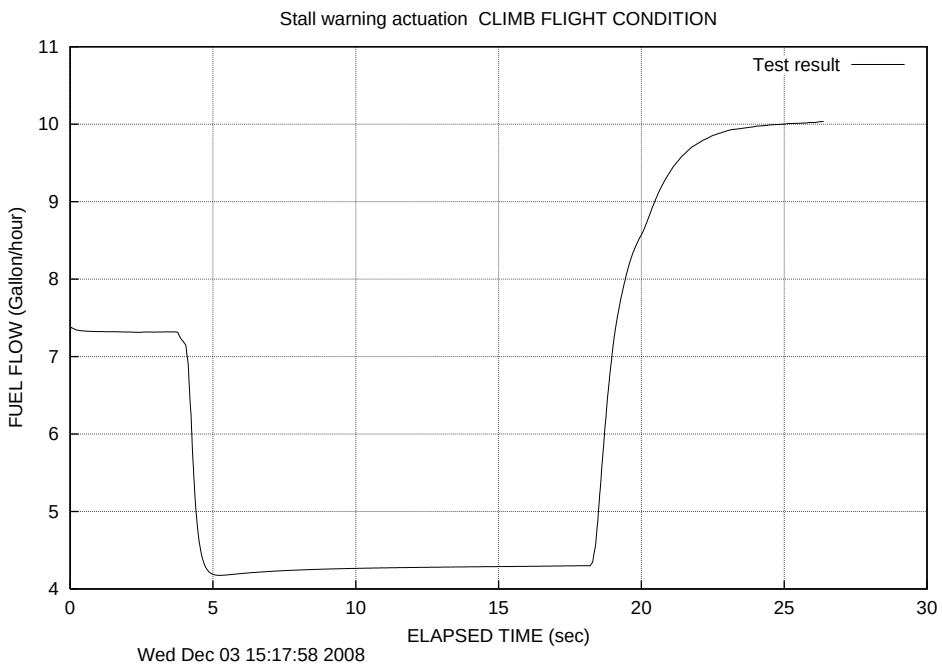

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:17:57 2008
11
10
9
8
7
6
5
4
3
2
0
5
10
15
20
25
30

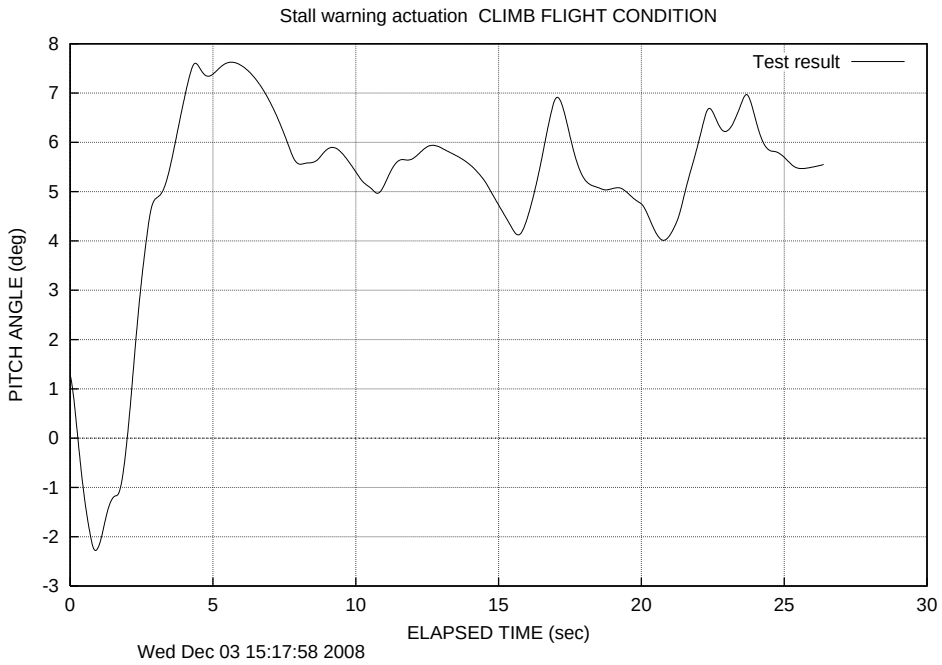

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:17:57 2008
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20
25
30

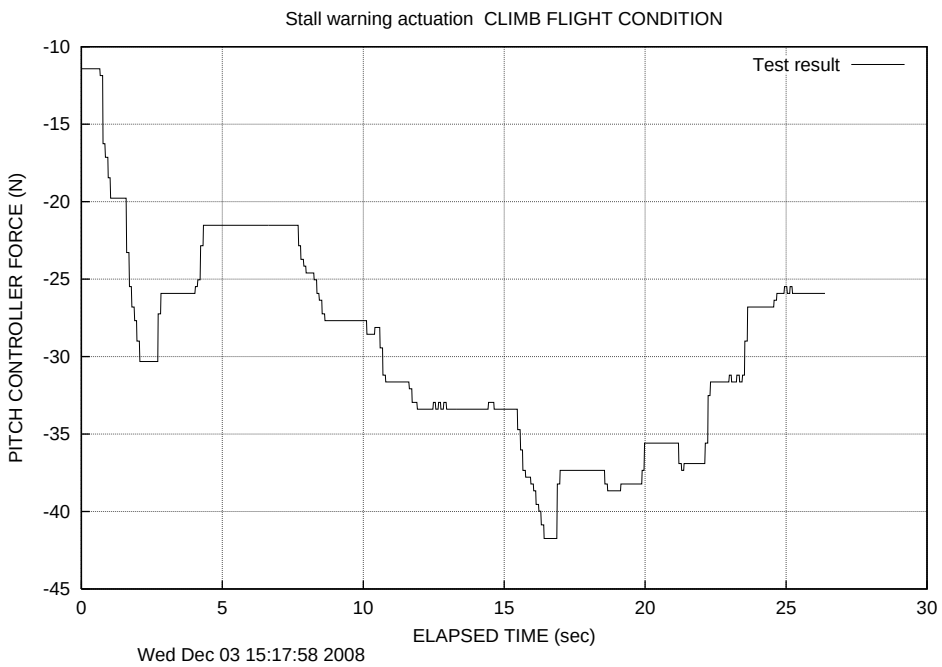

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:57 2008

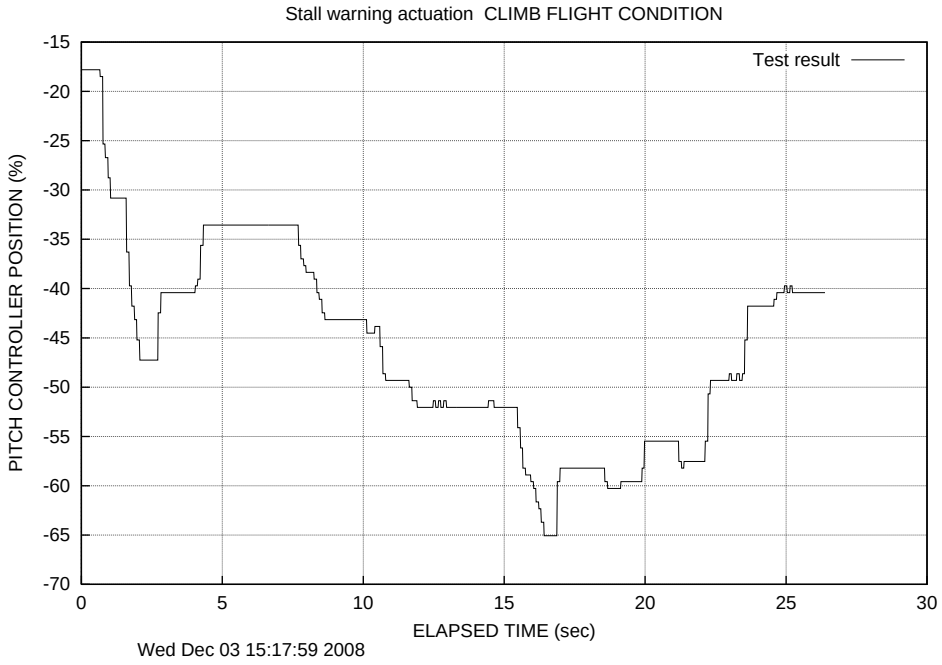

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-6.205
-6.21
-6.215
-6.22
-6.225
-6.23
-6.235
-6.24
-6.245
-6.25
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:57 2008

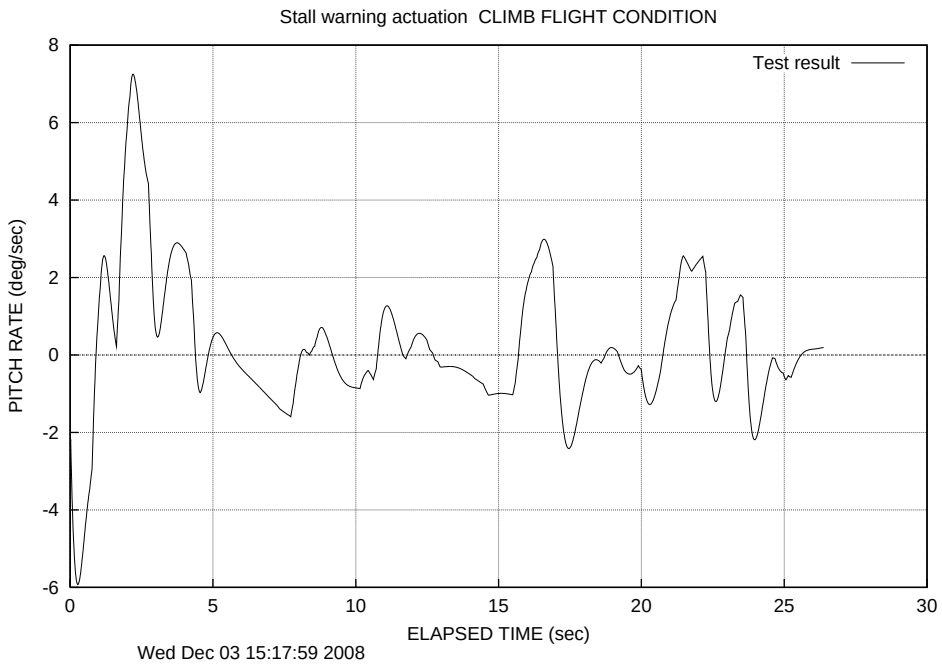

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2400
2200
2000
1800
1600
1400
1200
1000
800
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:57 2008

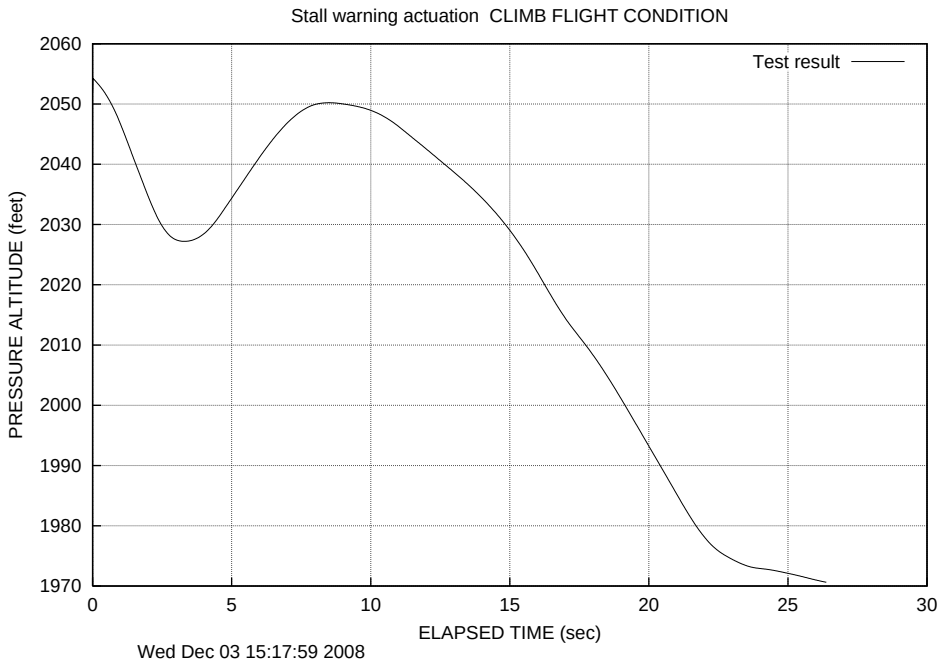

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
11
10
9
8
7
6
5
4
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:58 2008

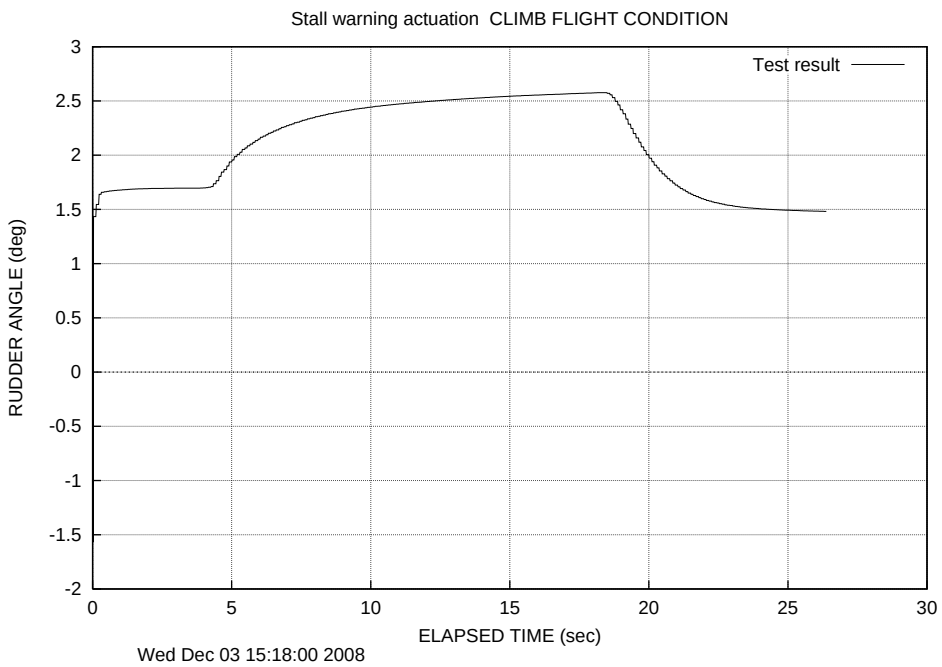

Stall warning actuation CLIMB FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
8
7
6
5
4
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:58 2008


Stall warning actuation CLIMB FLIGHT CONDITION
Test result
PITCH CONTROLLER FORCE (N)
-10
-15
-20
-25
-30
-35
-40
-45
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:58 2008


Stall warning actuation CLIMB FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:59 2008


Stall warning actuation CLIMB FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
8
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:59 2008


Stall warning actuation CLIMB FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
2060
2050
2040
2030
2020
2010
2000
1990
1980
1970
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:17:59 2008


Stall warning actuation CLIMB FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:18:00 2008

Source data	Section 3.14 of [1].
Comparison of results	The stall warning actuation test shows that the simulator has higher stall actuation speeds than measured in flight. Nevertheless, the approach configuration shows a significantly lower stall warning than the climb condition, which is the most important result for this test. The difference in absolute value compared to real flight is, therefore, thought to be acceptable. The stall warning actuation test thus shows compliance towards the Validation Reference Data result as described in Section 3.14 of [1].

6.3 Engine acceleration (1c1)

Test objective	To demonstrate that the simulated engine acceleration conforms to the class of aeroplane.
Demonstration procedure	Starting from a stabilised condition, rapidly advance the throttle setting from the idle power position to the go-around thrust setting.
References	[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	0	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	0.979	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-14.00	(%)
ROLL CONTROLLER POSITION	=	3.866	(%)
RUDDER PEDAL POSITION	=	8.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	60.8	(kts)
PRESSURE ALTITUDE	=	3691	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.5	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	3.7	(deg)
SIDESLIP ANGLE	=	0.5	(deg)
PITCH RATE	=	-2.4	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	0.6	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	1147	(rpm)
EXHAUST GAS TEMPERATURE	=	890.6	(deg F)
FUEL FLOW	=	4.39	(gallon/hour)

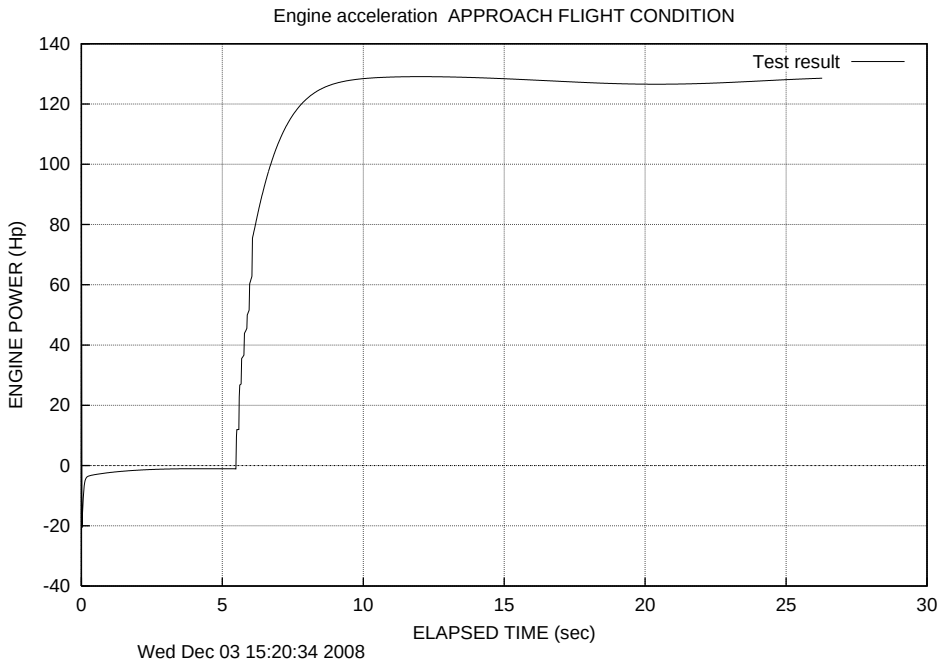
CONTROL SURFACES:

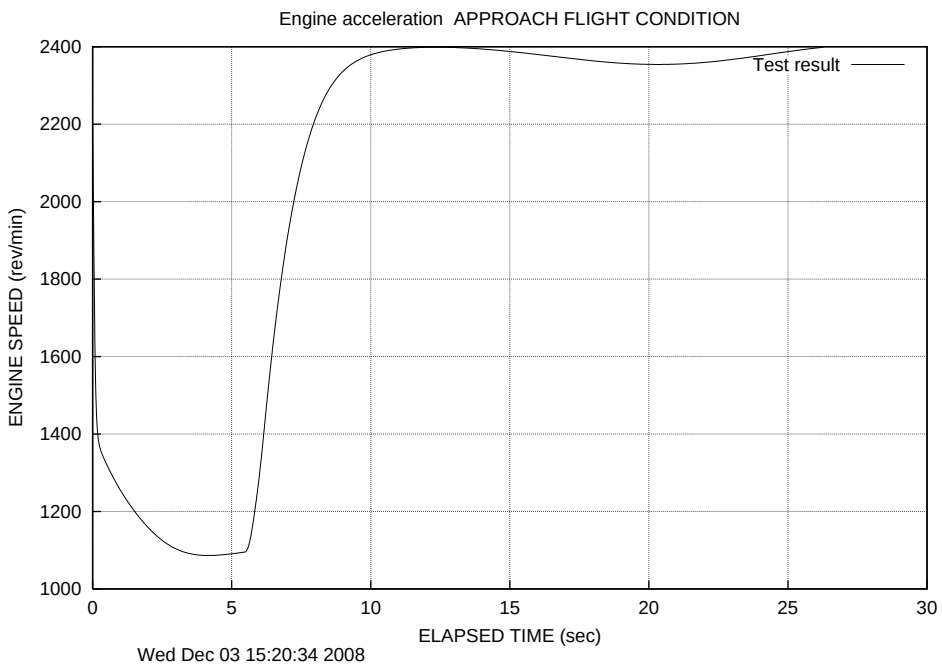
ELEVATOR ANGLE	=	-3.5	(deg)
LEFT AILERON ANGLE	=	0.6	(deg)
RIGHT AILERON ANGLE	=	-0.6	(deg)
RUDDER ANGLE	=	-1.3	(deg)
WING FLAP ANGLE	=	10	(deg)

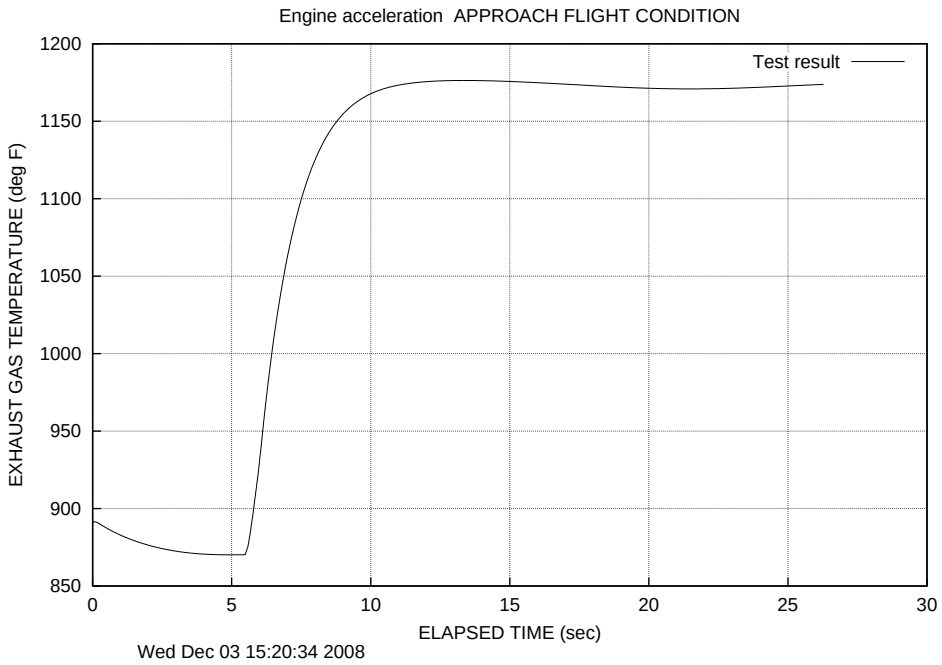
SWITCHES/BRAKES:

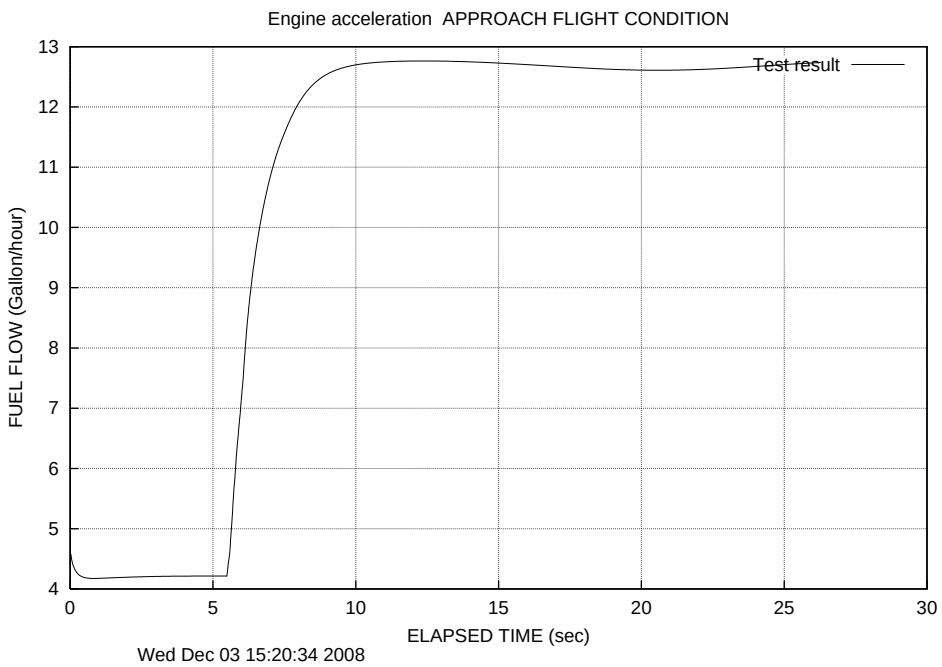
ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

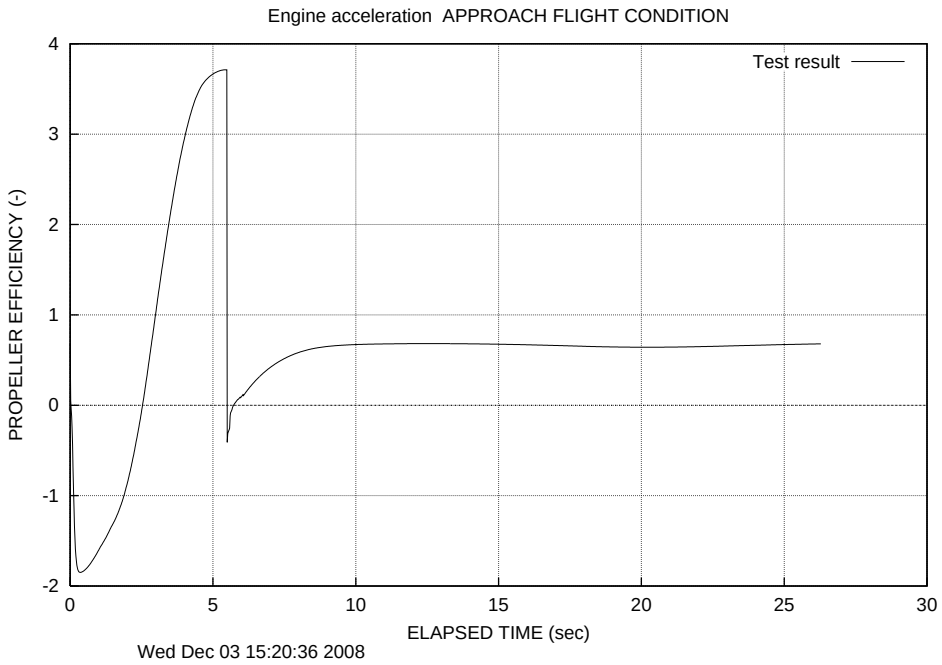
Manual test procedures	Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `602_FSTD_1f1_Approach.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'. Starting after 5 seconds with the throttle setting at idle: 1. From the idle throttle setting, push the throttle to its maximum, i.e. throttle setting is 55 mm. 2. Stop recording after 20 seconds have elapsed.
Evaluated parameters	ENGINE POWER ENGINE SPEED EXHAUST GAS TEMPERATURE FUEL FLOW INDICATED AIRSPEED PROPELLER EFFICIENCY THROTTLE SETTING THRUST PRESSURE ALTITUDE AMBIENT TEMPERATURE
Expected results	See Validation Reference Data result as described in Section 3.2 of [1].
Tolerances	CT&M
Test result	

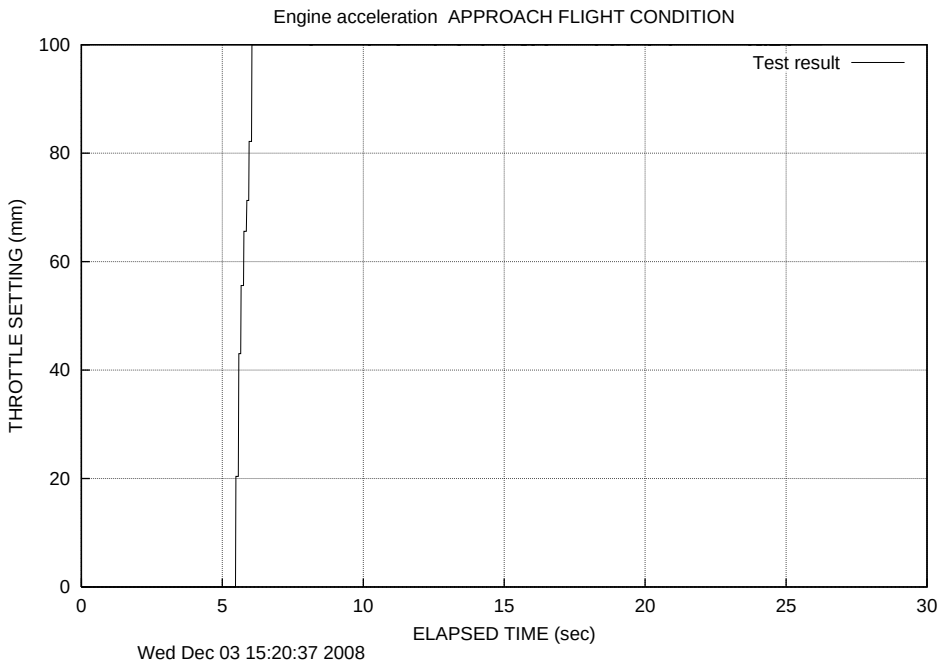

Engine acceleration APPROACH FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
140
120
100
80
60
40
20
0
-20
-40
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:34 2008

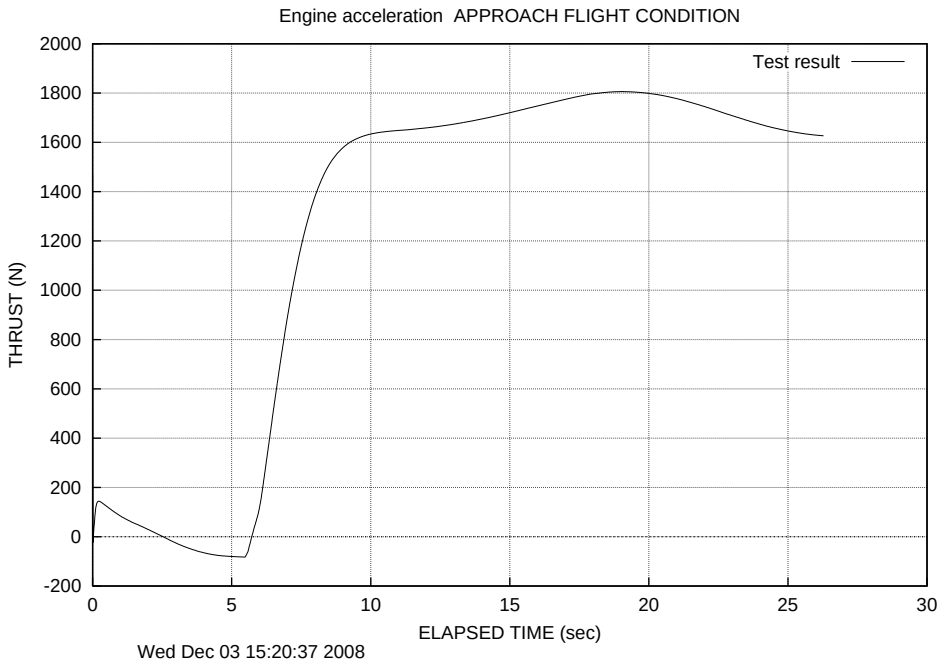

Engine acceleration APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2400
2200
2000
1800
1600
1400
1200
1000
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:34 2008

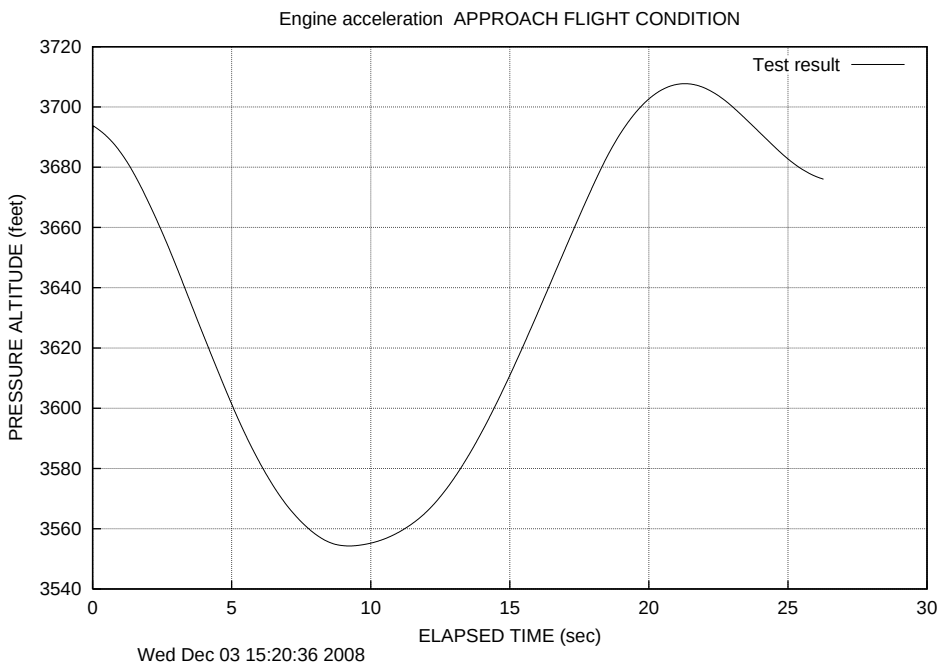

Engine acceleration APPROACH FLIGHT CONDITION
Test result
EXHAUST GAS TEMPERATURE (deg F)
1200
1150
1100
1050
1000
950
900
850
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:34 2008

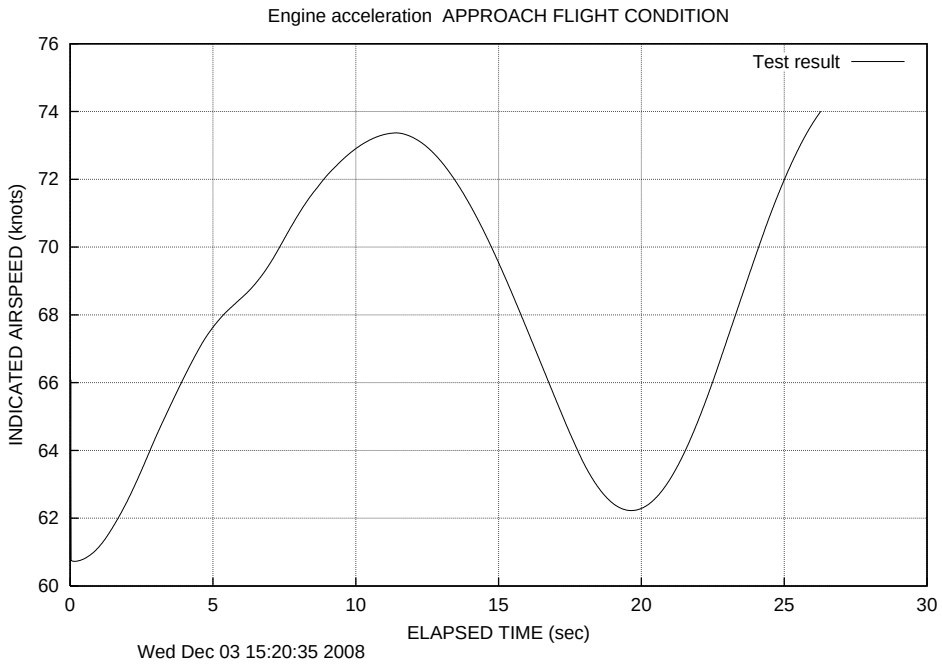

Engine acceleration APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
13
12
11
10
9
8
7
6
5
4
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:34 2008

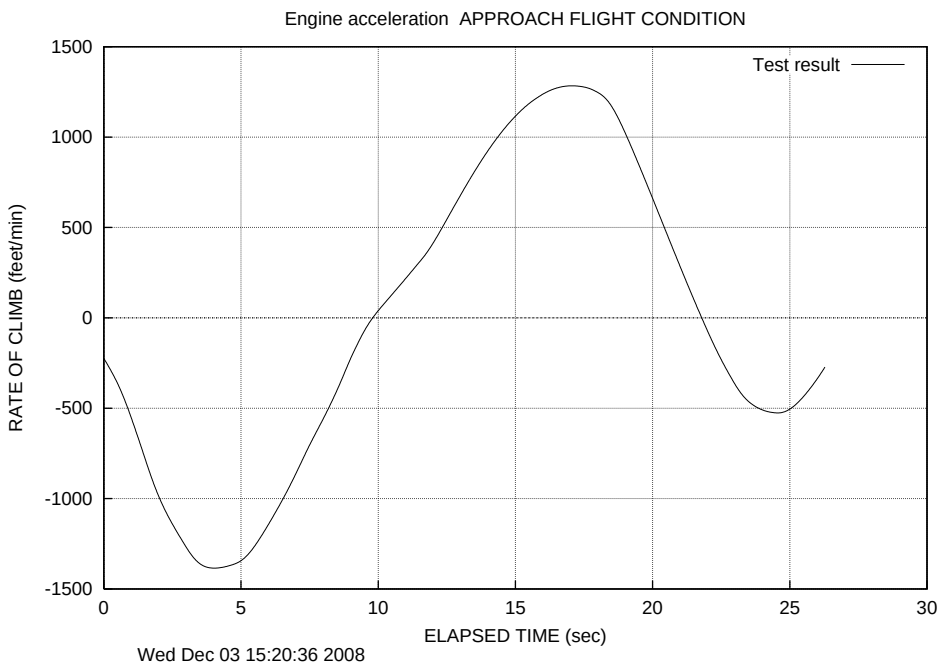

Engine acceleration APPROACH FLIGHT CONDITION
Test result
PROPELLER EFFICIENCY (-)
4
3
2
1
0
-1
-2
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:36 2008


Engine acceleration APPROACH FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
100
80
60
40
20
0
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:37 2008


Engine acceleration APPROACH FLIGHT CONDITION
Test result
THRUST (N)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:37 2008


Engine acceleration APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3720
3700
3680
3660
3640
3620
3600
3580
3560
3540
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 15:20:36 2008





Source data Section 3.2 of [1]

Comparison of results	The simulator test shows Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.2 of [1].

6.4 Engine deceleration (1c2)

Test objective	To demonstrate that the simulated engine deceleration conforms to the class of aeroplane.
Demonstration procedure	Starting from a stable on-ground condition with the engine at maximum take-off power and stabilised, rapidly retard the throttle setting to the idle power position.
References	[2], [3], [4]

Initial conditions

Ground flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	55	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	0.975	(-)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

PRESSURE ALTITUDE	=	-15	(ft)
AMBIENT TEMPERATURE	=	45.0	(deg F)

ENGINE PARAMETERS:

ENGINE SPEED	=	2369	(rpm)
EXHAUST GAS TEMPERATURE	=	1259	(deg F)
FUEL FLOW	=	13.4	(gallon/hour)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH

PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `603_FSTD_1f2_Ground.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the throttle setting at 55 mm:
1. From the maximum throttle setting, pull the throttle towards idle, i.e. throttle setting is 0 mm.
2. Stop recording after 40 seconds have elapsed.

Evaluated parameters

THROTTLE SETTING
ENGINE POWER
ENGINE SPEED
EXHAUST GAS TEMPERATURE
FUEL FLOW
THRUST
PROPELLER EFFICIENCY
AMBIENT TEMPERATURE
ATMOSPHERIC PRESSURE
PRESSURE ALTITUDE

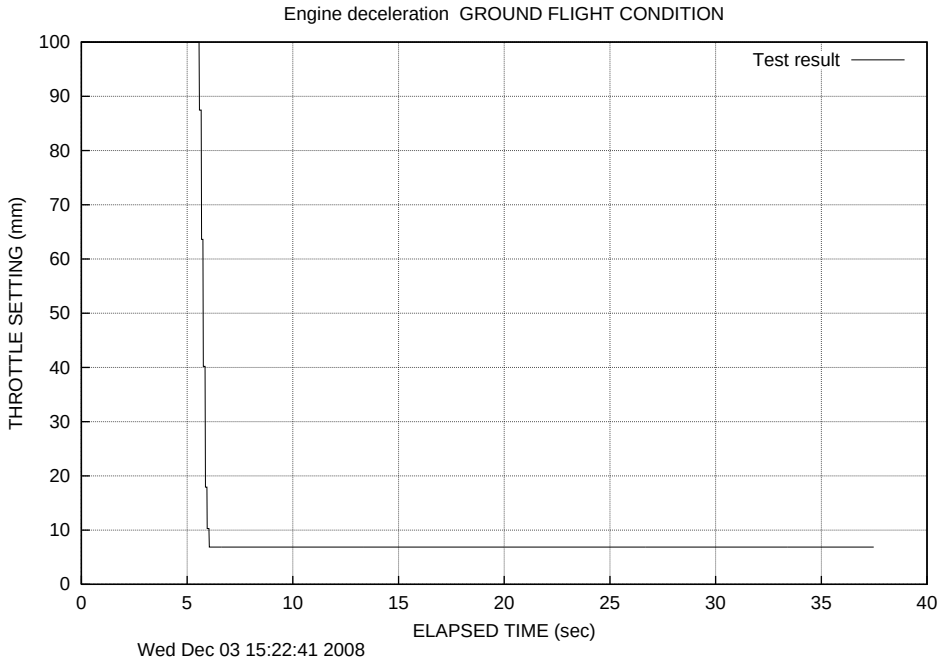
Expected results

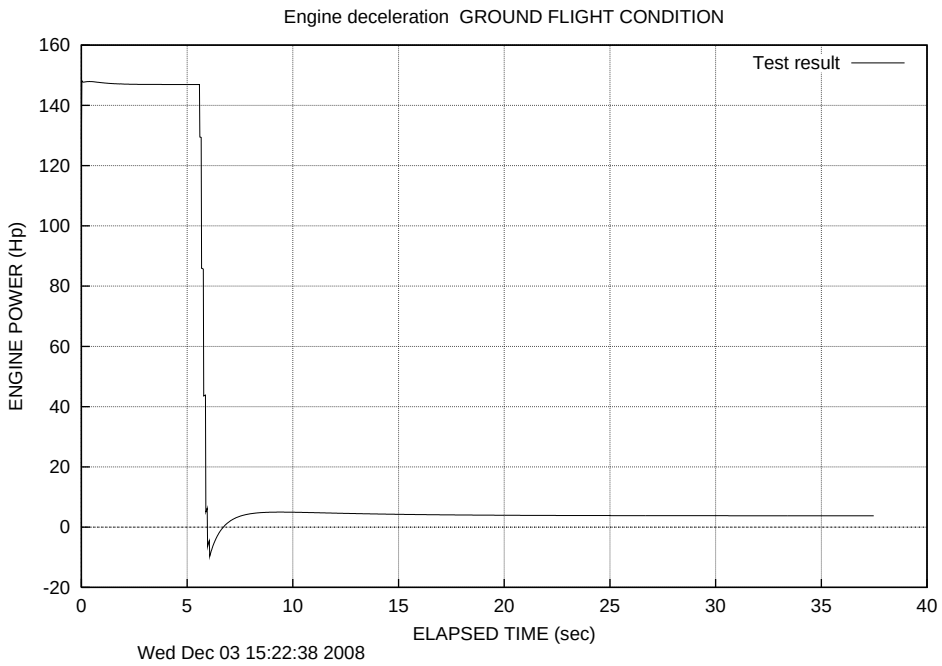
See Validation Reference Data result as described in Section 3.3 of [1].

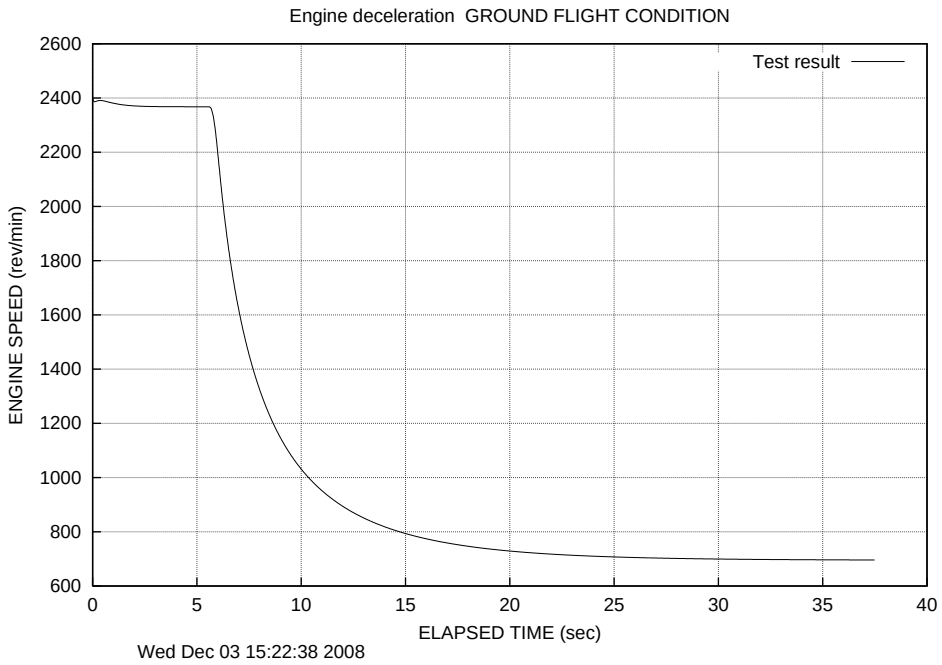
Tolerances

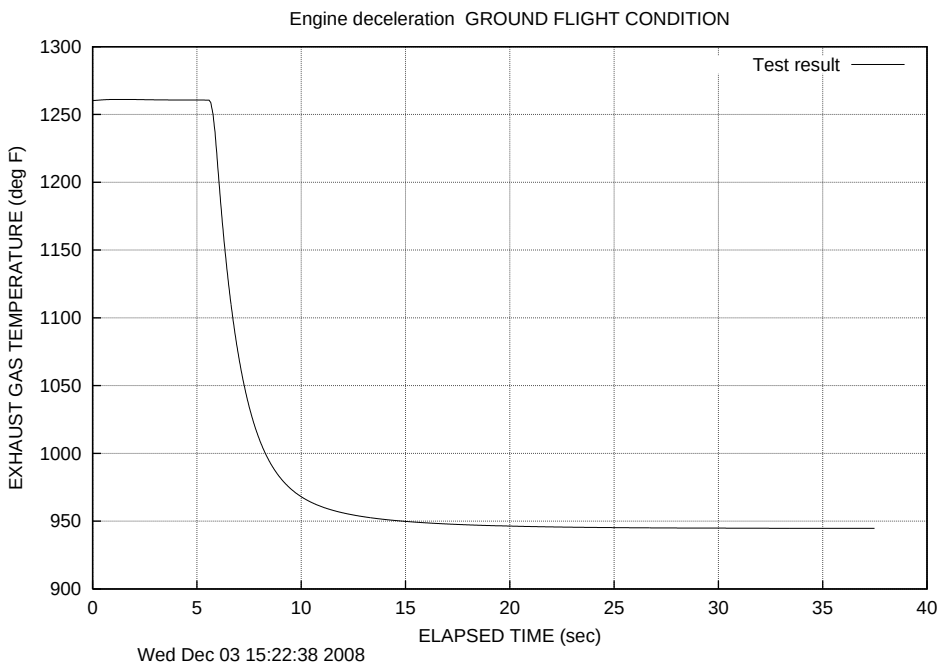
CT&M

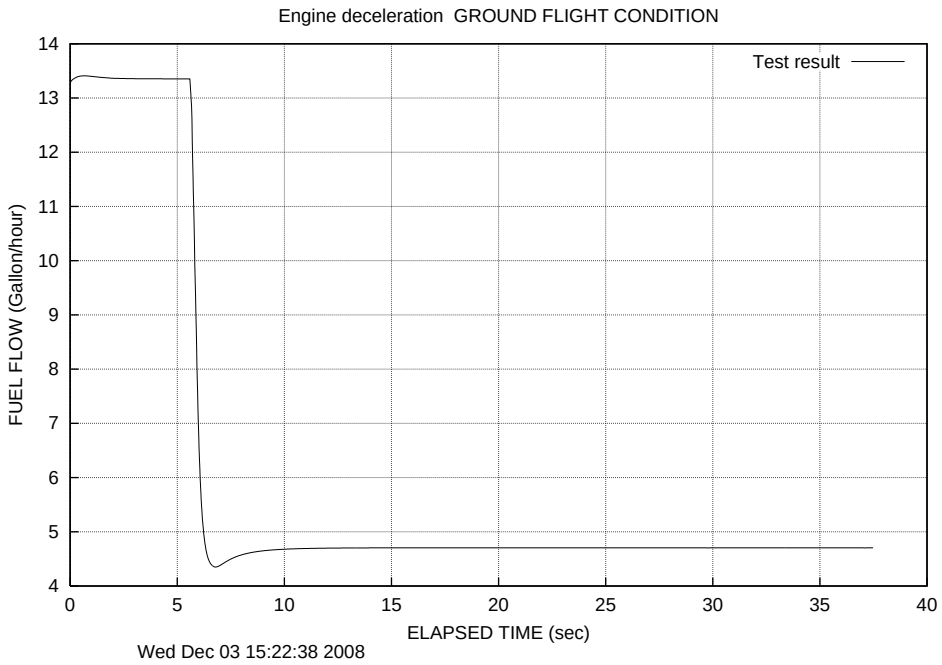
Test result

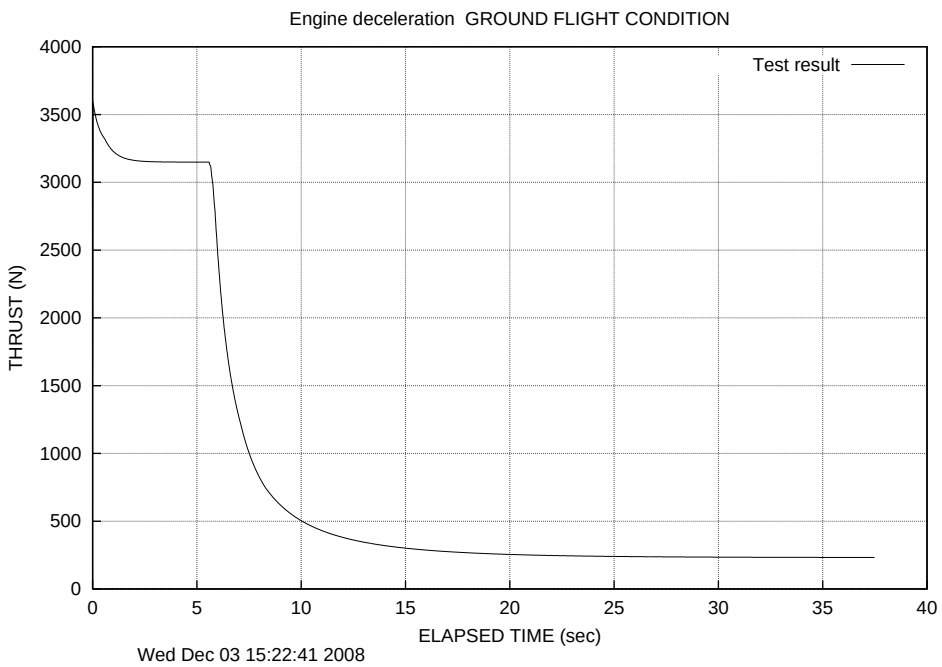

Engine deceleration GROUND FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
ELAPSED TIME (sec)
Wed Dec 03 15:22:41 2008

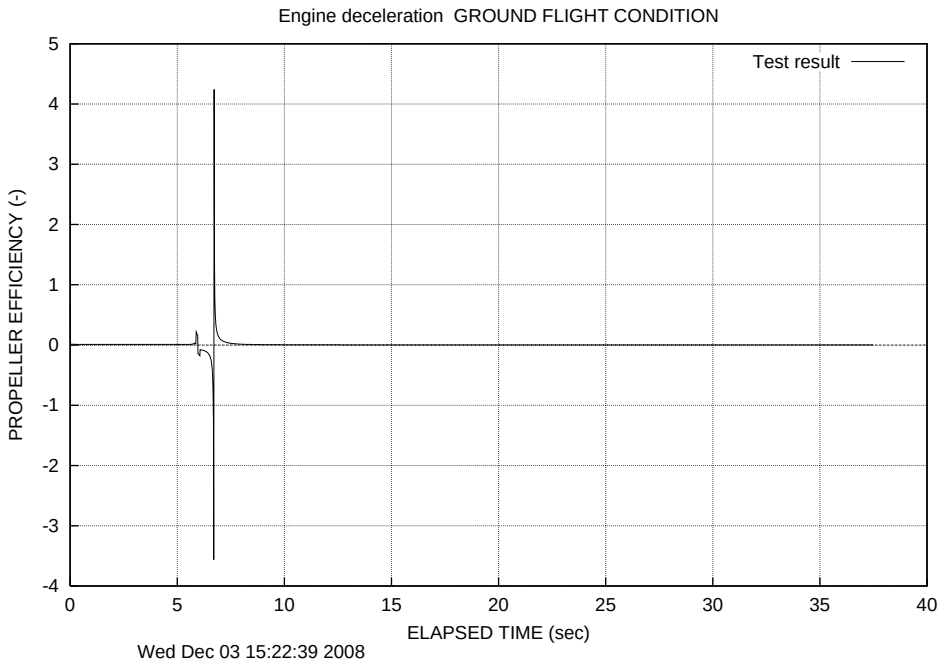

Engine deceleration GROUND FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
ELAPSED TIME (sec)
Wed Dec 03 15:22:38 2008


Engine deceleration GROUND FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 15:22:38 2008


Engine deceleration GROUND FLIGHT CONDITION
Test result
EXHAUST GAS TEMPERATURE (deg F)
1300
1250
1200
1150
1100
1050
1000
950
900
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 15:22:38 2008


Engine deceleration GROUND FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
14
13
12
11
10
9
8
7
6
5
4
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 15:22:38 2008


Engine deceleration GROUND FLIGHT CONDITION
Test result
THRUST (N)
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 15:22:41 2008



Source data	Section 3.3 of [1]
Comparison of results	The simulator test shows Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.3 of [1].

6.5 Pitch controller position vs. force (2a1)

Test objective	To demonstrate that the simulator pitch controller position versus pitch controller force characteristics conform to the class of aeroplane.
Demonstration procedure	Starting from the neutral position, move the pitch controller at a very slow rate over its full range to the aft and forward limit, then back through neutral to the opposite limit, then back to neutral again.
References	[2], [3], [4]
Initial conditions	**Approach flight condition:**

CONTROL INPUTS:

THROTTLE SETTING	=	38.39	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.346	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-6.667	(%)
ROLL CONTROLLER POSITION	=	9.794	(%)
RUDDER PEDAL POSITION	=	-4.727	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	70.1	(kts)
RATE OF CLIMB	=	11.8	(fpm)
PRESSURE ALTITUDE	=	4458	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.4	(deg)
BANK ANGLE	=	3.5	(deg)
ANGLE OF ATTACK	=	1.3	(deg)
SIDESLIP ANGLE	=	0.0	(deg)
PITCH RATE	=	-1.5	(deg/sec)
ROLL RATE	=	0.4	(deg/sec)
YAW RATE	=	1.0	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2668	(rpm)
EXHAUST GAS TEMPERATURE	=	1073	(deg F)
FUEL FLOW	=	8.20	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	2.0	(deg)
LEFT AILERON ANGLE	=	-0.3	(deg)
RIGHT AILERON ANGLE	=	0.3	(deg)
RUDDER ANGLE	=	-0.7	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `613_FSTD_2c7_Approach.sit` or `613_FSTD_2c7_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.
Note: for this qualification test the flight condition (i.e. the aircraft and engine states) will be frozen. This means that while the controller position is changed, the aircraft will remain in its trimmed state.

With the pitch controller position in the neutral position:
1. From the neutral position, push the Yoke to the maximum forward position (+100%).
2. From the maximum forward position, pull the Yoke to the maximum aft position (-100%).
3. From the maximum aft position, push the Yoke to the neutral position.
4. Stop recording.

Evaluated parameters

PITCH CONTROLLER FORCE
PITCH CONTROLLER POSITION

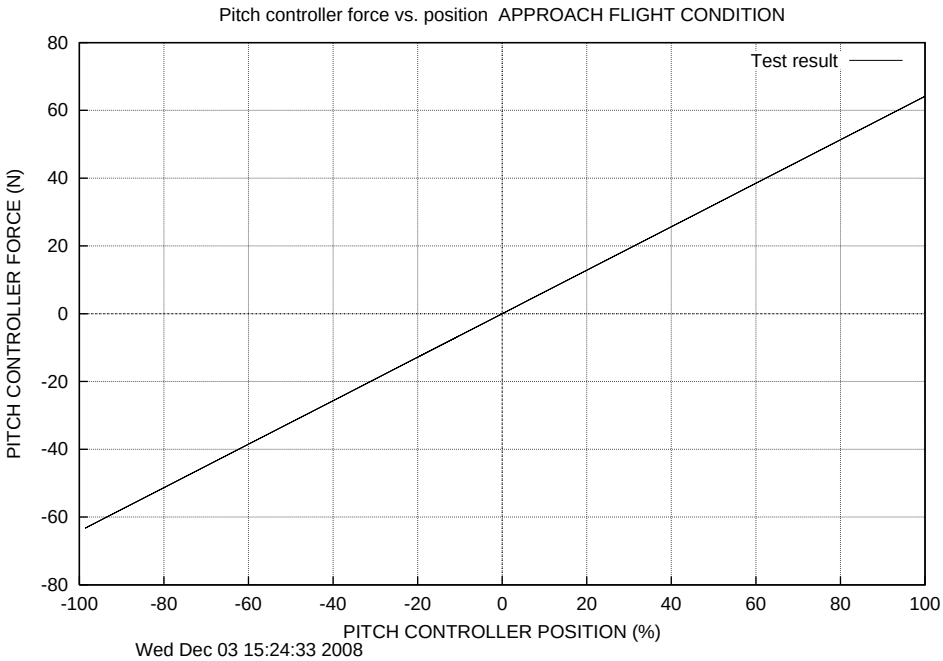
Expected results

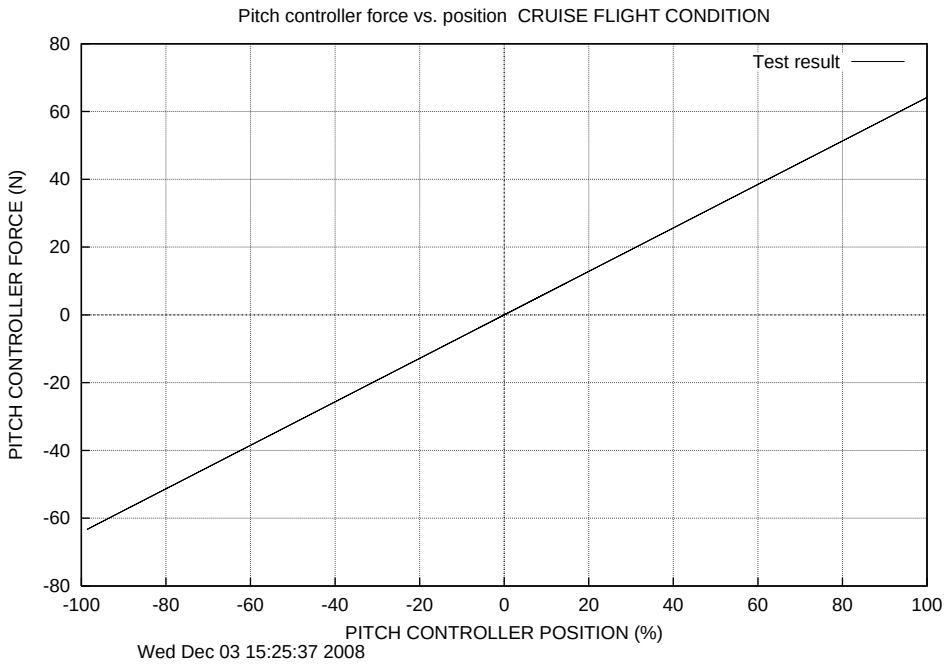
Under a cruise flight condition (indicated airspeed 90 kts, Flaps 0) the forces needed for pitch control are larger than the forces needed under an approach flight conditions (indicated airspeed 75 kts, Flaps 10). See section 3.4 of [1]

Tolerances

PITCH CONTROLLER FORCE ±2.2 daN (5 lb) or ±10%

Test result


Pitch controller force vs. position APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER FORCE (N)
80
60
40
20
0
-20
-40
-60
-80
-100
-80
-60
-40
-20
0
20
40
60
80
100
PITCH CONTROLLER POSITION (%)
Wed Dec 03 15:24:33 2008



Source data	Section 3.4 of [1]
Comparison of results	The pitch controller position versus force simulator test under approach and under cruise flight condition each show Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.4 of [1].

6.6 Roll controller position vs. force (2a2)

Test objective	To demonstrate that the simulator roll controller position versus roll controller force characteristics conform to the class of aeroplane.
Demonstration procedure	Starting from the neutral position, move the roll controller at a very slow rate over its full range to the left or right limit, then back through neutral to the opposite limit, then back to neutral again.
References	[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	35.10	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-11.33	(%)
ROLL CONTROLLER POSITION	=	-1.700	(%)
RUDDER PEDAL POSITION	=	2.545	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	70.1	(kts)
RATE OF CLIMB	=	11.8	(fpm)
PRESSURE ALTITUDE	=	4458	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.4	(deg)
BANK ANGLE	=	3.5	(deg)
ANGLE OF ATTACK	=	1.3	(deg)
SIDESLIP ANGLE	=	-0.4	(deg)
PITCH RATE	=	-1.5	(deg/sec)
ROLL RATE	=	0.4	(deg/sec)
YAW RATE	=	1.0	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	1861	(rpm)
EXHAUST GAS TEMPERATURE	=	1073	(deg F)
FUEL FLOW	=	8.20	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.4	(deg)
LEFT AILERON ANGLE	=	-0.4	(deg)
RIGHT AILERON ANGLE	=	0.4	(deg)
RUDDER ANGLE	=	-0.3	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Cruise flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	29.55	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-8.667	(%)
ROLL CONTROLLER POSITION	=	2.320	(%)
RUDDER PEDAL POSITION	=	2.545	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	87.2	(kts)
RATE OF CLIMB	=	-11.8	(fpm)
PRESSURE ALTITUDE	=	4505	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.7	(deg)

BANK ANGLE	=	1.3	(deg)
ANGLE OF ATTACK	=	2.0	(deg)
SIDESLIP ANGLE	=	-0.5	(deg)
PITCH RATE	=	-2.0	(deg/sec)
ROLL RATE	=	0.5	(deg/sec)
YAW RATE	=	0.1	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2113	(rpm)
EXHAUST GAS TEMPERATURE	=	1050	(deg F)
FUEL FLOW	=	7.44	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.8	(deg)
LEFT AILERON ANGLE	=	0.3	(deg)
RIGHT AILERON ANGLE	=	-0.3	(deg)
RUDDER ANGLE	=	-0.3	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `605_FSTD_2a2_Approach.sit` or `605_FSTD_2a2_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Note: for this qualification test the flight condition (i.e. the aircraft and engine states) will be frozen. This means that while the controller position is changed, the aircraft will remain in its trimmed state.

Starting with the roll controller position in the neutral position:
1. From the neutral position, turn the Yoke to the maximum clockwise position (-100%).
2. From the maximum clockwise position, turn the Yoke to the maximum counterclockwise position (+100%).
3. From the maximum counterclockwise position, turn the Yoke to the neutral position.
4. Stop recording.

Evaluated parameters

ROLL CONTROLLER FORCE
ROLL CONTROLLER POSITION

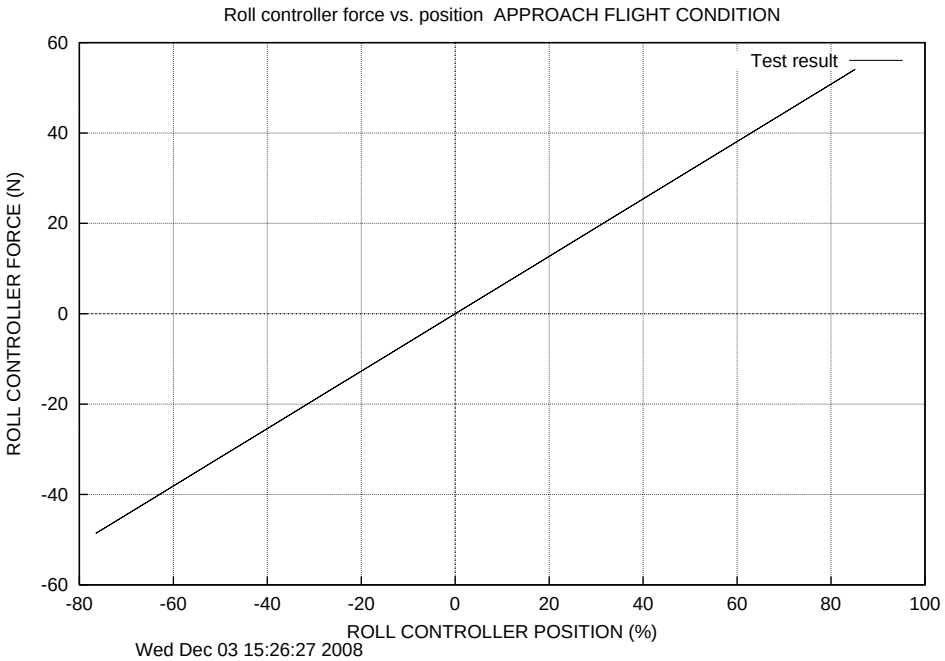
Expected results

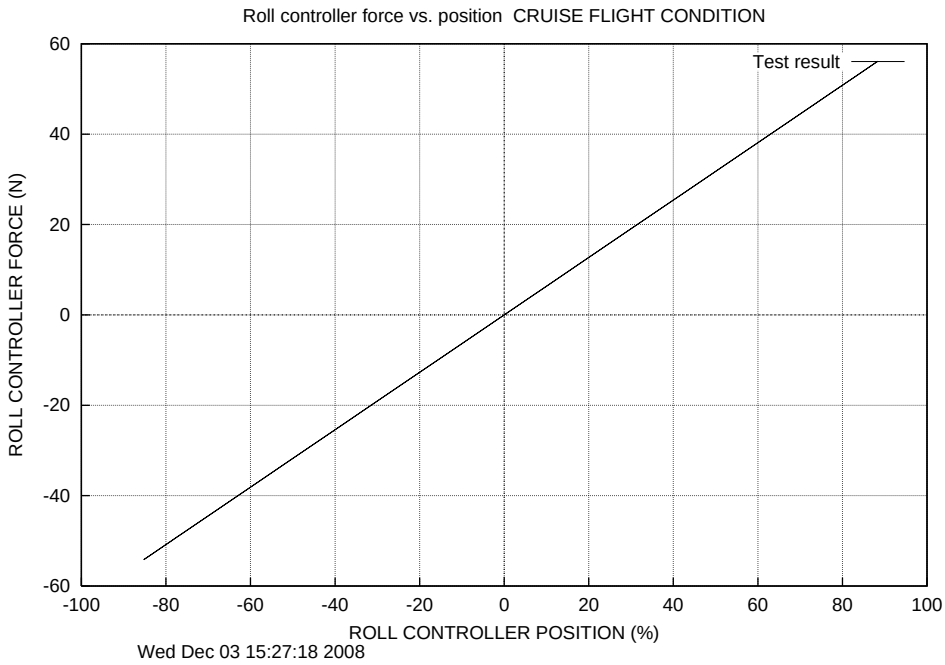
Under a cruise flight condition (indicated airspeed 90 kts, Flaps 0) the forces needed for roll control are larger than the forces needed under an approach flight conditions (indicated airspeed 75 kts, Flaps 10). See section 3.5 of [1]

Tolerances

ROLL CONTROLLER FORCE ±1.3 daN (3 lb) or ±10%

Test result


Roll controller force vs. position APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER FORCE (N)
60
40
20
0
-20
-40
-60
-80
-60
-40
-20
0
20
40
60
80
100
ROLL CONTROLLER POSITION (%)
Wed Dec 03 15:26:27 2008



Source data	Section 3.5 of [1]
Comparison of results	The roll controller position versus force simulator test under approach and under cruise flight condition each show Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.5 of [1].

6.7 Rudder pedal position vs. force (2a3)

Test objective	To demonstrate that the simulator rudder pedal static characteristics conform to the class of aeroplane.
Demonstration procedure	Starting from the neutral position, move the rudder pedal at a very slow rate over their full range to the left or right limit, then back through neutral to the opposite limit, then back to neutral again.
References	[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	35.10	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-13.33	(%)
ROLL CONTROLLER POSITION	=	4.124	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	32	(deg C)
BARO PRESSURE AT SEALEVEL	=	1016	(mbar)
WIND SPEED	=	6	(kt)
WIND SPEED DIRECTION	=	030	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.2	(kts)
RATE OF CLIMB	=	4.0	(fpm)
PRESSURE ALTITUDE	=	3058	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	4.4	(deg)
BANK ANGLE	=	1.5	(deg)
ANGLE OF ATTACK	=	3.7	(deg)
SIDESLIP ANGLE	=	-1.0	(deg)
PITCH RATE	=	2.4	(deg/sec)
ROLL RATE	=	-2.6	(deg/sec)
YAW RATE	=	0.1	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2093	(rpm)
EXHAUST GAS TEMPERATURE	=	1089	(deg F)
FUEL FLOW	=	8.22	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.8	(deg)
LEFT AILERON ANGLE	=	0.6	(deg)
RIGHT AILERON ANGLE	=	-0.6	(deg)
RUDDER ANGLE	=	-0.3	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH

SWITCH FUEL CUTOFF	=	OFF	

Initial conditions

Cruise flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	29.06	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-13.33	(%)
ROLL CONTROLLER POSITION	=	4.124	(%)
RUDDER PEDAL POSITION	=	2.545	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	32	(deg C)
BARO PRESSURE AT SEALEVEL	=	1016	(mbar)
WIND SPEED	=	6	(kt)
WIND SPEED DIRECTION	=	030	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	89.1	(kts)
RATE OF CLIMB	=	-37.0	(fpm)
PRESSURE ALTITUDE	=	3005	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.2	(deg)
BANK ANGLE	=	0.7	(deg)

ANGLE OF ATTACK	=	1.9	(deg)
SIDESLIP ANGLE	=	-0.2	(deg)
PITCH RATE	=	4.4	(deg/sec)
ROLL RATE	=	-2.7	(deg/sec)
YAW RATE	=	-0.9	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2116	(rpm)
EXHAUST GAS TEMPERATURE	=	1058	(deg F)
FUEL FLOW	=	7.50	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.8	(deg)
LEFT AILERON ANGLE	=	0.6	(deg)
RIGHT AILERON ANGLE	=	-0.6	(deg)
RUDDER ANGLE	=	-0.3	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `606_FSTD_2a3_Approach.sit` or `606_FSTD_2a3_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Note: for this qualification test the flight condition (i.e. the aircraft and engine states) will be frozen. This means that while the controller position is changed, the aircraft will remain in its trimmed state.

Starting with the rudder pedal position in the neutral position:
1. From the neutral position, push the left pedal to the maximum forward position (+100%) while the right pedal remains free.
2. Push the right pedal to the maximum forward position (-100%) while the left pedal remains free.
3. Push the left pedal from the maximum aft position to the neutral position while the right pedal remains free.
4. Stop recording.

Evaluated parameters

RUDDER PEDAL FORCE
RUDDER PEDAL POSITION

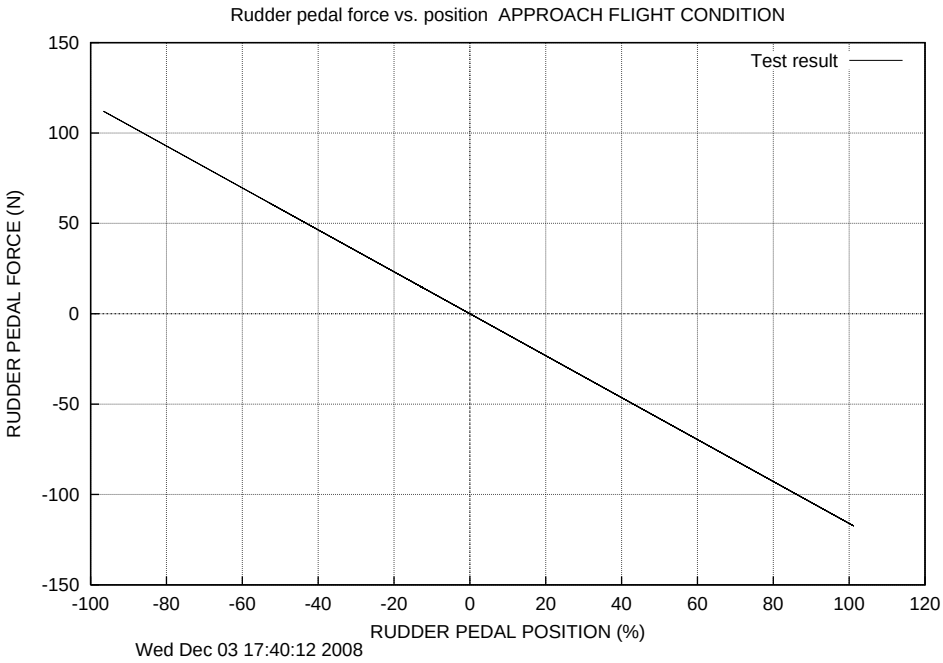
Expected results

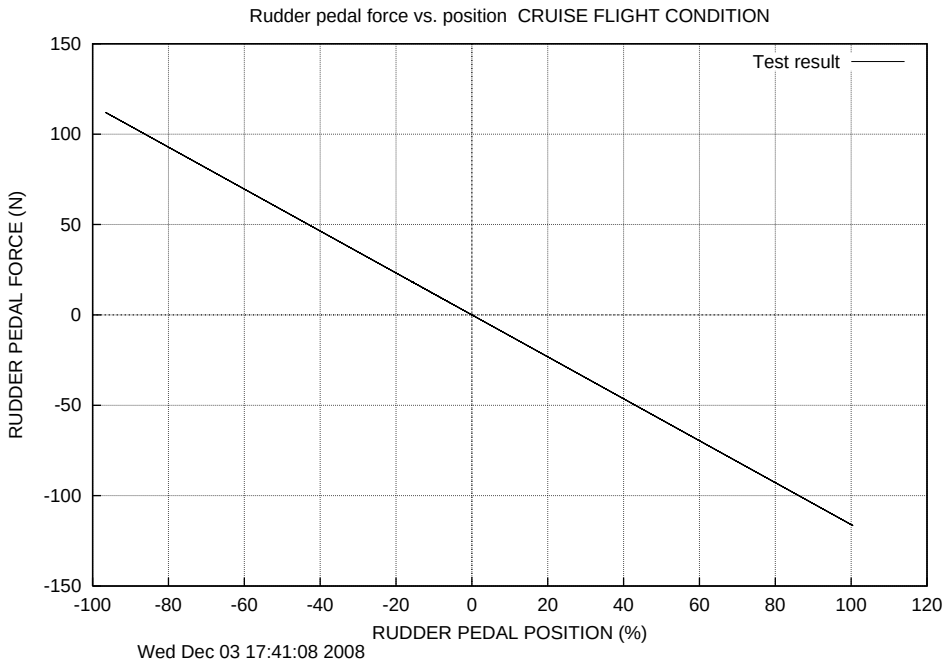
Under a cruise flight condition (indicated airspeed 90 kts, Flaps 0) the forces needed for rudder control are larger than the forces needed under an approach flight conditions (indicated airspeed 75 kts, Flaps 10). Aerodynamic loading of the rudder control surface/system has a relatively small contribution to the rudder pedal forces compared to force contribution due to the springs in the rudder pedal system. See section 3.6 of [1].

Tolerances

RUDDER PEDAL FORCE	±2.2 daN (5 lb) or ±10%

Test result


Rudder pedal force vs. position APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL FORCE (N)
150
100
50
0
-50
-100
-150
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
RUDDER PEDAL POSITION (%)
Wed Dec 03 17:40:12 2008



Source data	Section 3.6 of [1]
Comparison of results	The rudder pedal position versus force simulator test under approach and under cruise flight condition each show Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.6 of [1].

6.8 Trimwheel position vs. trim tab angle (2a4)

Test objective	To demonstrate that the trimwheel is satisfactorily calibrated relative to the elevator trim tab angle and conforms to the class of aeroplane.
Demonstration procedure	The trimwheel is moved to the specified positions. The elevator trim tab deflection is then checked.
References	[2], [3], [4]

Initial conditions

Ground flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	0	(mm)
MIXTURE SETTING	=	0	(mm)

CONTROL SURFACES:

ELEVATOR ANGLE	=	1.3	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	OFF
PARKING BRAKE	=	SET
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `607_FSTD_2a6_Ground.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting with the trimwheel position at 0.00 turns:

1. From the neutral position, slowly move the trimwheel to the maximum nose up position (-1.4 turns).
2. From the maximum nose up position, slowly move the trimwheel to the maximum nose down position (+2.8 turns).
3. From the maximum nose down position, slowly move back the trimwheel to the neutral position.
4. Stop recording.

Evaluated parameters

ELEVATOR TRIM TAB ANGLE
TRIMWHEEL POSITION

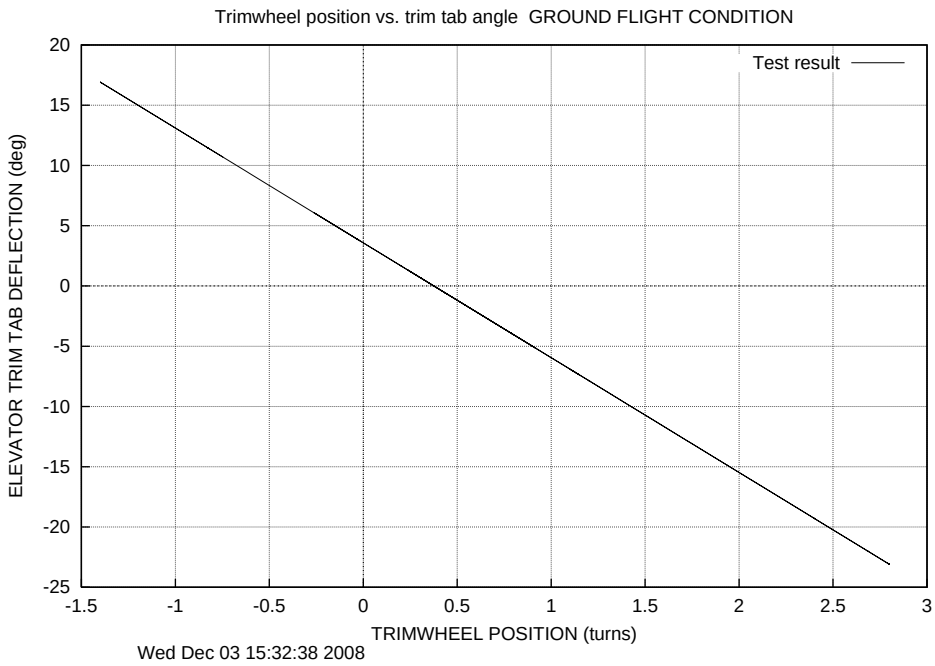
Expected results

A trimwheel movement maximum nose up of -1.4 turns is expected to correspond with a maximum down (positive) elevator trim tab deflection of 17 degrees. A trimwheel movement maximum nose down of +2.8 turns is expected to correspond with a maximum down (negative) elevator trim tab deflection of -23 degrees.

Tolerances

ELEVATOR TRIM TAB ANGLE $\pm 1°$

Test result



Source data

Section 3.7 of [1]

Comparison of results	The trimwheel position vs. trim tab angle simulator test shows compliance towards the Validation Reference Data result as described in Section 3.7 of [1].

6.9 Alignment of throttle vs. selected engine parameter (2a5)

Test objective	To demonstrate that the alignment of the throttle in the simulator with reference to the resultant key engine parameters conforms to the class of aeroplane.
Demonstration procedure	The throttle is moved to several specified positions and the engine key parameters are recorded.
References	[2], [3], [4]

Initial conditions

Ground flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	0	(mm)
MIXTURE SETTING	=	55	(mm)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

ENGINE PARAMETERS:

ENGINE SPEED	=	641	(rpm)
EXHAUST GAS TEMPERATURE	=	934	(deg F)
FUEL FLOW	=	4.58	(gallon/hour)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `608_FSTD_2a8_Ground.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the throttle setting at idle:
1. From the idle position, push the throttle such that the engine speed reaches 1000 RPM.
2. After 20 seconds, pull the throttle such that the engine speed reaches 1500 RPM.
3. After 40 seconds, pull the throttle such that the engine speed reaches 2000 RPM.
4. After 60 seconds, push the throttle to its maximum i.e. 55 mm.
5. Stop recording after 80 seconds have elapsed.

Evaluated parameters

THROTTLE SETTING
ENGINE SPEED
ENGINE TORQUE
EXHAUST GAS TEMPERATURE
FUEL FLOW
THRUST

Expected results

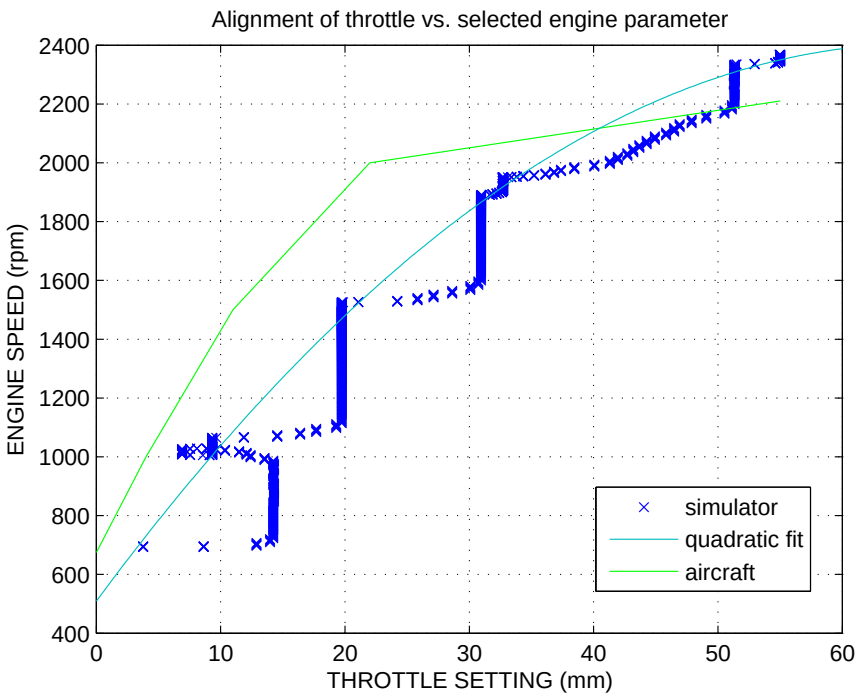
On ground the maximum engine speed of 2700 rpm is not expected to be reached at full throttle (full rich mixture). Engine torque, exhaust gas temperature and fuel flow will all increase as the throttle setting increases. See section 3.8 of [1].

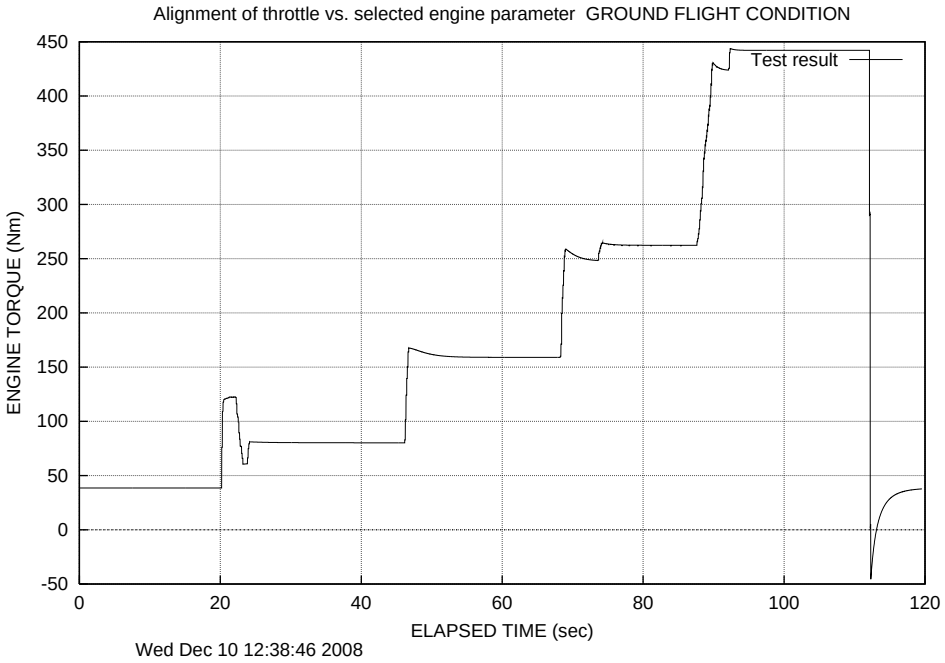
Tolerances

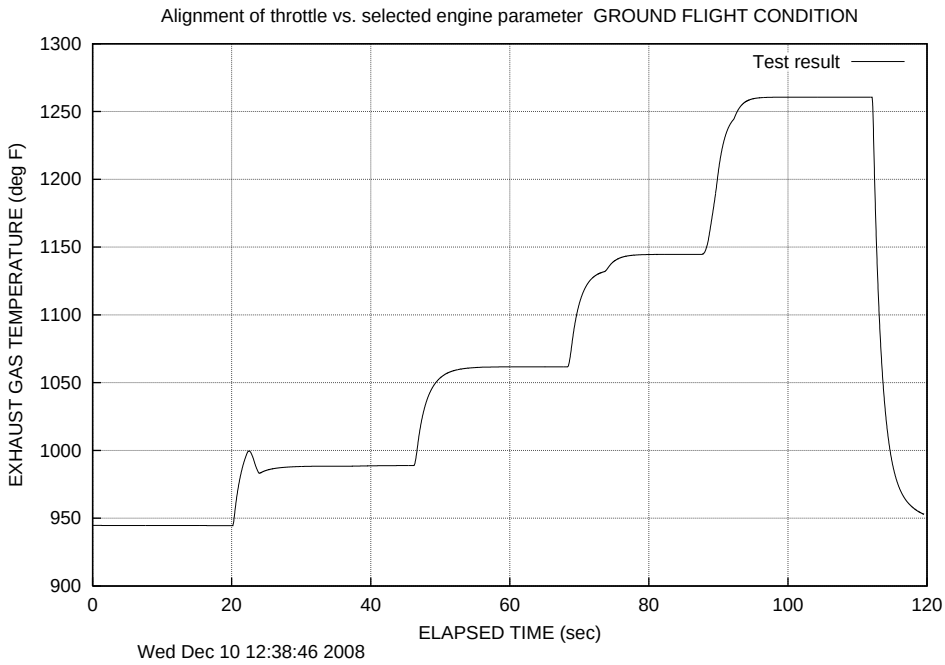
THROTTLE SETTING ±2 cm (0.8")

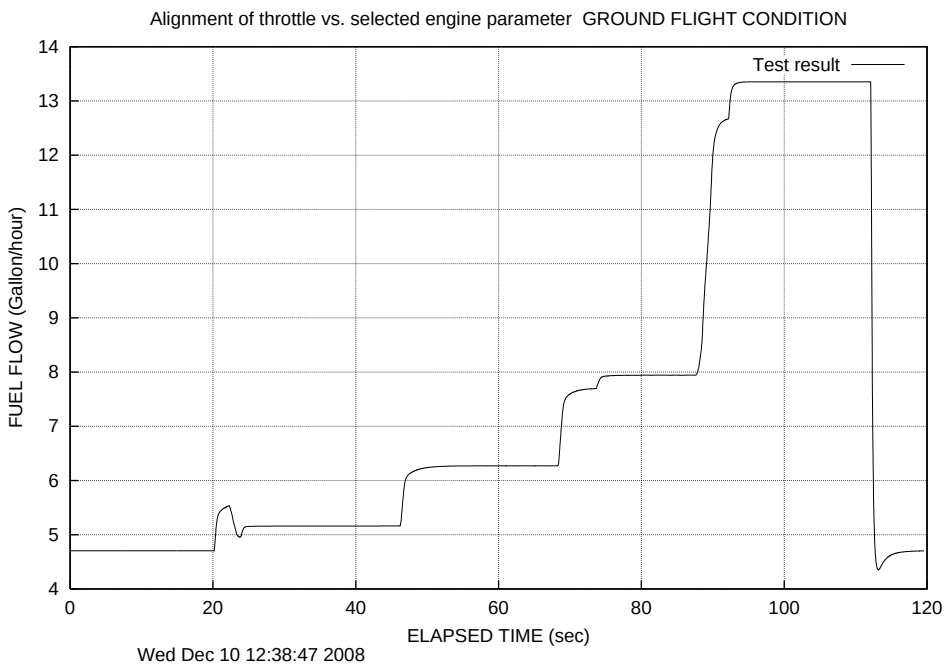
Test result

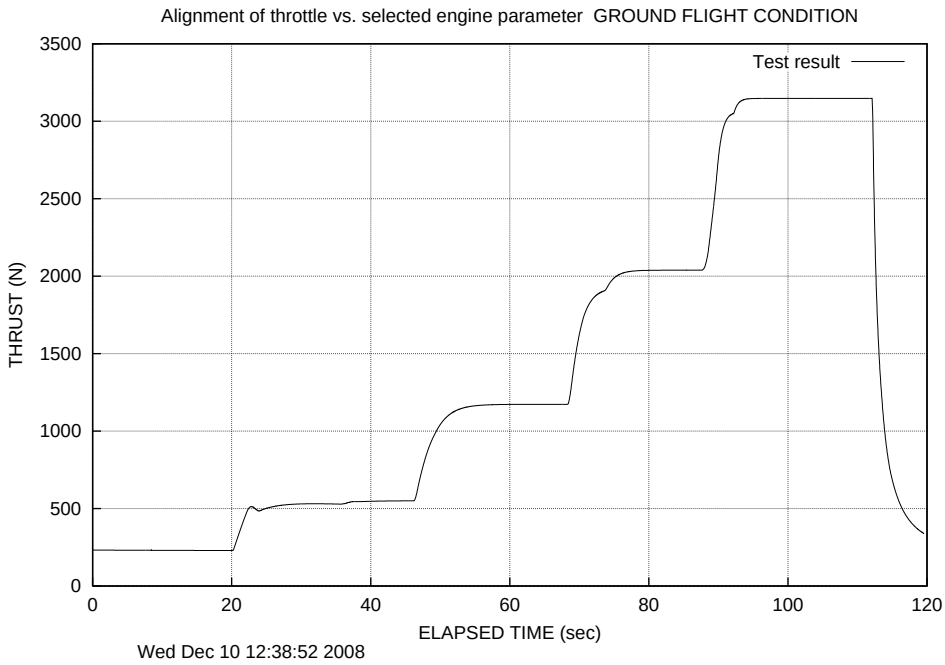
THROTTLE SETTING (mm)	ENGINE SPEED (rpm)
0	693
6.1	1000
16.9	1500
54.8	2000
55	2369




Alignment of throttle vs. selected engine parameter GROUND FLIGHT CONDITION
Test result
ENGINE TORQUE (Nm)
450
400
350
300
250
200
150
100
50
0
-50
0
20
40
60
80
100
120
ELAPSED TIME (sec)
Wed Dec 10 12:38:46 2008


Alignment of throttle vs. selected engine parameter GROUND FLIGHT CONDITION
Test result
EXHAUST GAS TEMPERATURE (deg F)
1300
1250
1200
1150
1100
1050
1000
950
900
0
20
40
60
80
100
120
ELAPSED TIME (sec)
Wed Dec 10 12:38:46 2008


Alignment of throttle vs. selected engine parameter GROUND FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
14
13
12
11
10
9
8
7
6
5
4
0
20
40
60
80
100
120
ELAPSED TIME (sec)
Wed Dec 10 12:38:47 2008



Source data	Section 3.8 of [1]
Comparison of results	The alignment of throttle vs. selected engine parameter simulator test shows compliance towards the Validation Reference Data result as described in Section 3.8 of [1].

6.10 Power change force (2b1-1)

Due to the nature of the control system (spring loaded) no force changes due to power changes will be noticeable.

6.11 Power change dynamics (2b1-2)

Test objective	To demonstrate that the simulator response to an engine power change conforms to the class of aeroplane.
Demonstration procedure	Starting from the prescribed trimmed condition, increase engine thrust to match the desired power setting and allow the airplane to respond freely. Record the time history of an uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after an increased throttle input.
References	[2], [3], [4]
Initial conditions	**Cruise flight condition:**

CONTROL INPUTS:

THROTTLE SETTING	=	38.66	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.035	(-)
FLAP LEVER POSITION	=	0.0	(deg)
FLAP INDICATOR POSITION	=	0.0	(deg)
PITCH CONTROLLER POSITION	=	-6.667	(%)
ROLL CONTROLLER POSITION	=	-3.400	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	99.4	(kts)
RATE OF CLIMB	=	176	(fpm)
PRESSURE ALTITUDE	=	3894	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	2.2	(deg)
BANK ANGLE	=	-4.3	(deg)
ANGLE OF ATTACK	=	0.7	(deg)
SIDESLIP ANGLE	=	-0.2	(deg)
PITCH RATE	=	0.7	(deg/sec)
ROLL RATE	=	1.3	(deg/sec)
YAW RATE	=	-0.9	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2462	(rpm)
EXHAUST GAS TEMPERATURE	=	1112	(deg F)
FUEL FLOW	=	9.15	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-0.2	(deg)
LEFT AILERON ANGLE	=	0.7	(deg)
RIGHT AILERON ANGLE	=	-0.7	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `609_FSTD_2c1_Cruise.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the throttle at the prescribed trimmed initial condition:
1. From the initial throttle setting, push the throttle to the maximum setting of 100%.
3. Stop recording after 20 seconds have elapsed.

Evaluated parameters

ANGLE OF ATTACK
BANK ANGLE
ENGINE POWER
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED
PITCH ANGLE
PITCH RATE
PRESSURE ALTITUDE
RATE OF CLIMB
PITCH CONTROLLER POSITION
ELEVATOR ANGLE
ELEVATOR TRIM TAB ANGLE
RUDDER ANGLE

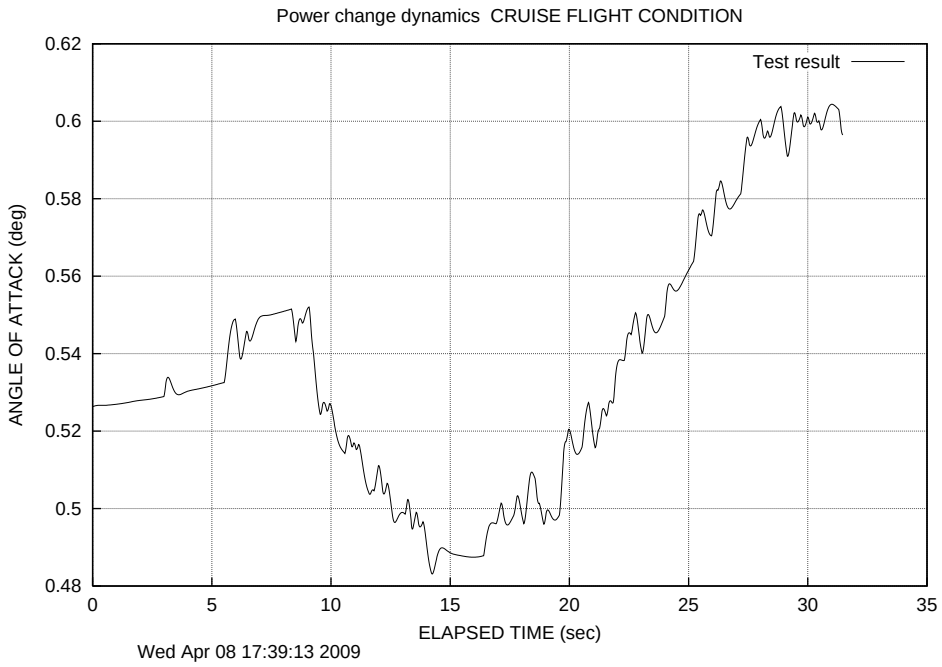
Expected results

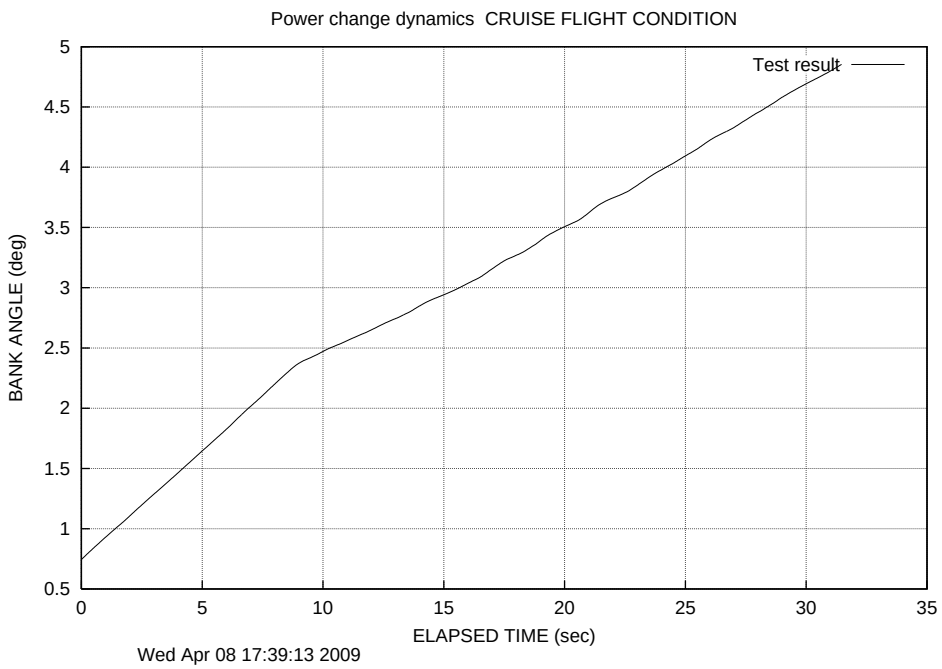
An increase of throttle setting while the elevator and elevator trim tab angle remain fixed, will initially lead to an increase in airspeed. The ultimate result of increasing the throttle setting will be a change in flight path angle (or pitch angle). See section 3.9 of [1].

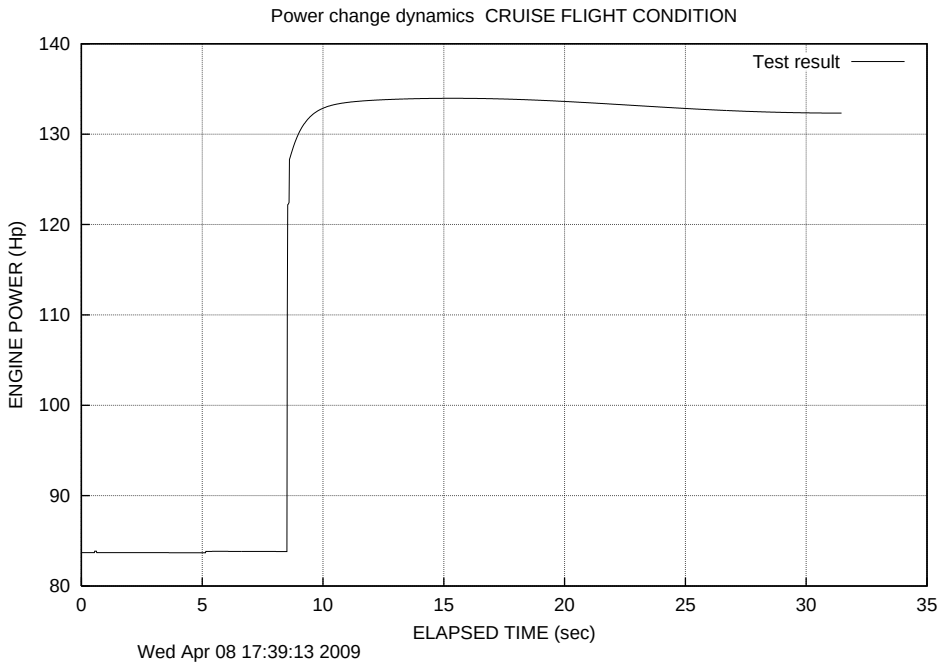
Tolerances

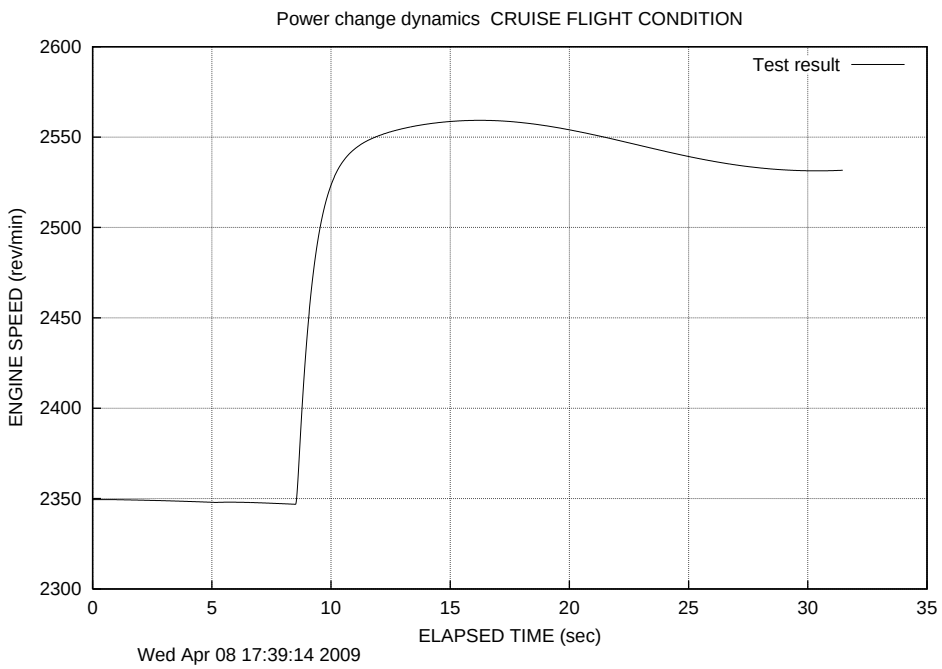
INDICATED AIRSPEED	±3 knots
PITCH ANGLE	±1.5° or ±20%
PRESSURE ALTITUDE	±100 feet

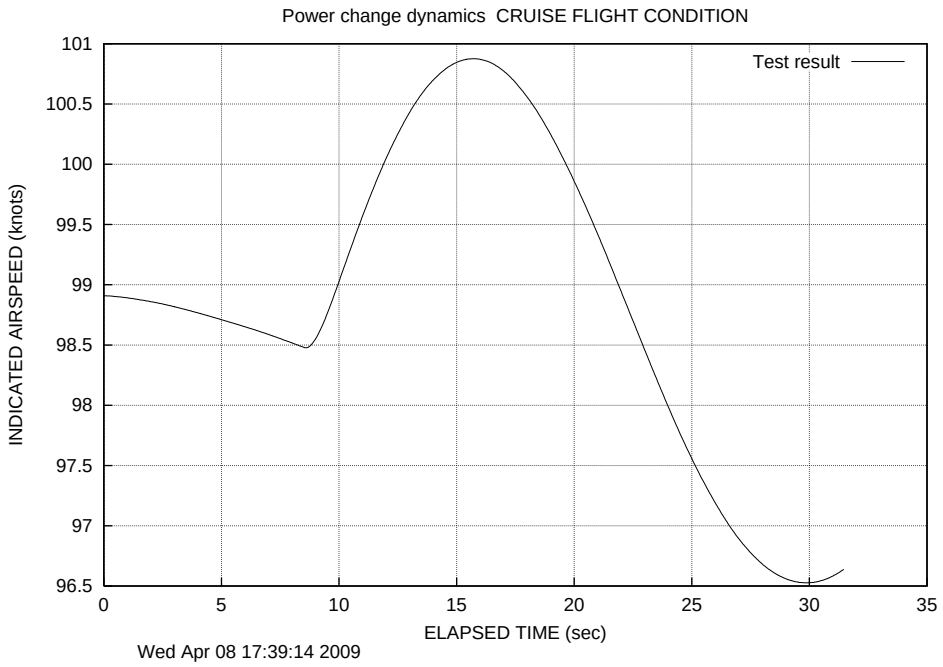
Test result

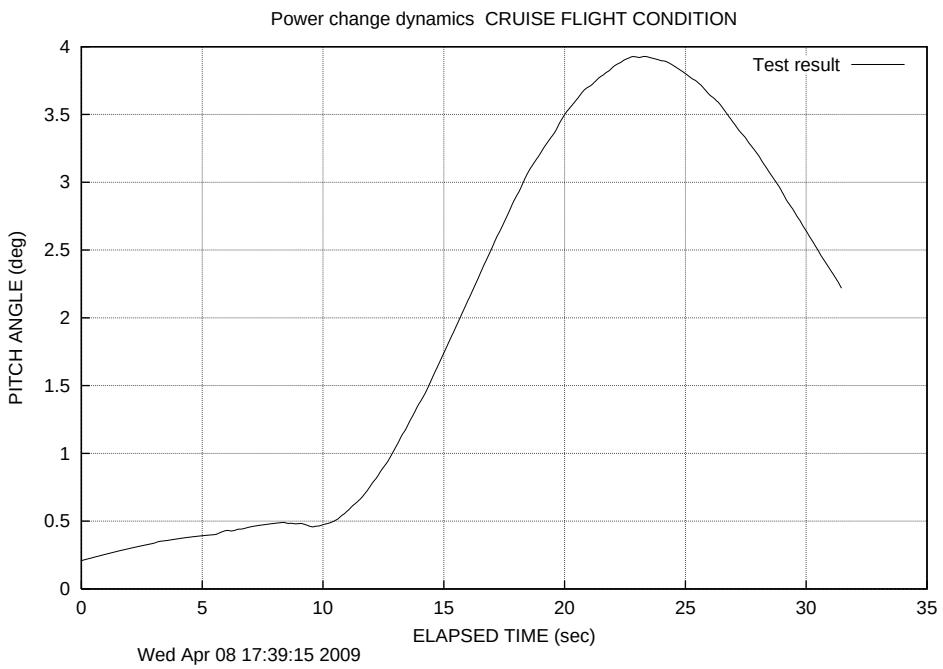

Power change dynamics CRUISE FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
0.62
0.6
0.58
0.56
0.54
0.52
0.5
0.48
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:13 2009

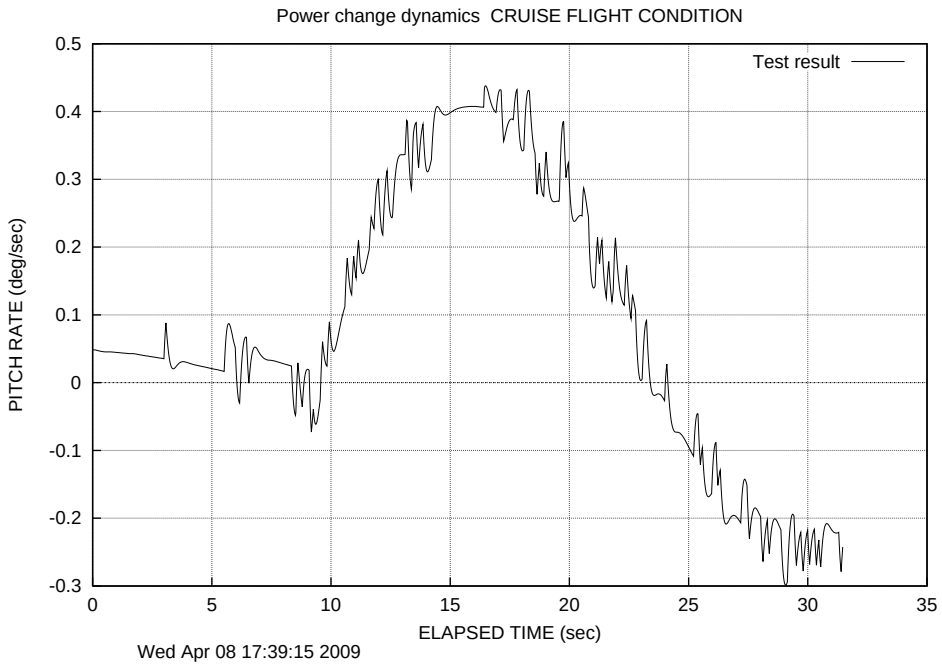

Power change dynamics CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:13 2009

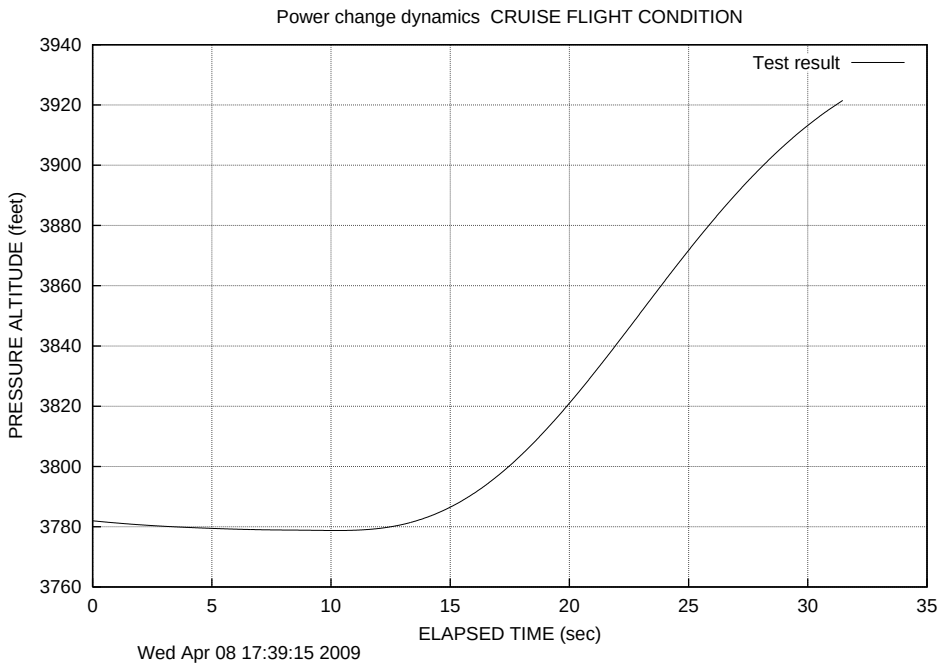

Power change dynamics CRUISE FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
140
130
120
110
100
90
80
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:13 2009

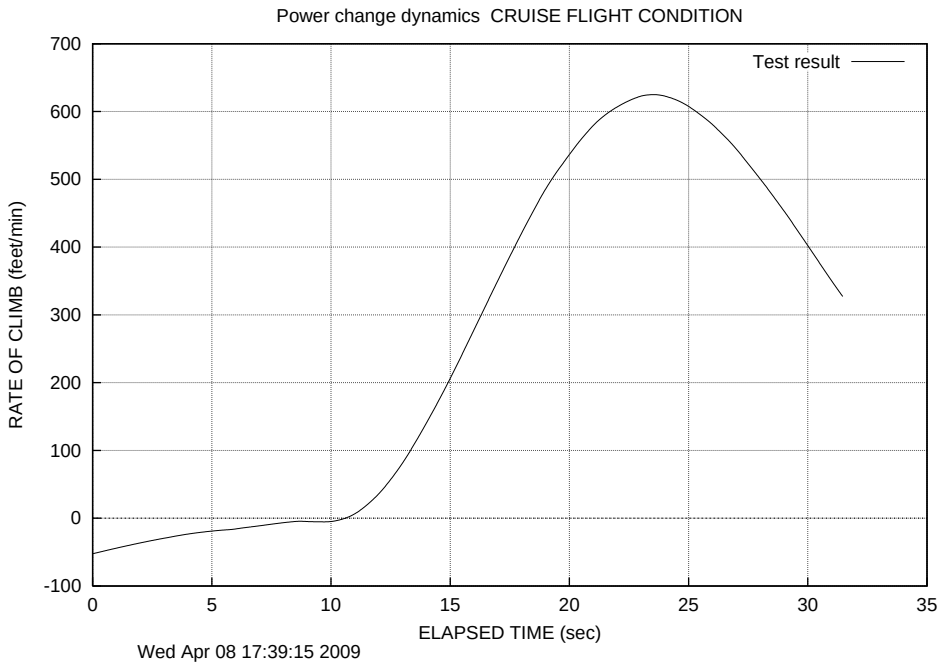

Power change dynamics CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2600
2550
2500
2450
2400
2350
2300
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:14 2009

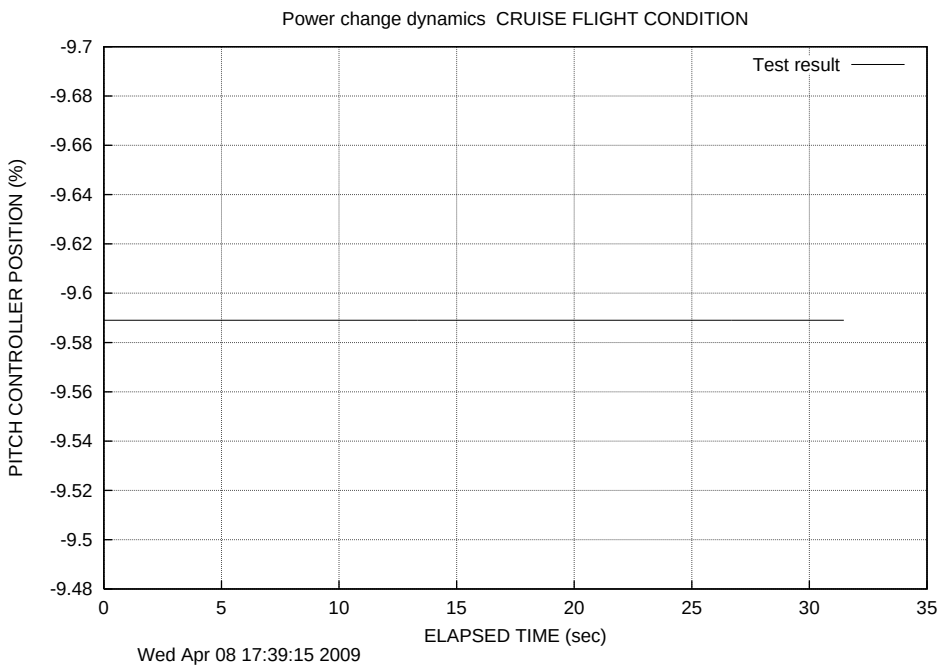

Power change dynamics CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
101
100.5
100
99.5
99
98.5
98
97.5
97
96.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:14 2009

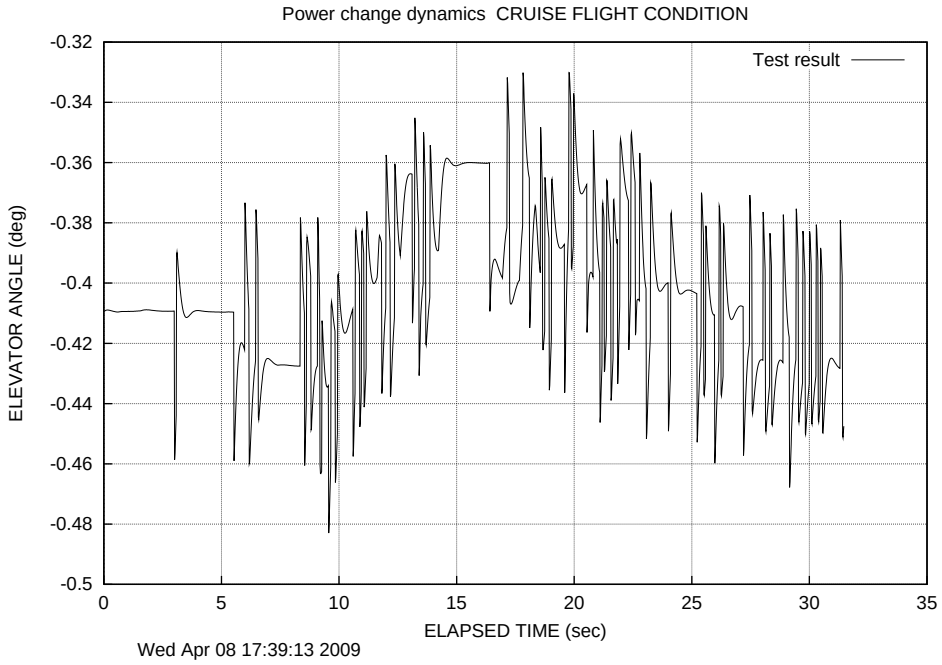

Power change dynamics CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:15 2009

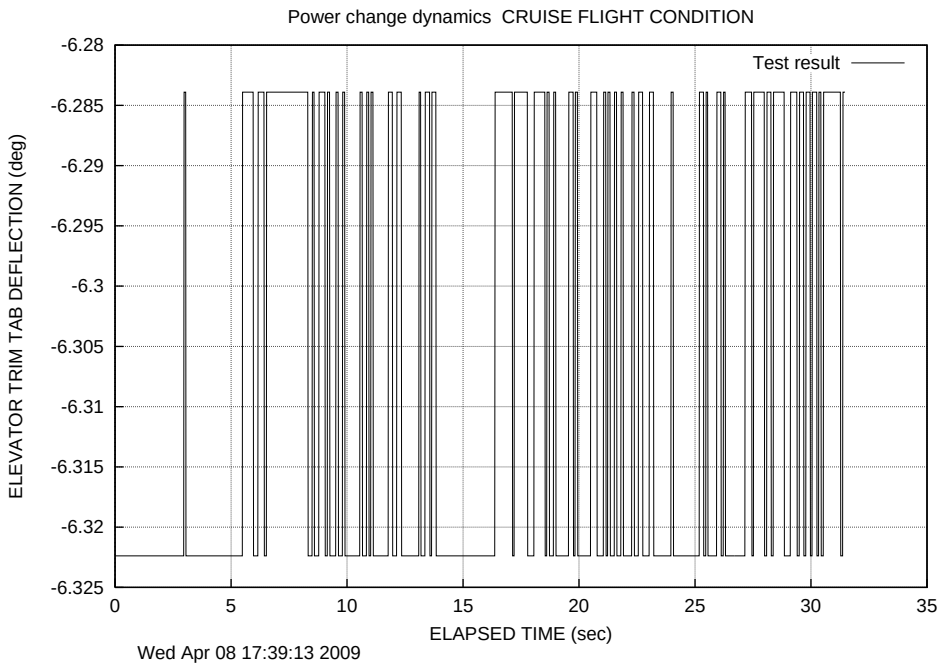

Power change dynamics CRUISE FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:15 2009

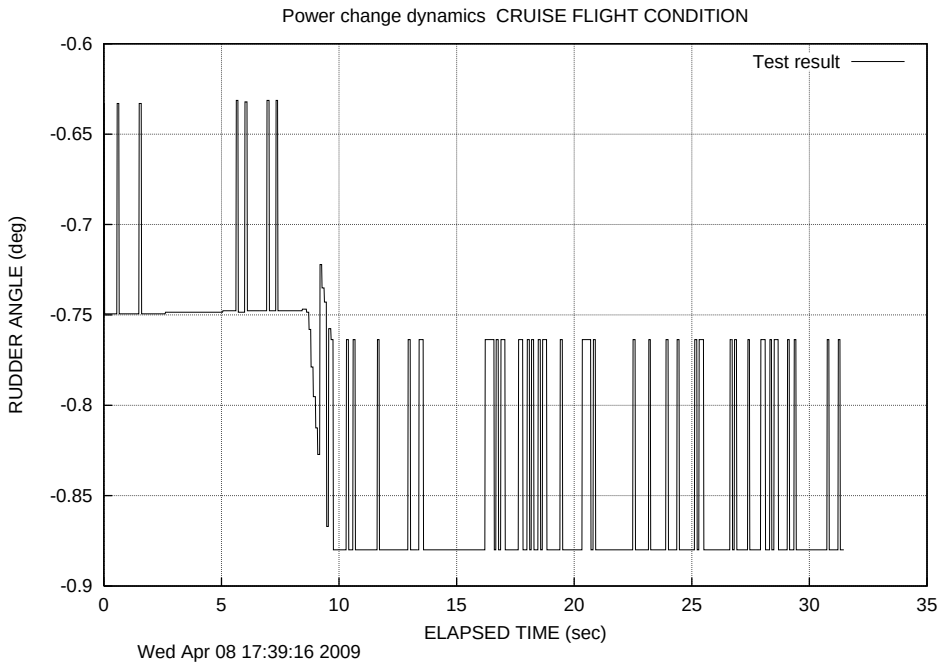

Power change dynamics CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3940
3920
3900
3880
3860
3840
3820
3800
3780
3760
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:15 2009


Power change dynamics CRUISE FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:15 2009


Power change dynamics CRUISE FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
-9.7
-9.68
-9.66
-9.64
-9.62
-9.6
-9.58
-9.56
-9.54
-9.52
-9.5
-9.48
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:15 2009


Power change dynamics CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
-0.32
-0.34
-0.36
-0.38
-0.4
-0.42
-0.44
-0.46
-0.48
-0.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:13 2009


Power change dynamics CRUISE FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-6.28
-6.285
-6.29
-6.295
-6.3
-6.305
-6.31
-6.315
-6.32
-6.325
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Apr 08 17:39:13 2009



Source data	Section 3.9 of [1]
Comparison of results	Similarly to the Validation Reference Data result as described in Section 3.9 of [1], the flight path angle increase as a result of the power change dynamics simulator test.

6.12 Flap change force (2b2-1)

Due to the nature of the control system (spring loaded) no force changes due to flap changes will be noticeable.

6.13 Flap change dynamics (2b2-2)

Test objective

To demonstrate that the simulator response to a flap retraction in the take-off flight condition and a flap extension in the approach to landing and conforms to the class of aeroplane.

Demonstration procedure

Starting from the prescribed trimmed condition, retract (takeoff) or extend (approach) flaps and allow the simulator to respond freely. Record the time history of an uncontrolled free response recommended for a time increment of 5 sec before and 15 sec after flap lever position change.

References

[2], [3], [4]

Initial conditions

Takeoff flight condition (retraction):

CONTROL INPUTS:

THROTTLE SETTING	=	31.87	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	0.999	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-5.333	(%)
ROLL CONTROLLER POSITION	=	5.412	(%)
RUDDER PEDAL POSITION	=	4.727	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	72.5	(kts)
RATE OF CLIMB	=	298	(fpm)
PRESSURE ALTITUDE	=	4061	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	3.7	(deg)
BANK ANGLE	=	1.1	(deg)
ANGLE OF ATTACK	=	1.7	(deg)
SIDESLIP ANGLE	=	-0.9	(deg)
PITCH RATE	=	-0.5	(deg/sec)
ROLL RATE	=	-3.2	(deg/sec)
YAW RATE	=	0.7	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2036	(rpm)
EXHAUST GAS TEMPERATURE	=	1063	(deg F)
FUEL FLOW	=	7.72	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-0.5	(deg)
LEFT AILERON ANGLE	=	0.8	(deg)
RIGHT AILERON ANGLE	=	-0.8	(deg)
RUDDER ANGLE	=	-0.6	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON

SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Approach flight condition (extension):

CONTROL INPUTS:

THROTTLE SETTING	=	35.26	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	0.958	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-11.33	(%)
ROLL CONTROLLER POSITION	=	0.258	(%)
RUDDER PEDAL POSITION	=	4.727	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)
WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	76.3	(kts)
RATE OF CLIMB	=	-147	(fpm)
PRESSURE ALTITUDE	=	3972	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	2.2	(deg)
BANK ANGLE	=	-2.2	(deg)
ANGLE OF ATTACK	=	3.6	(deg)
SIDESLIP ANGLE	=	-0.8	(deg)
PITCH RATE	=	1.4	(deg/sec)
ROLL RATE	=	0.0	(deg/sec)
YAW RATE	=	-0.7	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2121	(rpm)
EXHAUST GAS TEMPERATURE	=	1082	(deg F)
FUEL FLOW	=	8.17	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	4.1	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	-0.7	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `610_FSTD_2c2_Takeoff.sit` or `610_FSTD_2c2_Approach.sit` for the Takeoff or Approach flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Takeoff flight condition (retraction):

Starting after 5 seconds with the flap lever selected at 10 degrees:
1. From the 10 degrees position, move the flap lever to the flaps 0 degrees position.
2. Stop recording after 20 seconds have elapsed.

Approach flight condition (extension):

Starting after 5 seconds with the flap lever selected at 10 degrees:
1. From the 0 degrees position, move the flap lever to the flaps 10 degrees position.
2. Stop recording after 20 seconds have elapsed.

Evaluated parameters

ANGLE OF ATTACK
BANK ANGLE
ELEVATOR ANGLE
ELEVATOR TRIM TAB ANGLE
ENGINE SPEED
FLAP INDICATOR POSITION
FLAP LEVER POSITION
FUEL FLOW
INDICATED AIRSPEED
PITCH ANGLE
PITCH CONTROLLER POSITION
PITCH RATE
PRESSURE ALTITUDE
RATE OF CLIMB
RUDDER ANGLE
WING FLAP ANGLE

Expected results

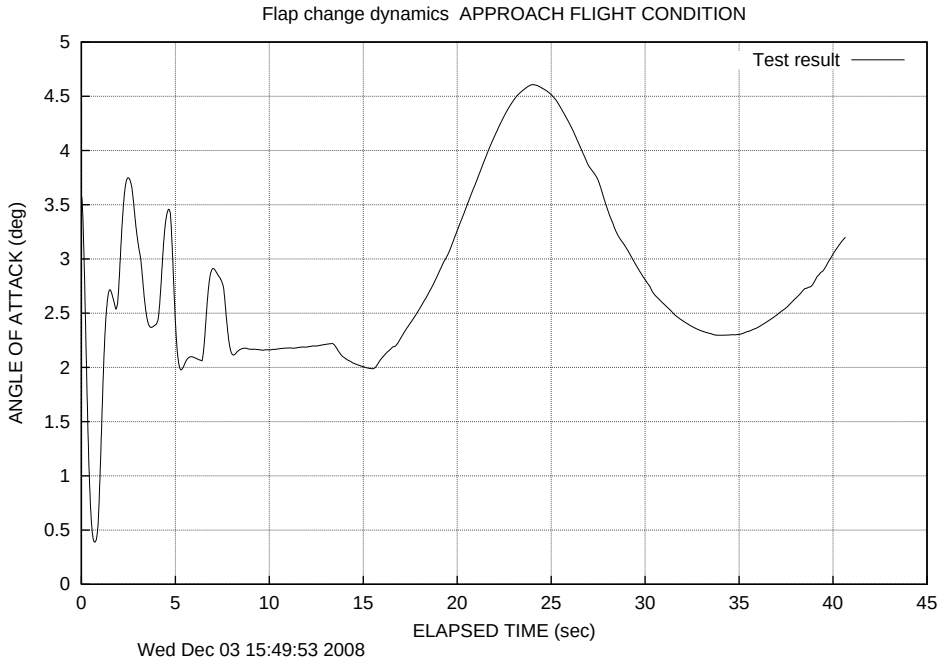
From a trimmed flight condition, after a flap extension indicated airspeed will decrease, pitch angle will increase and pressure altitude increase. A flap retraction has an opposite effect on indicated airspeed, pitch angle and pressure altitude. See section 3.10 of [1].

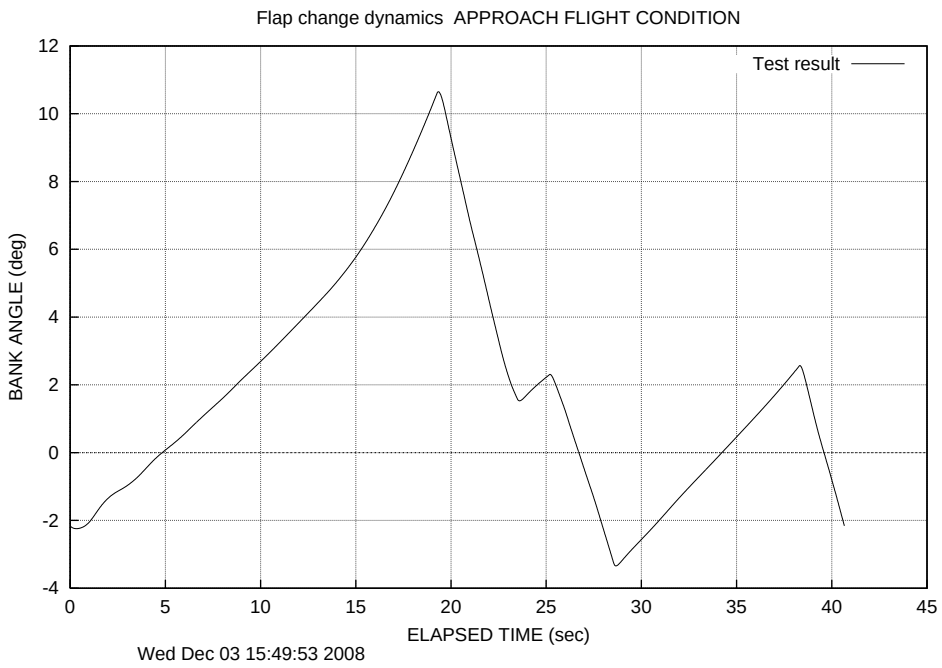
Tolerances

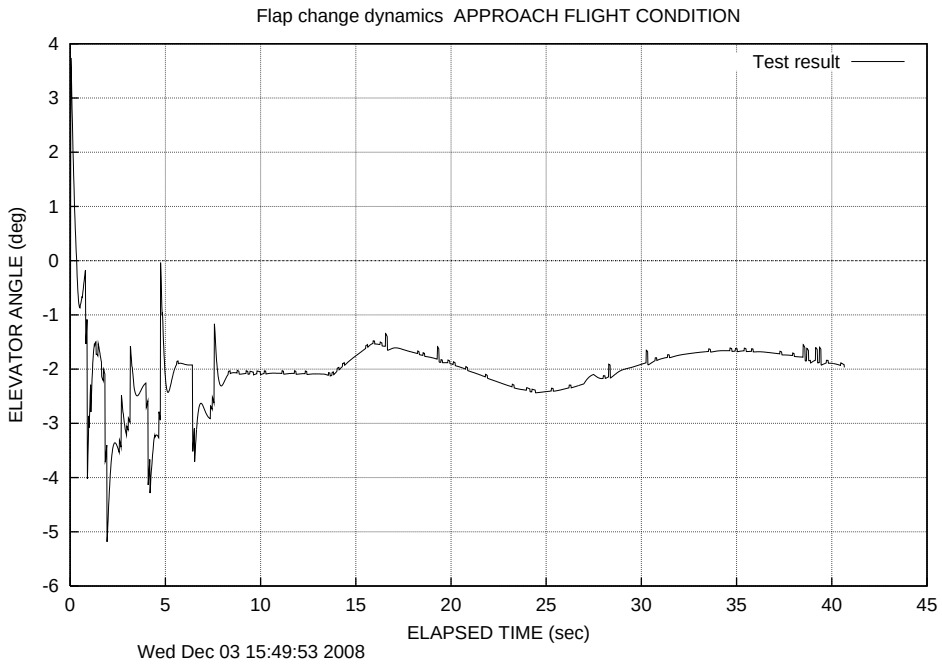
INDICATED AIRSPEED	±3 kts
PITCH ANGLE	±1.5° or ±20%
PRESSURE ALTITUDE	±100 ft

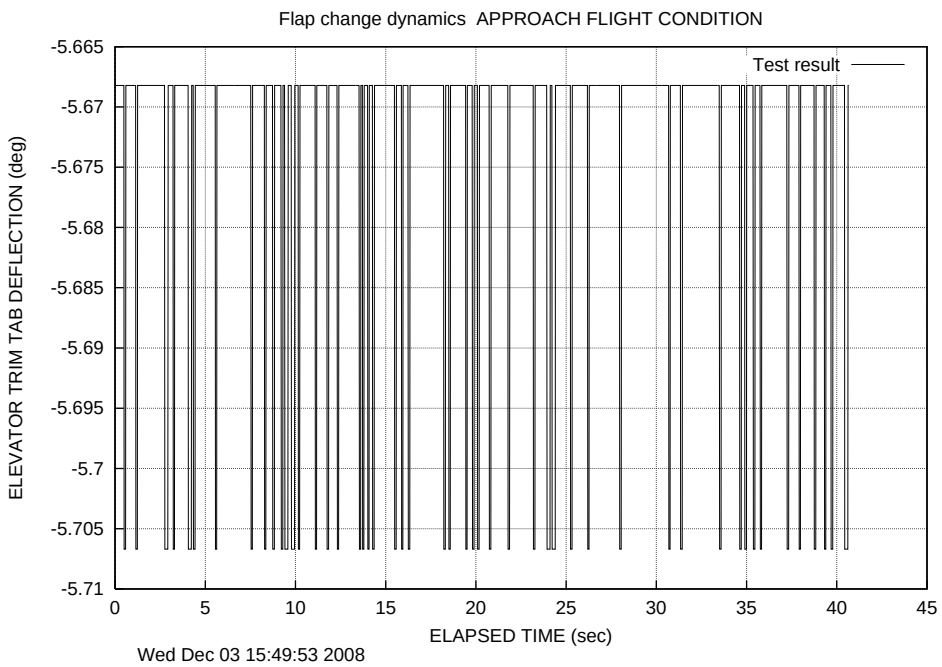
Test result

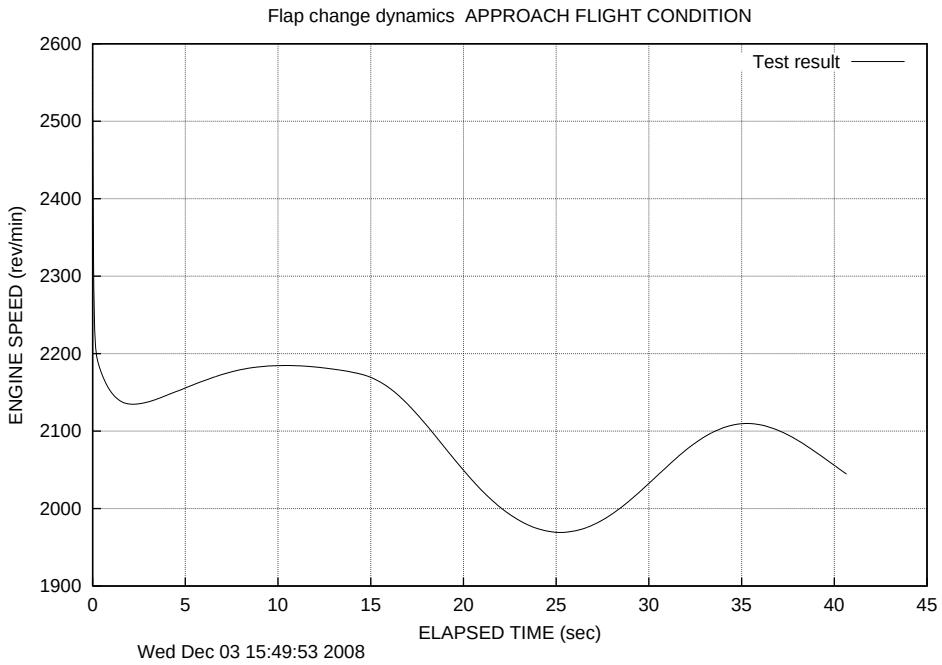
Approach flight condition:

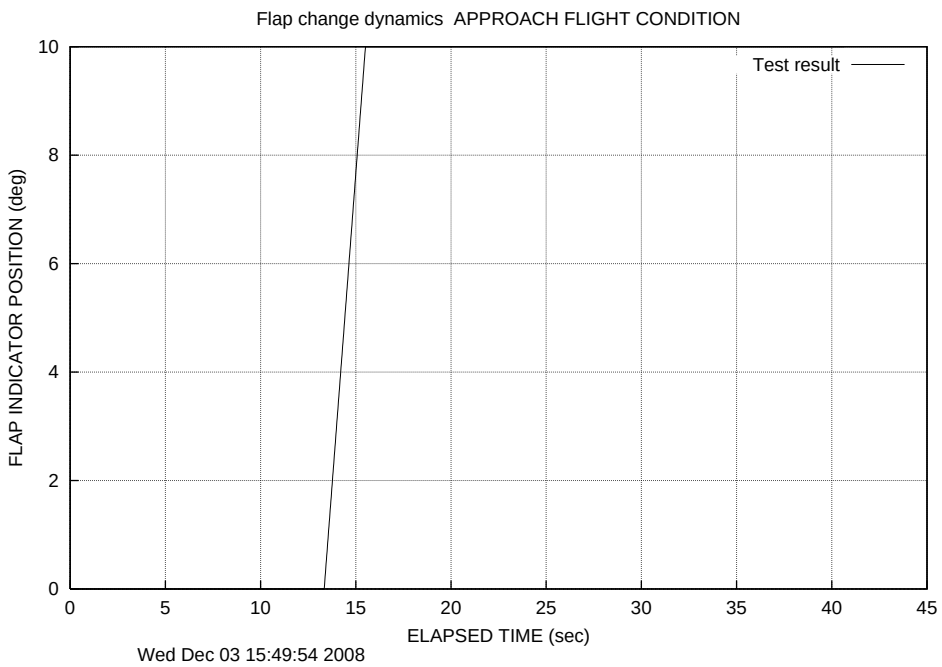


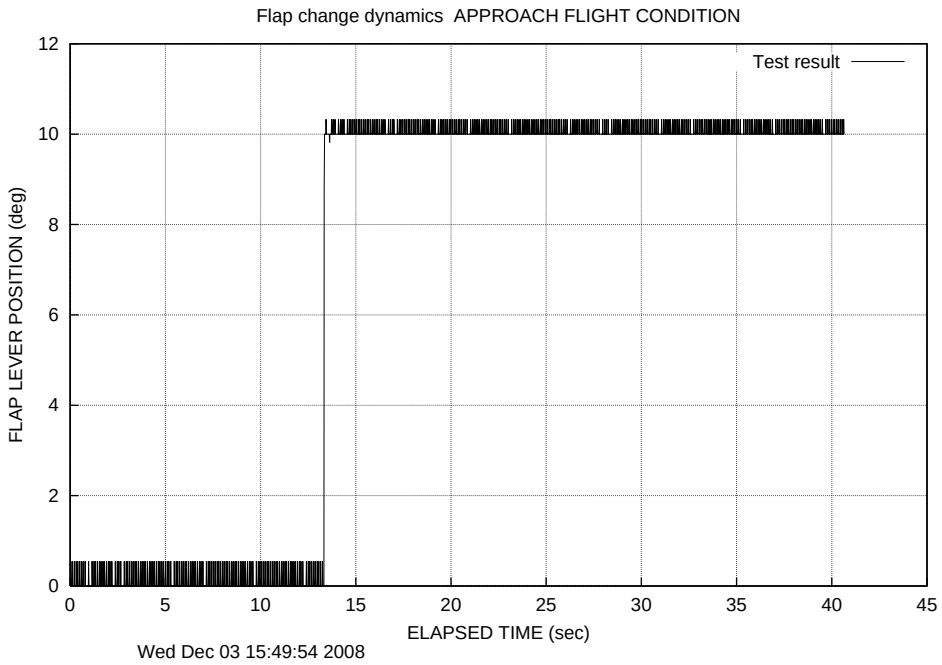


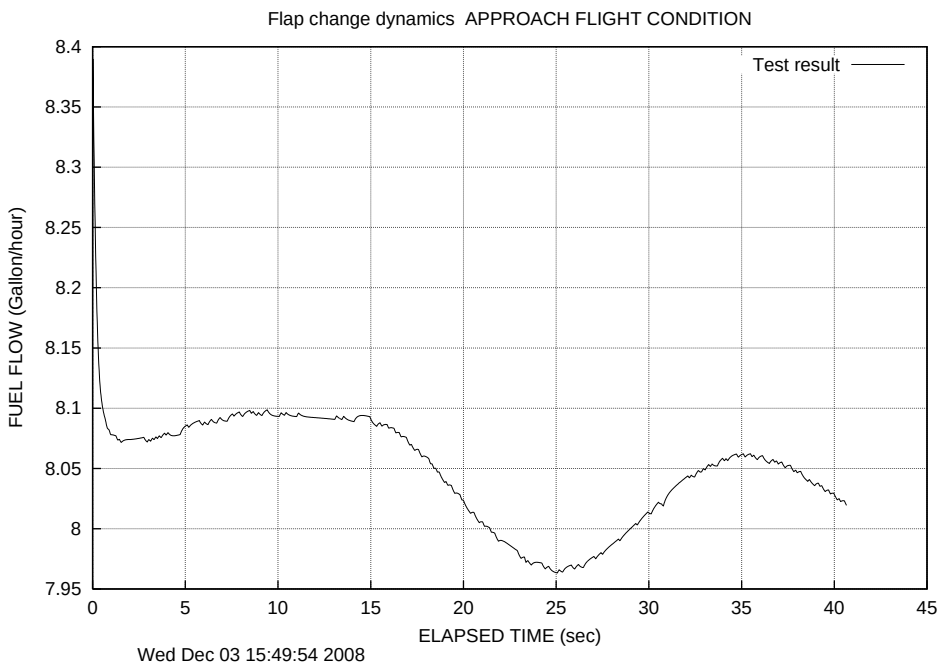

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
4
3
2
1
0
-1
-2
-3
-4
-5
-6
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:53 2008

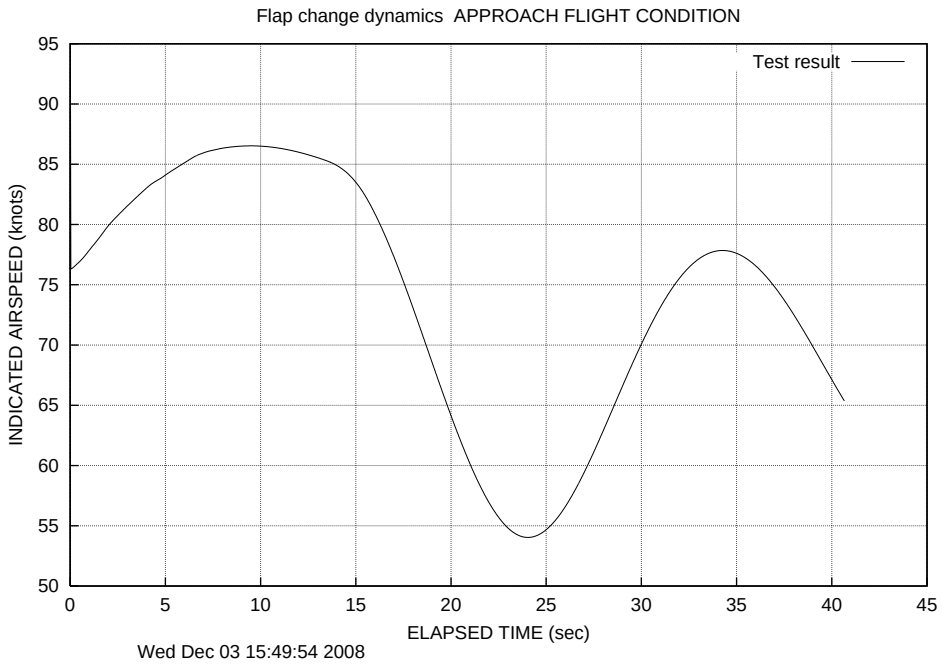

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-5.665
-5.67
-5.675
-5.68
-5.685
-5.69
-5.695
-5.7
-5.705
-5.71
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:53 2008

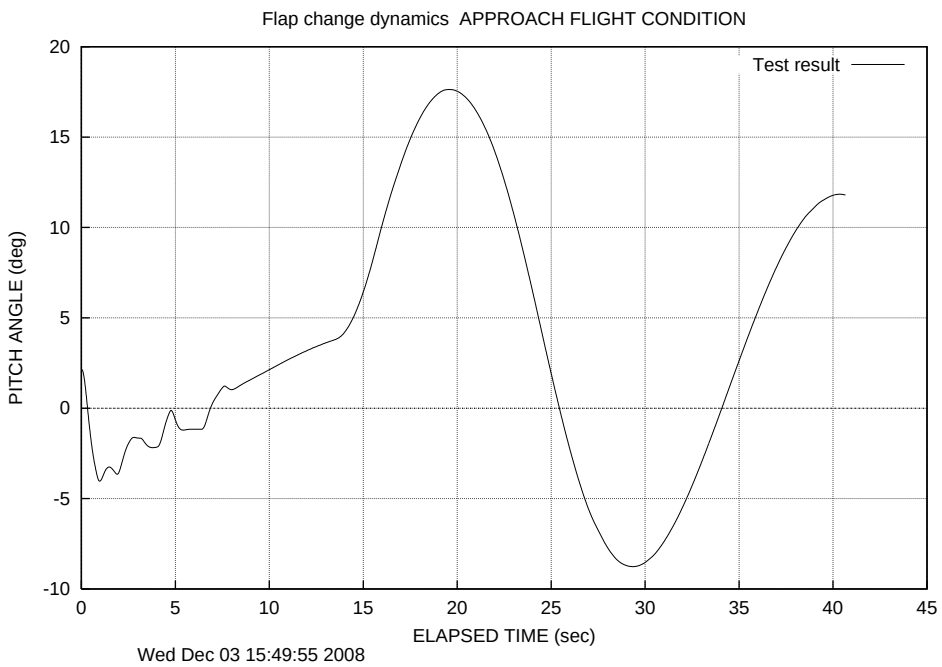

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2600
2500
2400
2300
2200
2100
2000
1900
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:53 2008

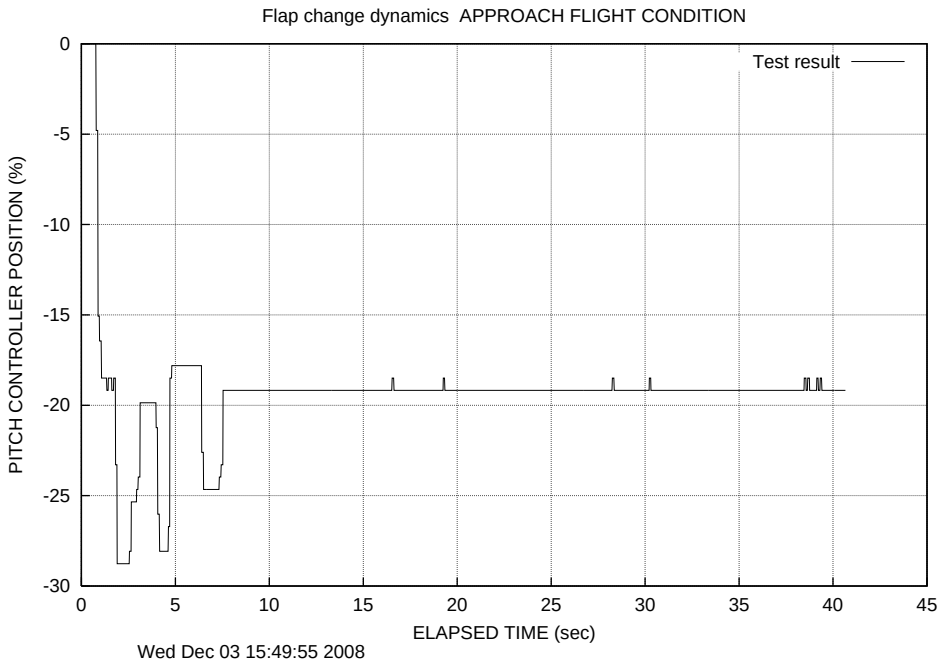

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
FLAP INDICATOR POSITION (deg)
10
8
6
4
2
0
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:54 2008

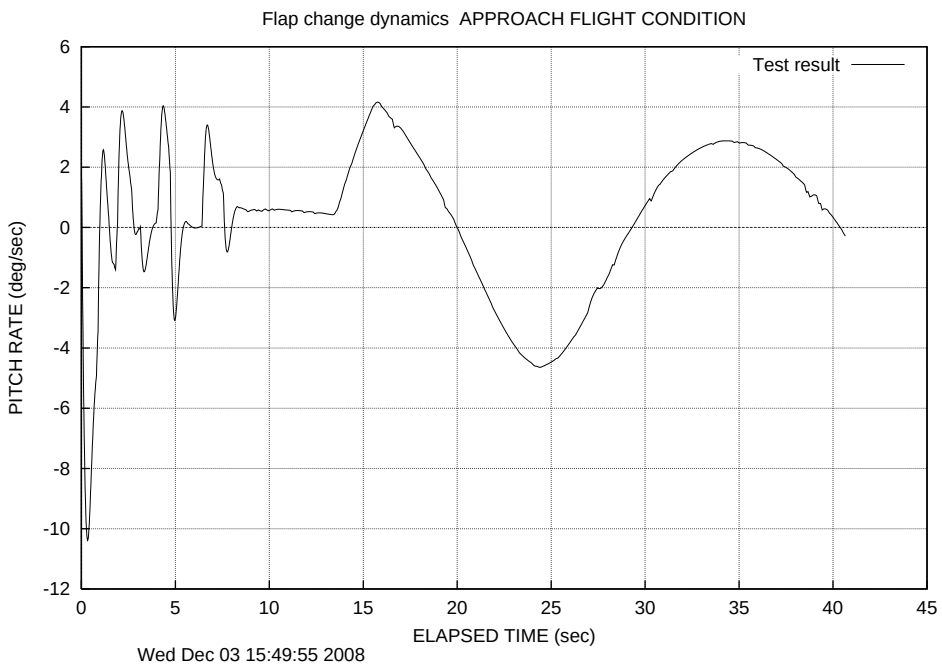

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
FLAP LEVER POSITION (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:49:54 2008
0
2
4
6
8
10
12
0
5
10
15
20
25
30
35
40
45

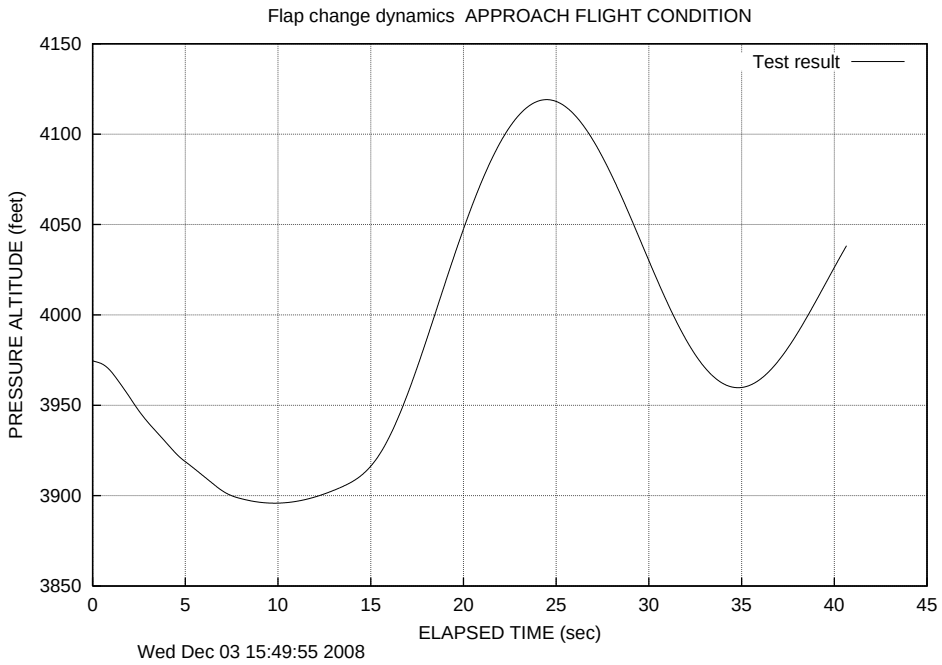

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
ELAPSED TIME (sec)
Wed Dec 03 15:49:54 2008
7.95
8
8.05
8.1
8.15
8.2
8.25
8.3
8.35
8.4
0
5
10
15
20
25
30
35
40
45

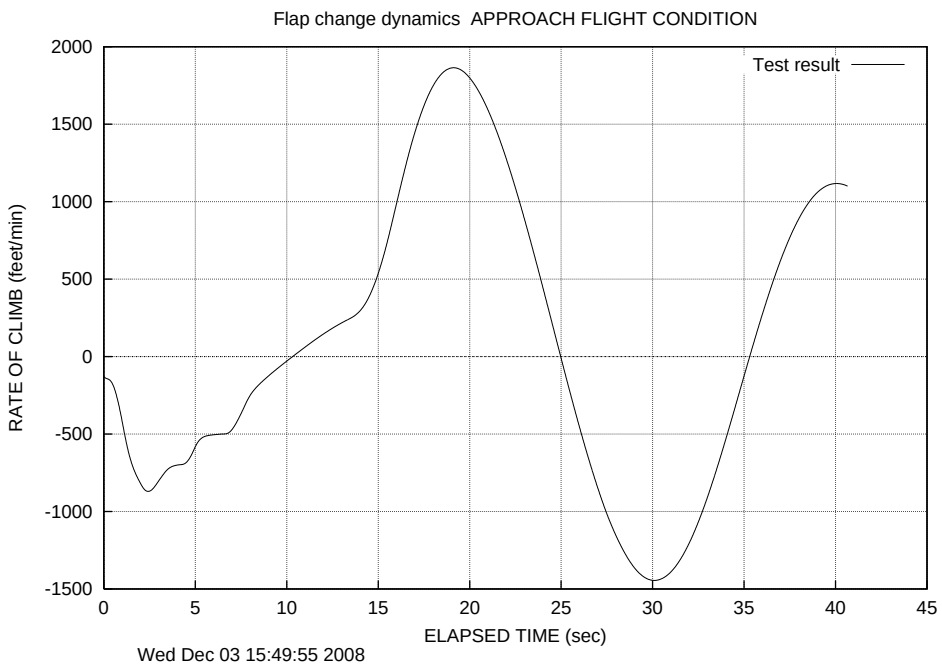

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
95
90
85
80
75
70
65
60
55
50
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:54 2008

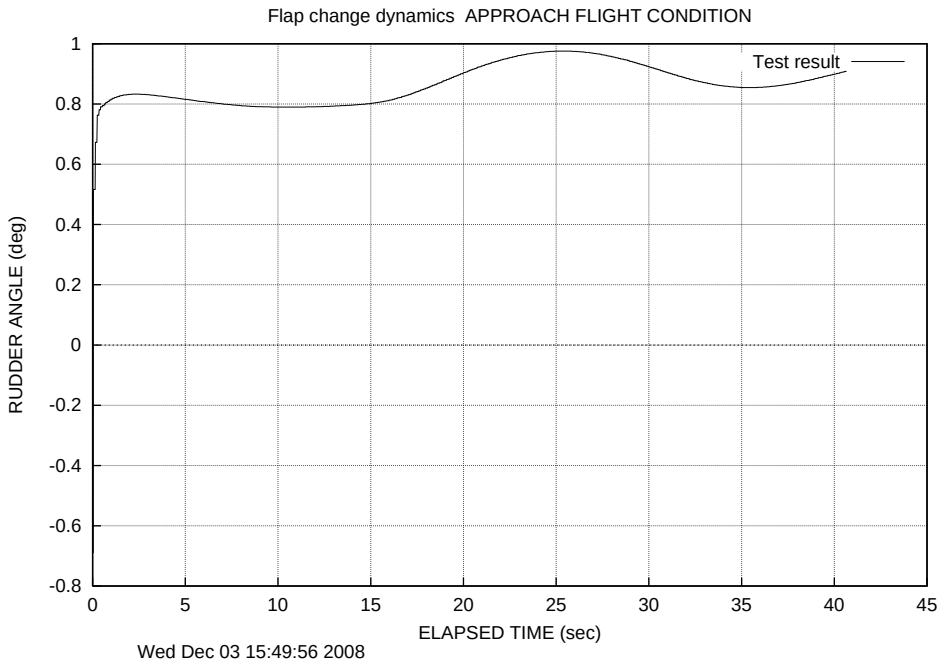

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
20
15
10
5
0
-5
-10
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:55 2008

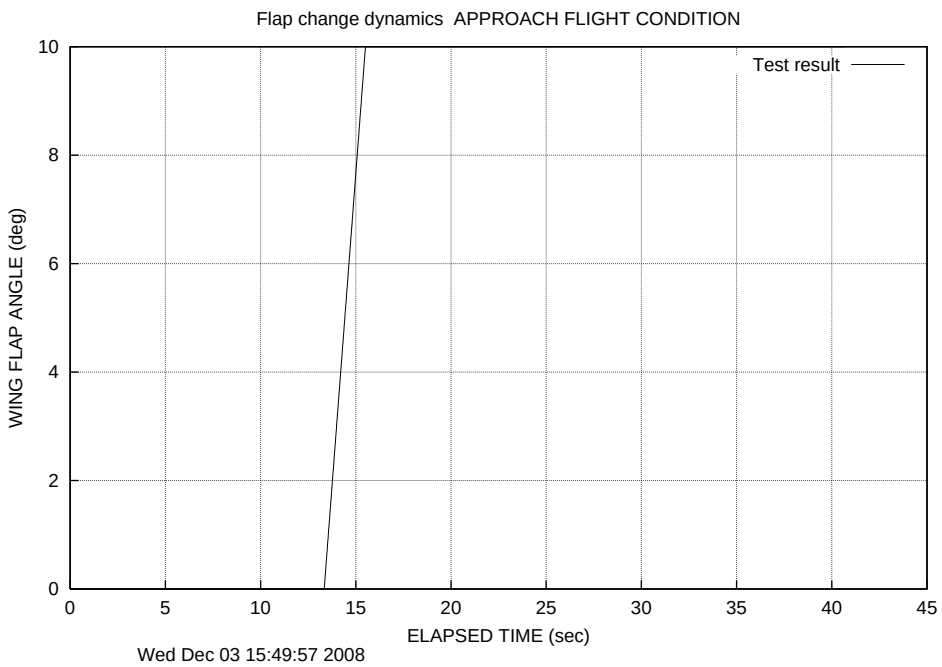

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:55 2008


Flap change dynamics APPROACH FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
6
4
2
0
-2
-4
-6
-8
-10
-12
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:55 2008

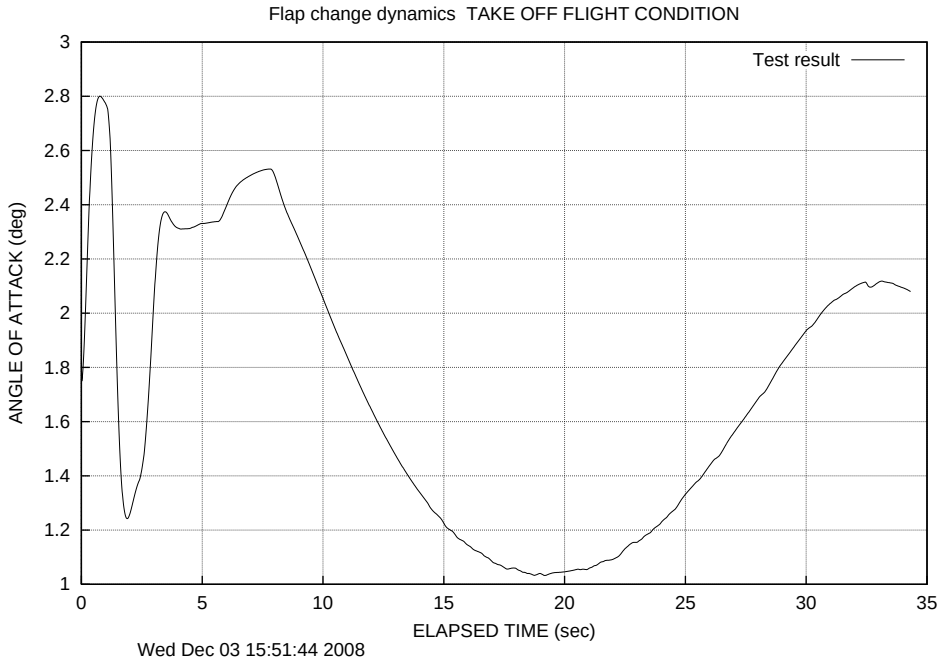

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4150
4100
4050
4000
3950
3900
3850
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:55 2008

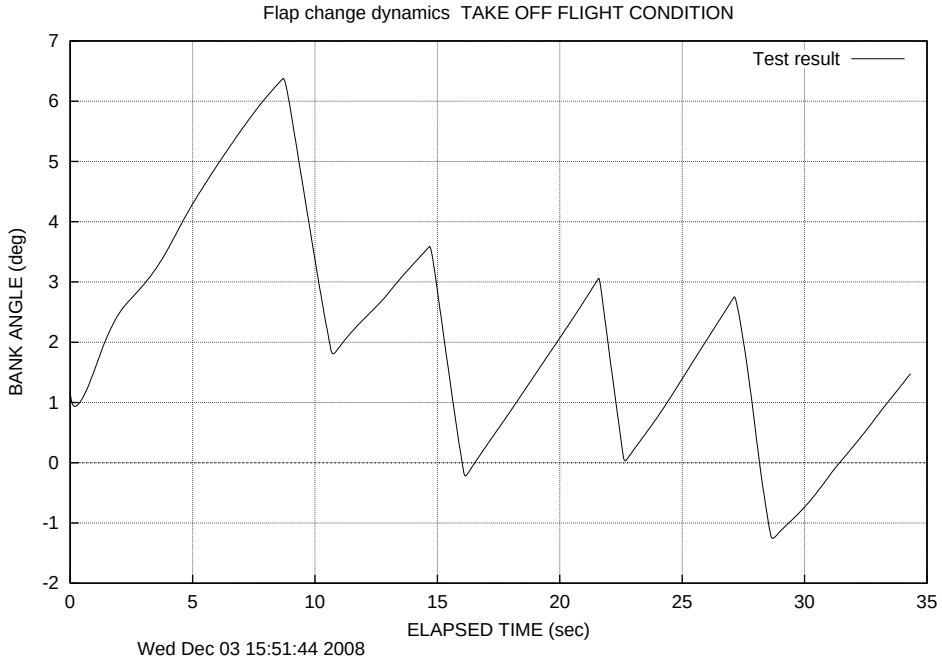

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
2000
1500
1000
500
0
-500
-1000
-1500
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:55 2008

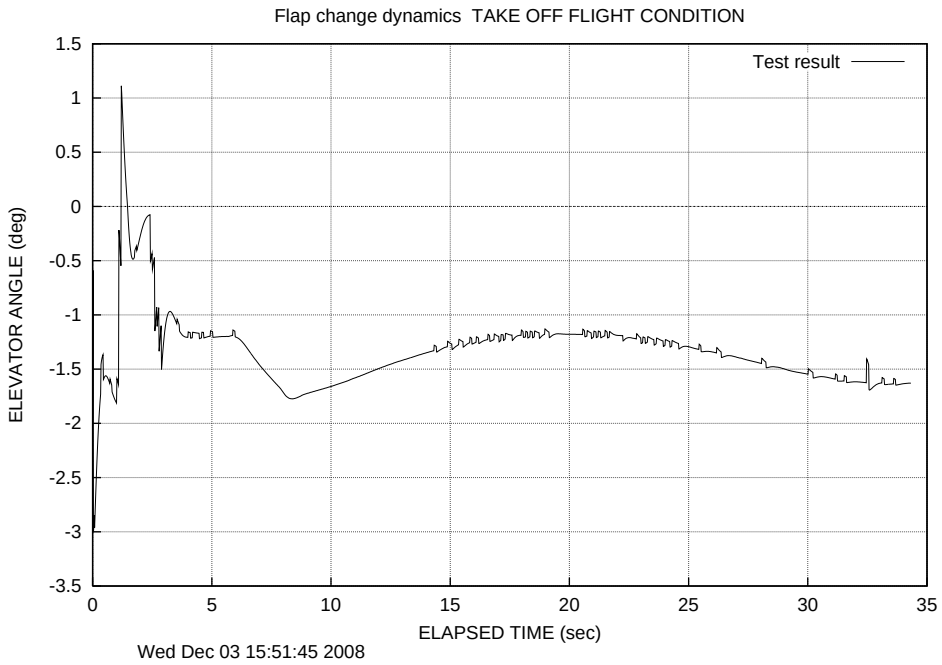

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:56 2008

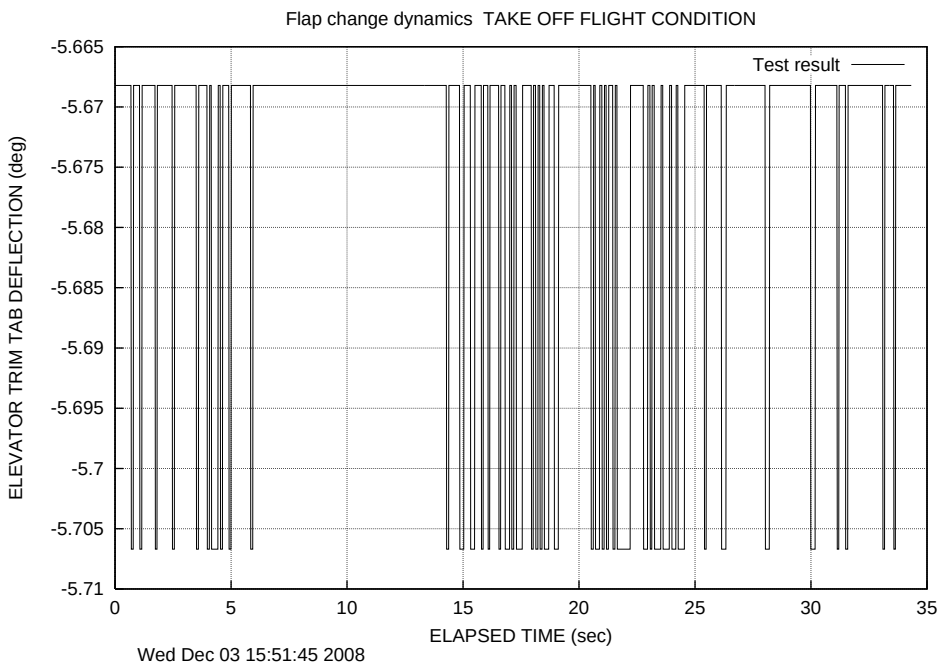

Flap change dynamics APPROACH FLIGHT CONDITION
Test result
WING FLAP ANGLE (deg)
10
8
6
4
2
0
0
5
10
15
20
25
30
35
40
45
ELAPSED TIME (sec)
Wed Dec 03 15:49:57 2008

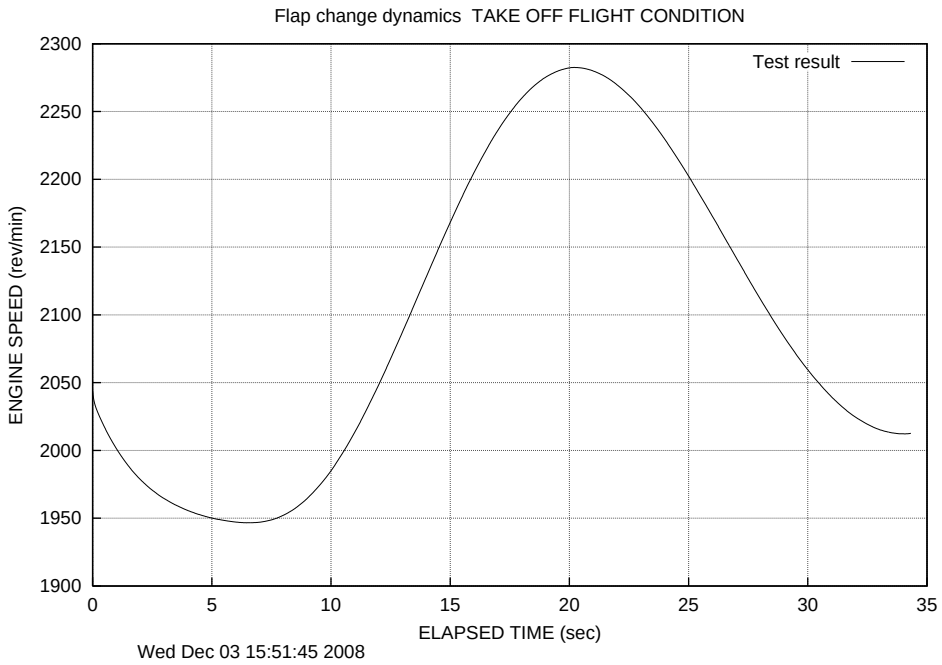
Takeoff flight condition:

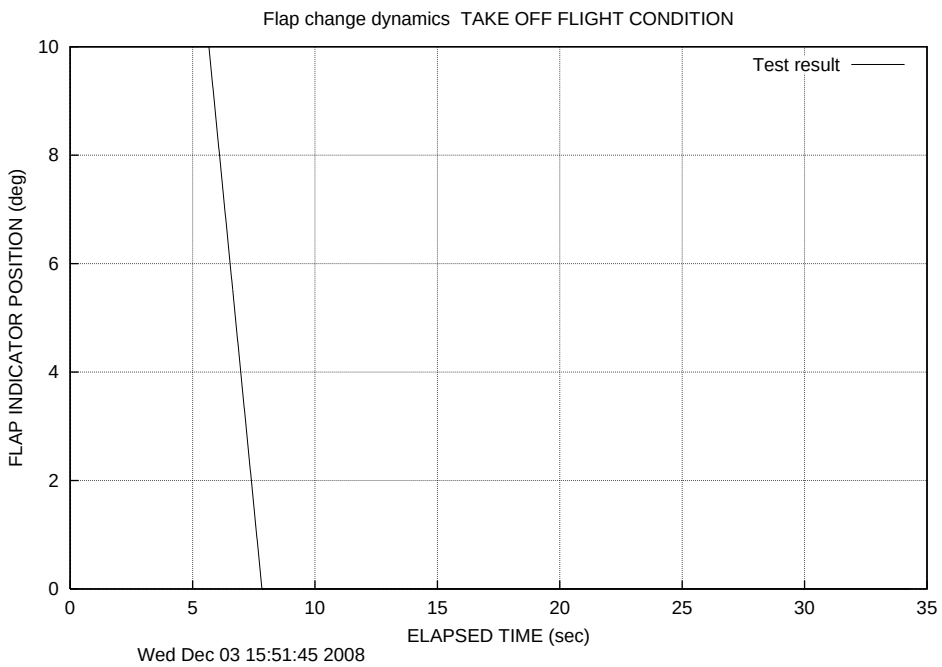


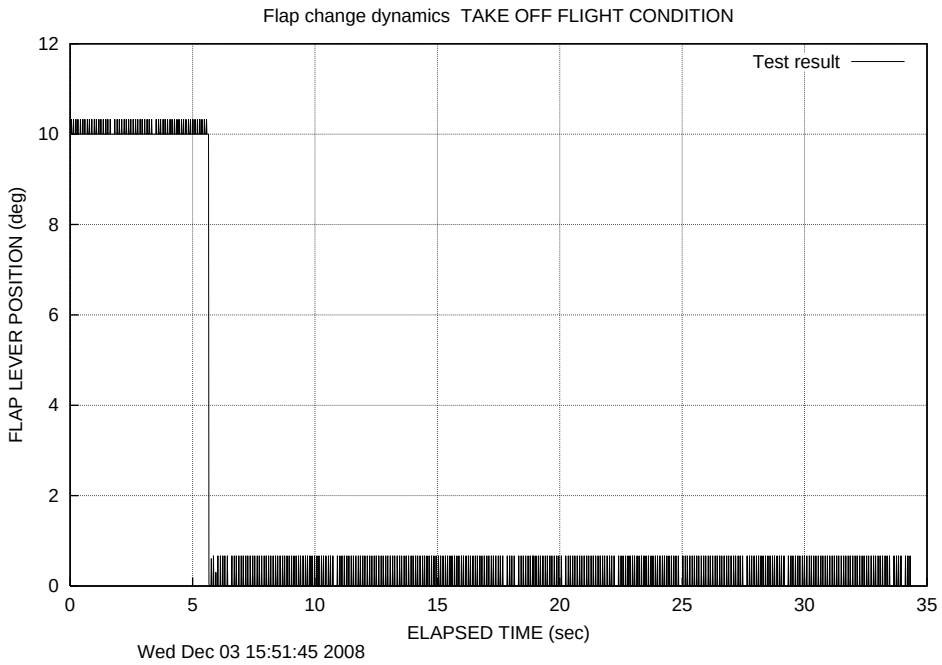


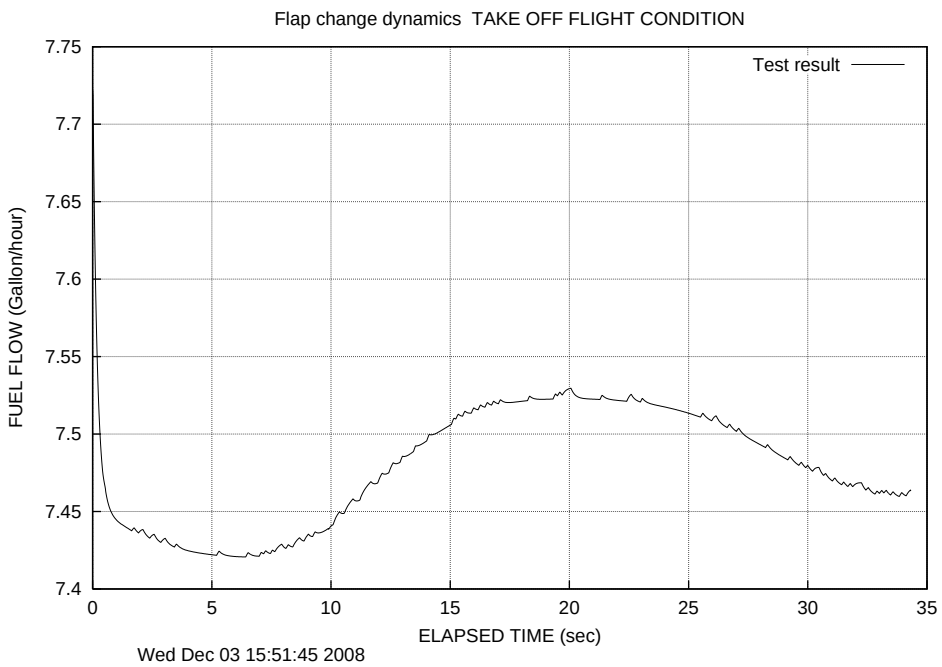

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008

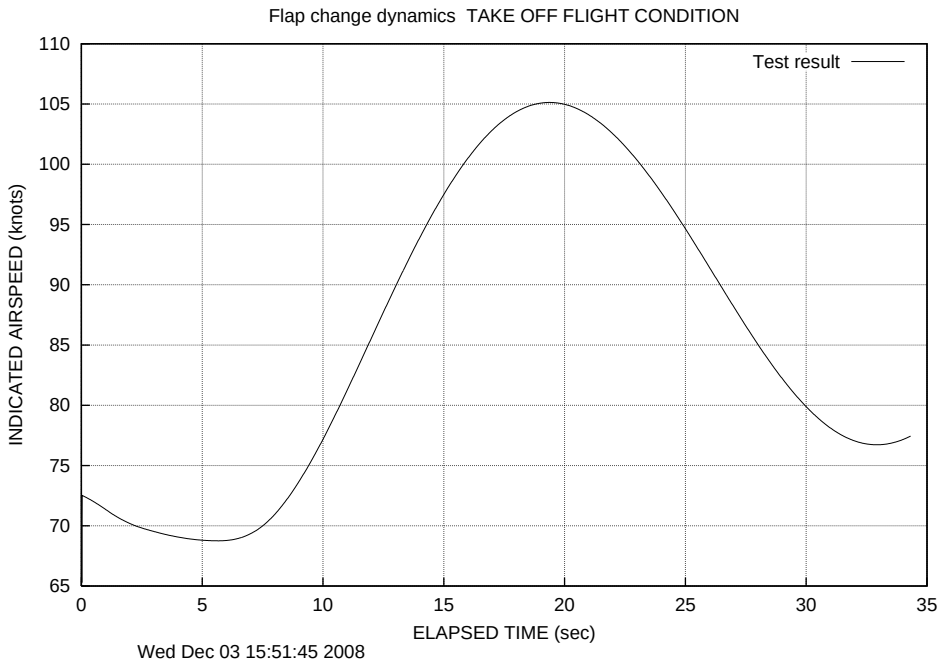

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-5.665
-5.67
-5.675
-5.68
-5.685
-5.69
-5.695
-5.7
-5.705
-5.71
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008

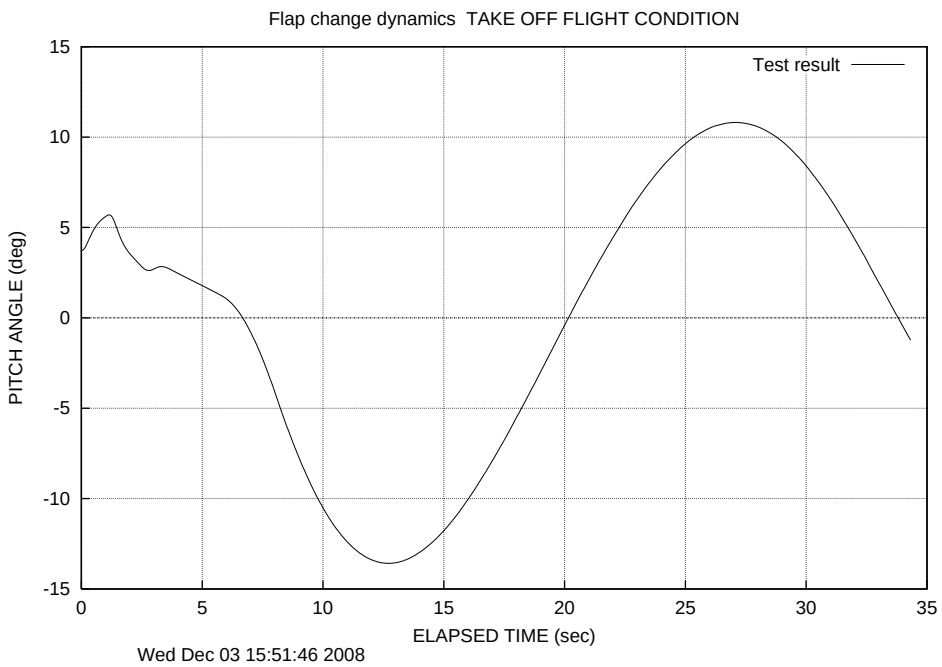

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2300
2250
2200
2150
2100
2050
2000
1950
1900
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008

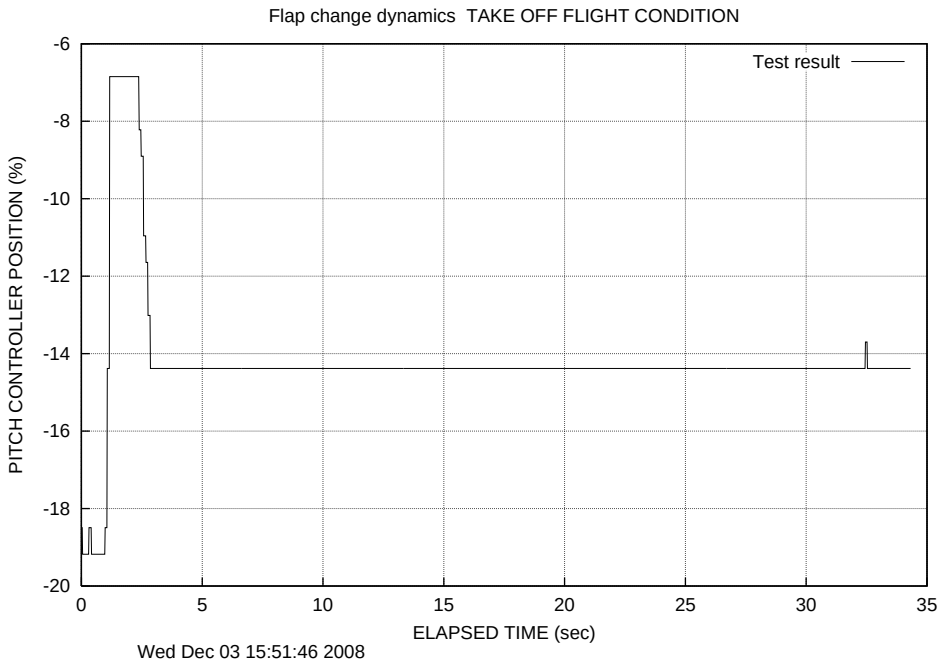

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
FLAP INDICATOR POSITION (deg)
10
8
6
4
2
0
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008

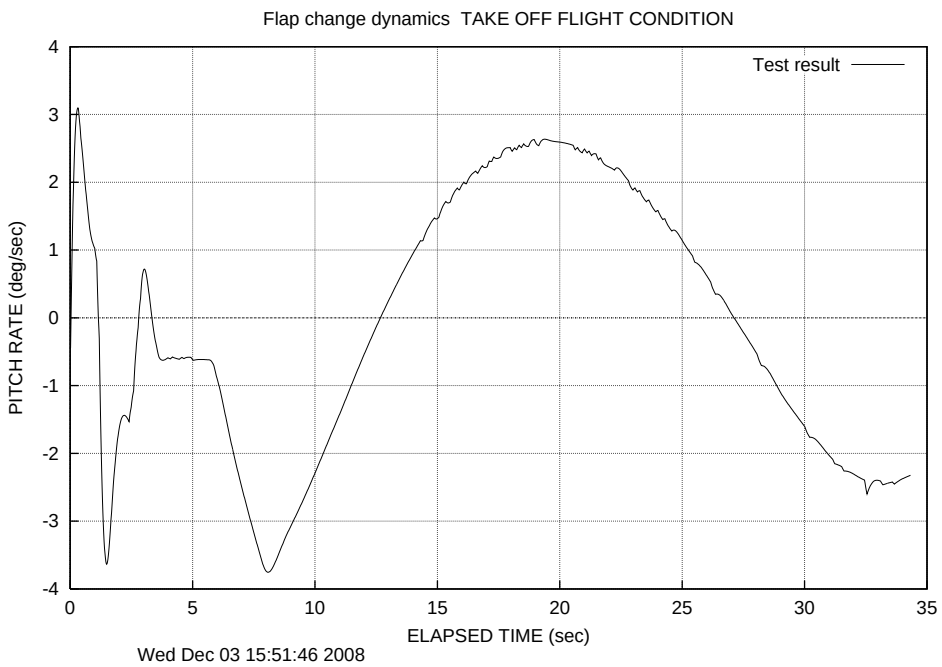

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
FLAP LEVER POSITION (deg)
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008
0
2
4
6
8
10
12
0
5
10
15
20
25
30
35

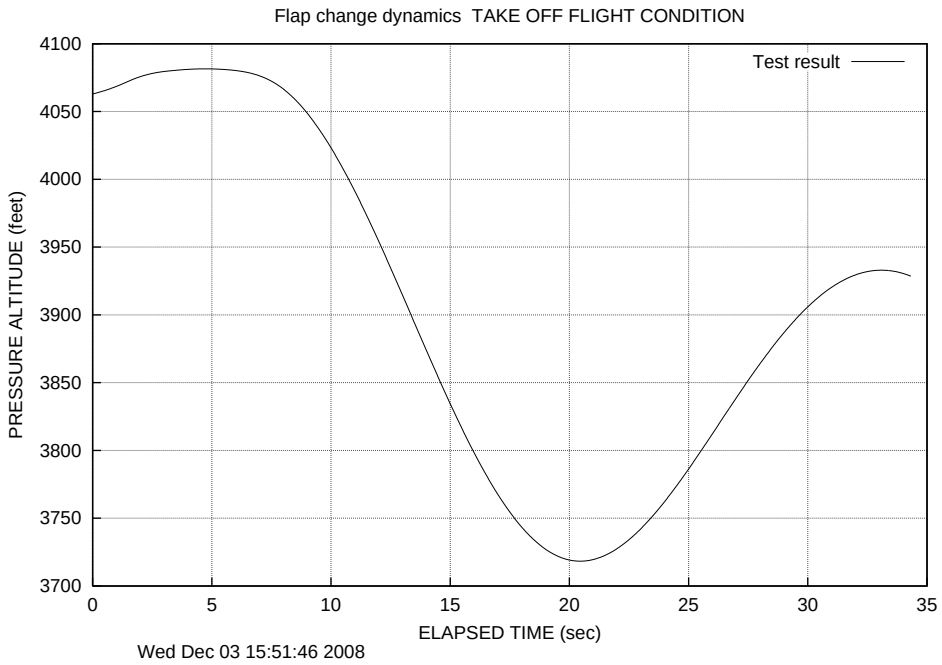

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008
7.4
7.45
7.5
7.55
7.6
7.65
7.7
7.75
0
5
10
15
20
25
30
35

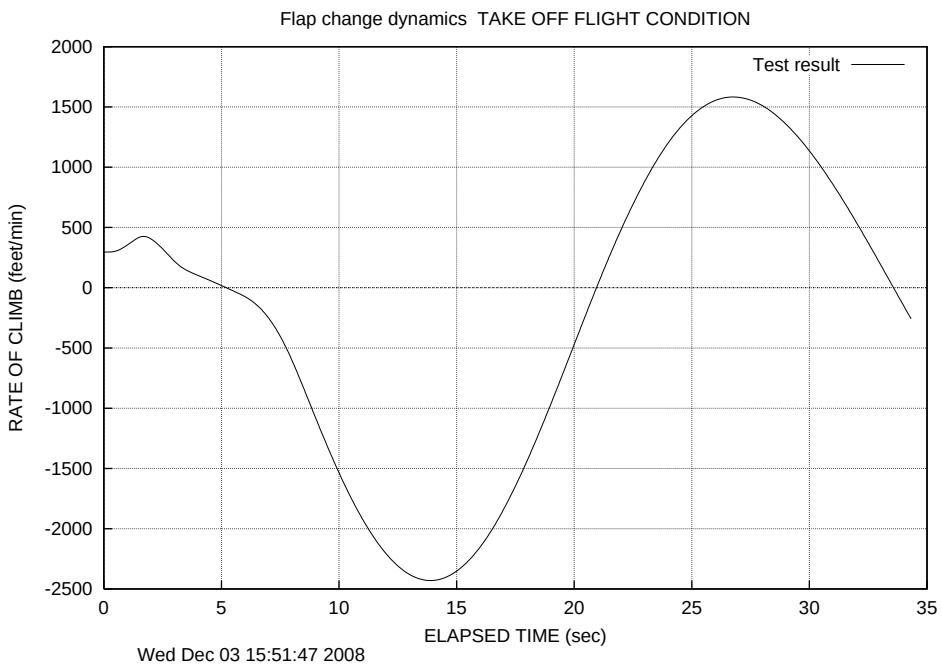

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
110
105
100
95
90
85
80
75
70
65
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:45 2008

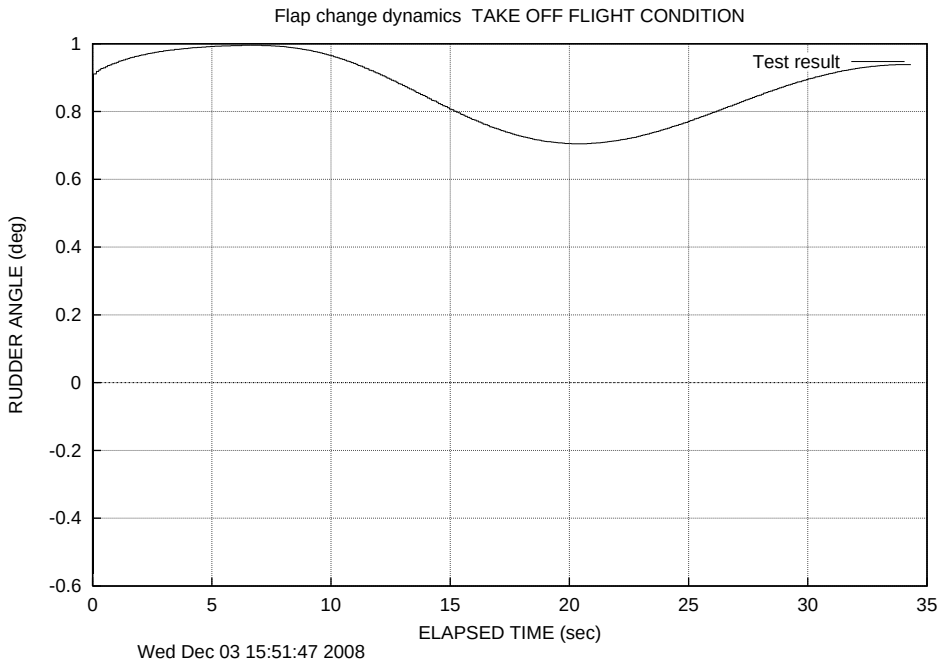

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
15
10
5
0
-5
-10
-15
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:46 2008

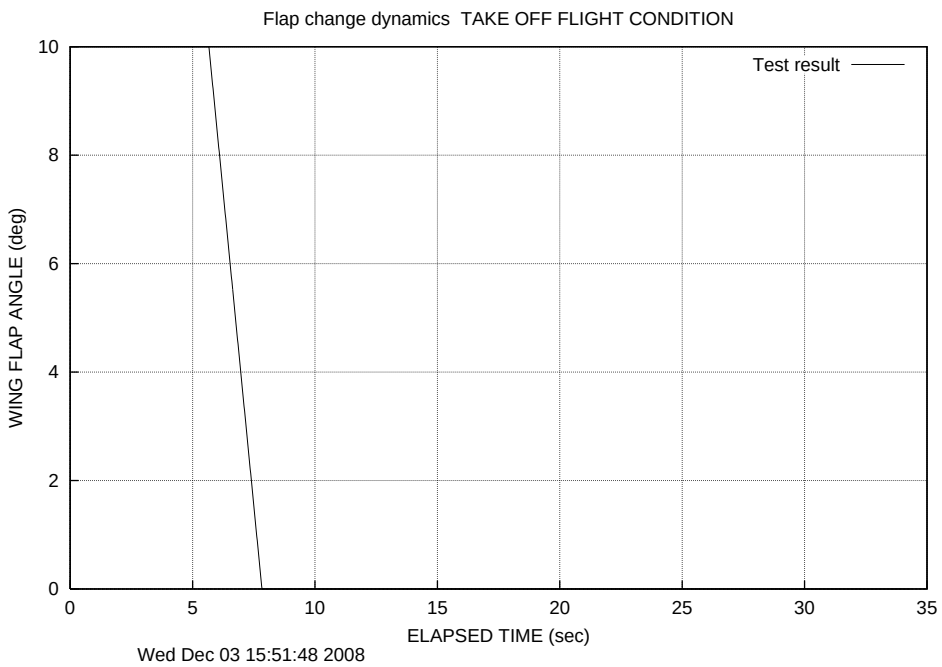

Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
-6
-8
-10
-12
-14
-16
-18
-20
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:46 2008


Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
4
3
2
1
0
-1
-2
-3
-4
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:46 2008


Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4100
4050
4000
3950
3900
3850
3800
3750
3700
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:46 2008


Flap change dynamics TAKE OFF FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
2000
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 15:51:47 2008





Source data Section 3.10 of [1]

Comparison of results	The flap change dynamics simulator test shows compliance towards the Validation Reference Data result as described in Section 3.10 of [1].

6.14 Spoiler/Speedbrake change dynamics (2b3)

Not applicable.

6.15 Gear change force (2b4-1)

Not applicable (fixed gear).

6.16 Gear and Flap/Slat operating times (2b5)

Test objective	To demonstrate that the simulator response time to a flap retraction in the take-off flight condition and a flap extension in the approach to landing and conforms to the class of aeroplane.	
Demonstration procedure	Starting from the prescribed trimmed condition, retract (takeoff) or extend (approach) flaps and allow the simulator to respond freely. Record the time to completion of the flap retraction or extension	
Expected results	For both flap retraction as well as flap extension response times of approximately 2 seconds are expected	
Tolerances	TIME	±3 sec

Test results - extension
UP to APPROACH = 2 seconds

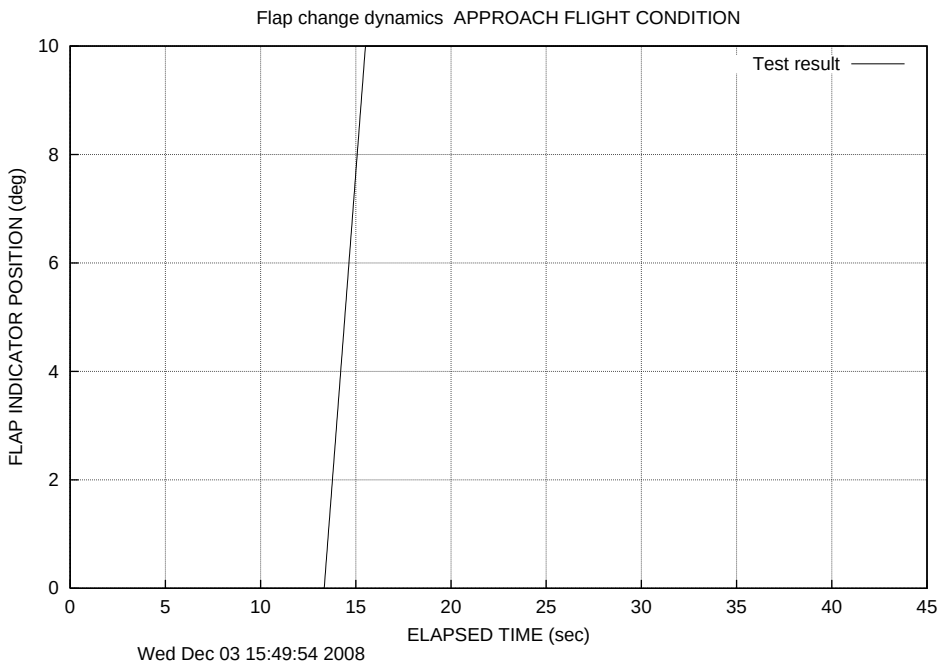


Figure 6.1: Flap extension from UP (0 deg) to APPROACH (10 deg)

Test results - retraction
APPROACH to UP = 2 seconds

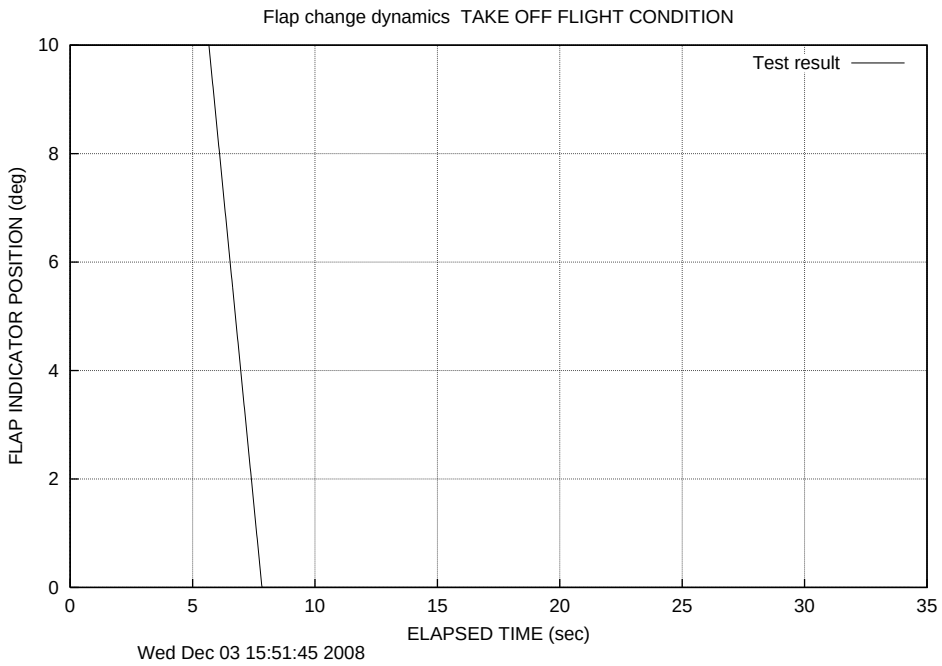


Figure 6.2: Flap retraction from to APPROACH (10 deg) to UP (0 deg)

6.17 Longitudinal trim (2b6)

Test objective	To demonstrate that the simulator inter-relationships of lift, drag, thrust and longitudinal trim conform to the class of aeroplane.
Demonstration procedure	Establish steady state wings level constant altitude flight condition, setting thrust as required to achieve target speed.
References	[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	33.97	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.290	(-)
FLAP LEVER POSITION	=	10.0	(deg)
FLAP INDICATOR POSITION	=	10.0	(deg)
PITCH CONTROLLER POSITION	=	-13.33	(%)
ROLL CONTROLLER POSITION	=	4.897	(%)
RUDDER PEDAL POSITION	=	2.545	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	73.6	(kts)
RATE OF CLIMB	=	-59.5	(fpm)
PRESSURE ALTITUDE	=	4275	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.7	(deg)
BANK ANGLE	=	-5.6	(deg)
ANGLE OF ATTACK	=	1.3	(deg)
SIDESLIP ANGLE	=	0.0	(deg)
PITCH RATE	=	-0.2	(deg/sec)
ROLL RATE	=	-3.0	(deg/sec)
YAW RATE	=	-1.2	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2080	(rpm)
EXHAUST GAS TEMPERATURE	=	1069	(deg F)
FUEL FLOW	=	7.97	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.2	(deg)
LEFT AILERON ANGLE	=	0.7	(deg)
RIGHT AILERON ANGLE	=	-0.7	(deg)
RUDDER ANGLE	=	-0.2	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Cruise flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.072	(-)
FLAP LEVER POSITION	=	0.0	(deg)
FLAP INDICATOR POSITION	=	0.0	(deg)
PITCH CONTROLLER POSITION	=	-10.00	(%)
ROLL CONTROLLER POSITION	=	1.031	(%)
RUDDER PEDAL POSITION	=	1.818	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	89.6	(kts)
RATE OF CLIMB	=	198	(fpm)
PRESSURE ALTITUDE	=	4980	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	2.5	(deg)
BANK ANGLE	=	-4.3	(deg)
ANGLE OF ATTACK	=	1.5	(deg)
SIDESLIP ANGLE	=	-0.4	(deg)

PITCH RATE	=	0.1	(deg/sec)
ROLL RATE	=	-0.4	(deg/sec)
YAW RATE	=	-1.1	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2289	(rpm)
EXHAUST GAS TEMPERATURE	=	1083	(deg F)
FUEL FLOW	=	8.80	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.0	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	-0.3	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

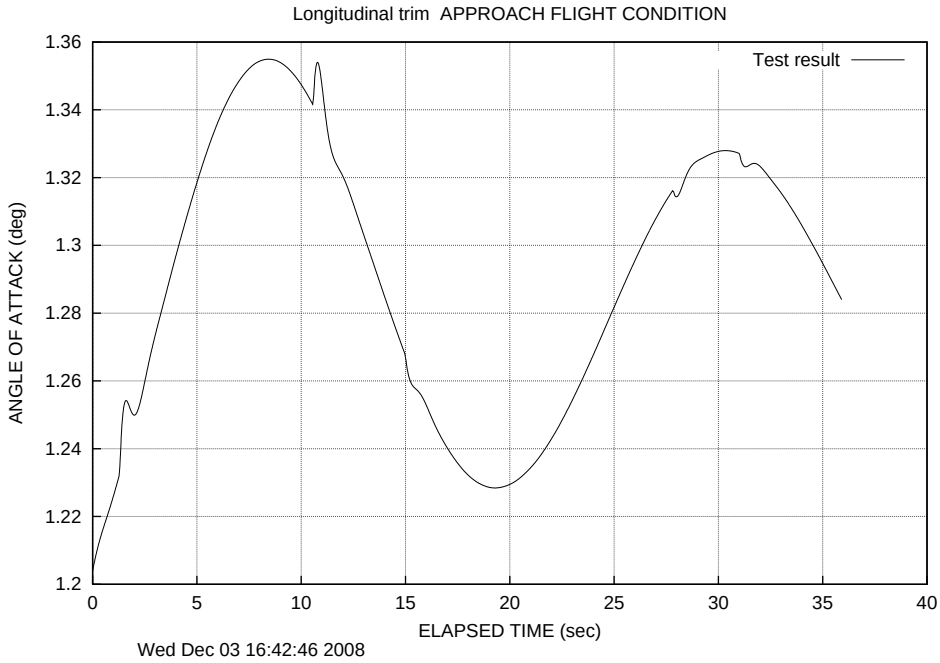
Manual test procedures

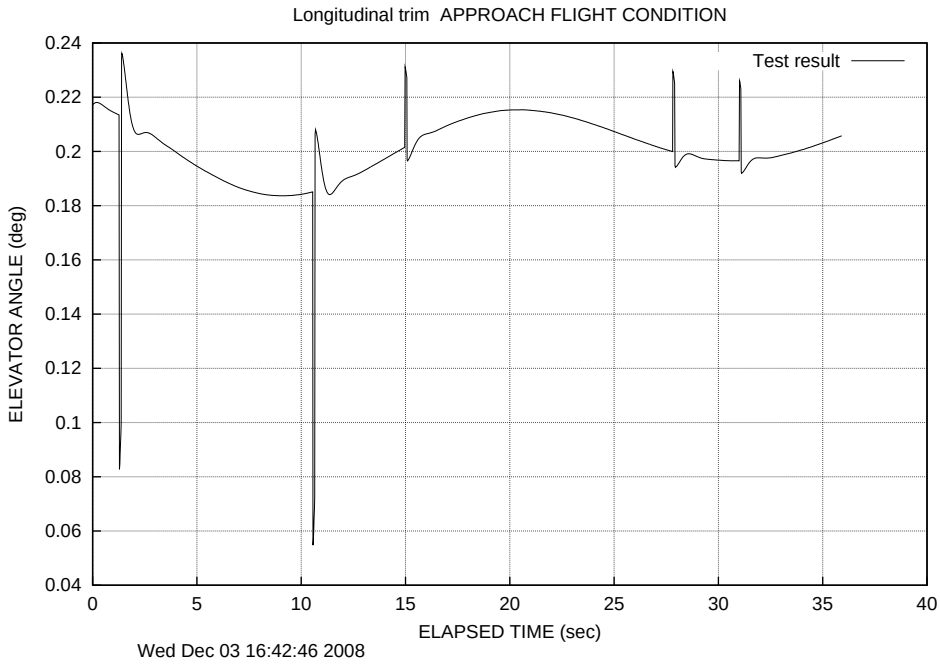
Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `611_FSTD_2c5_Approach.sit` or `611_FSTD_2c5_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

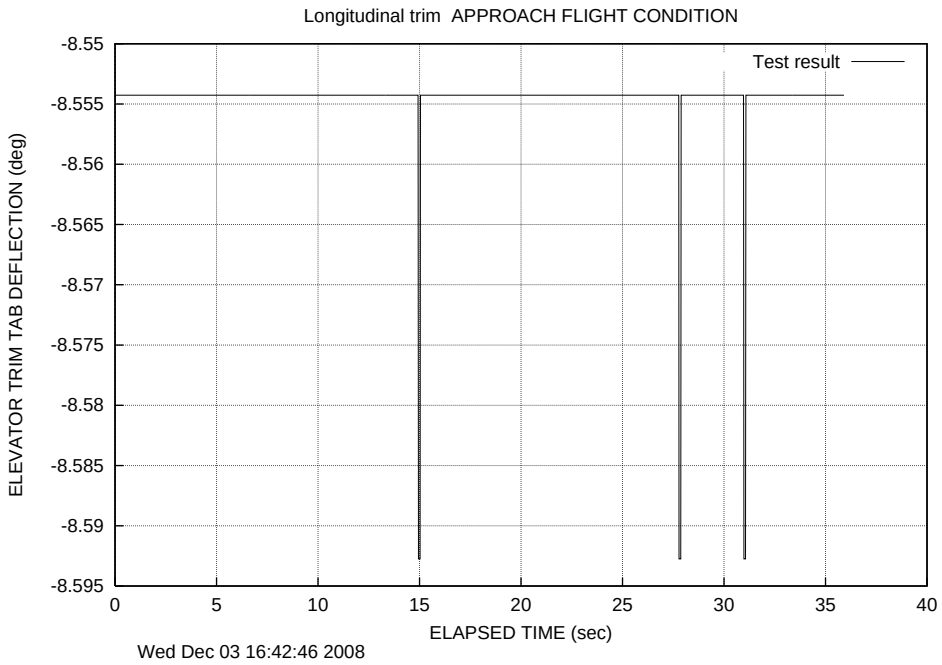
This test does not require any manual control inputs. Only small inputs to the Yoke in roll may be given to correct for the asymmetric effect due to engine torque and propwash. The test may be stopped after at least 30 seconds have elapsed.

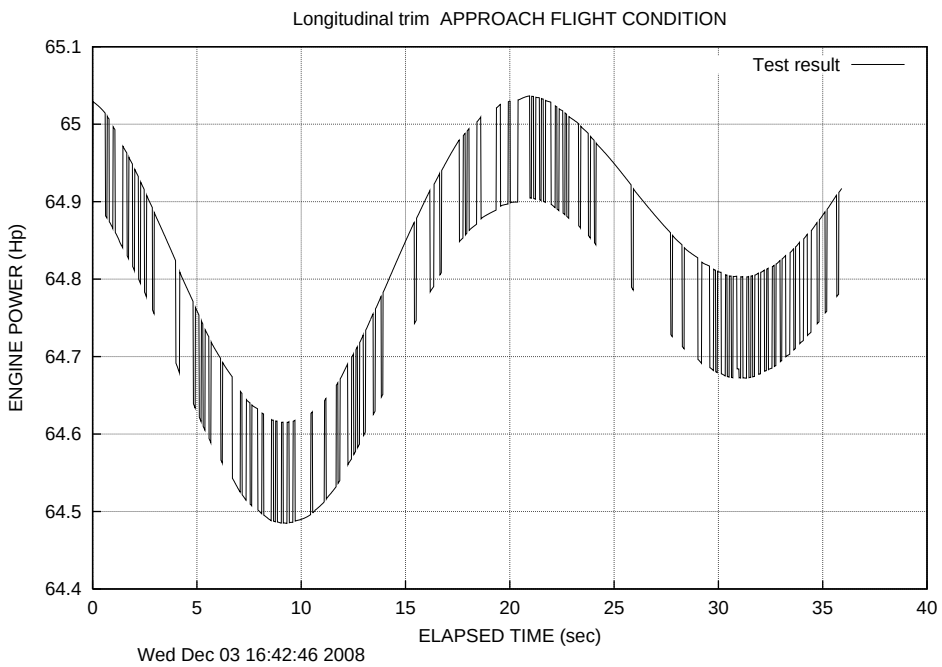
Evaluated parameters	ANGLE OF ATTACK ELEVATOR ANGLE ELEVATOR TRIM TAB ANGLE ENGINE POWER ENGINE SPEED FUEL FLOW INDICATED AIRSPEED PITCH ANGLE PITCH ANGULAR ACCELERATION PITCH CONTROLLER POSITION PRESSURE ALTITUDE RATE OF CLIMB ROLL ANGULAR ACCELERATION RUDDER ANGLE THROTTLE SETTING THRUST YAW ANGULAR ACCELERATION
Expected results	Angle of attack, engine power, engine speed, fuel flow, indicated airspeed, pitch angle and pressure altitude and thrust are expected to remain close to their initially trimmed values and only slowly divert from their initial values as time progresses. Pitch angular acceleration, rate of climb, roll angular acceleration and yaw angular acceleration are expected to have their values remain close to zero as time advances. See section 3.11 of [1].
Tolerances	ELEVATOR TRIM TAB ANGLE $\pm 2°$ PITCH ANGLE $\pm 2°$ THRUST $\pm 5\%$
Test result	

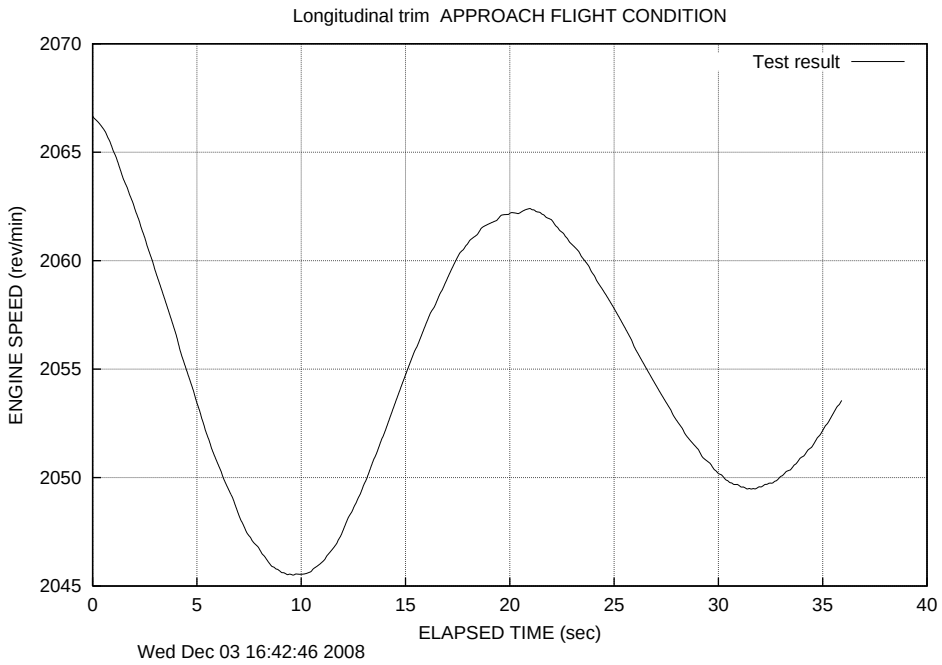
Approach flight condition:

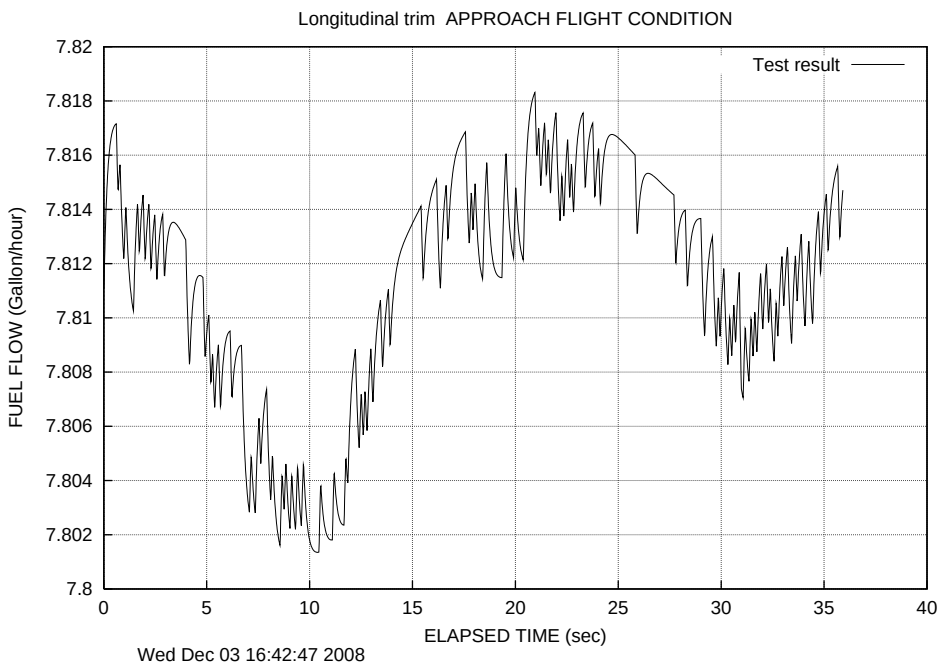


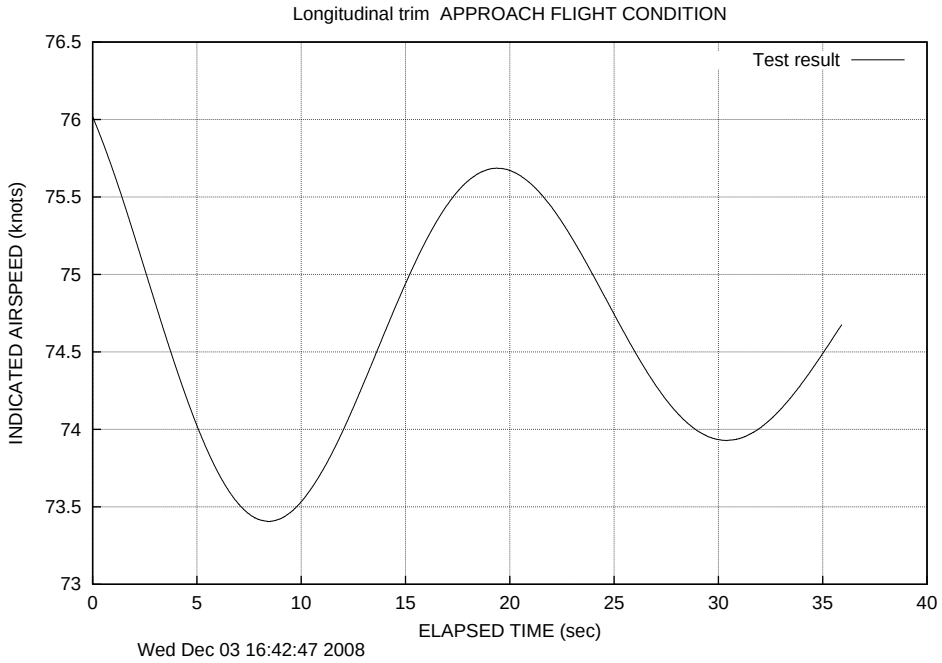


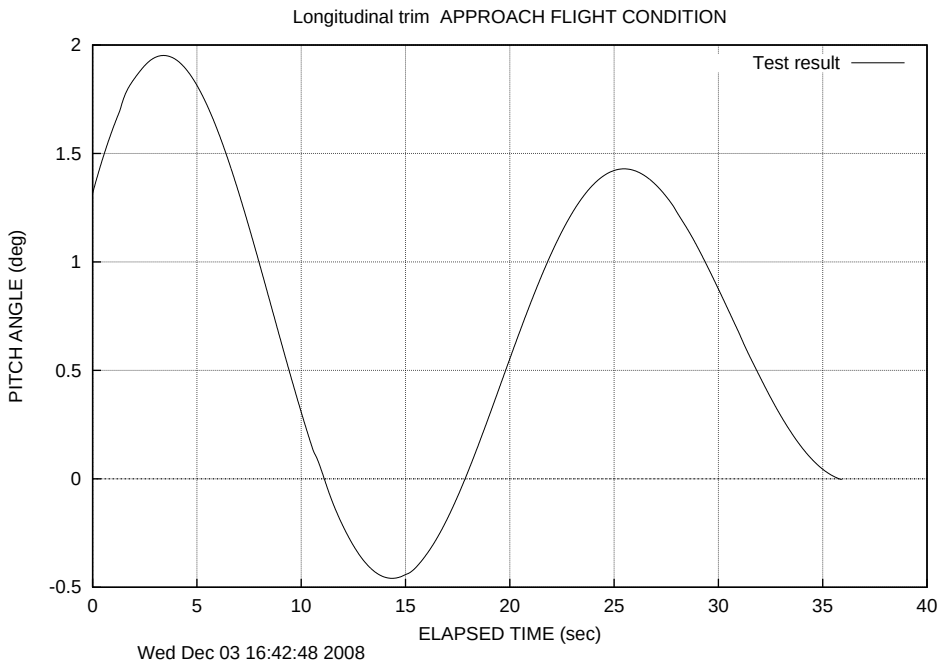

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-8.55
-8.555
-8.56
-8.565
-8.57
-8.575
-8.58
-8.585
-8.59
-8.595
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:46 2008

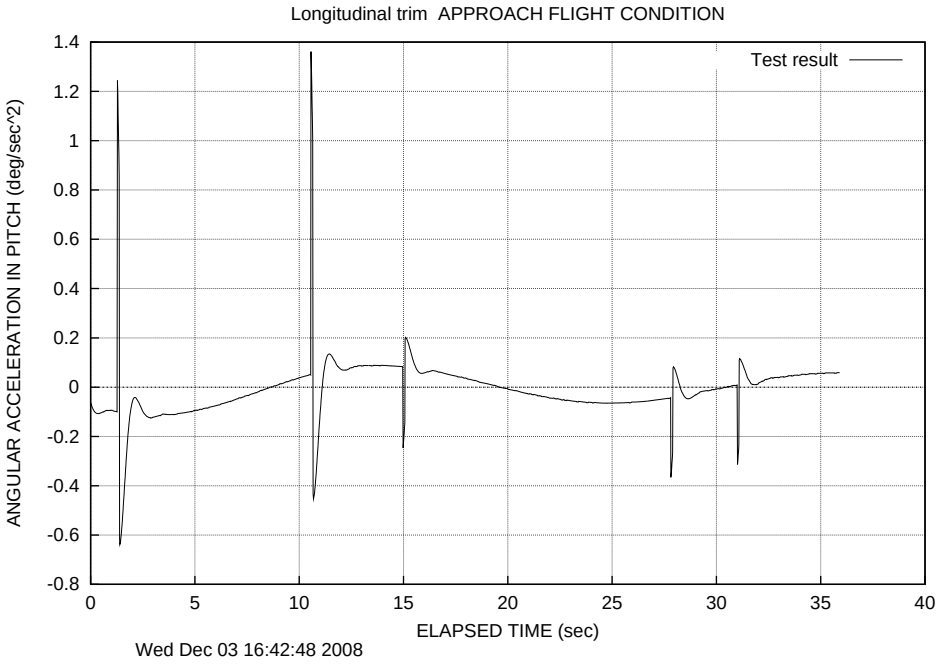

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
65.1
65
64.9
64.8
64.7
64.6
64.5
64.4
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:46 2008

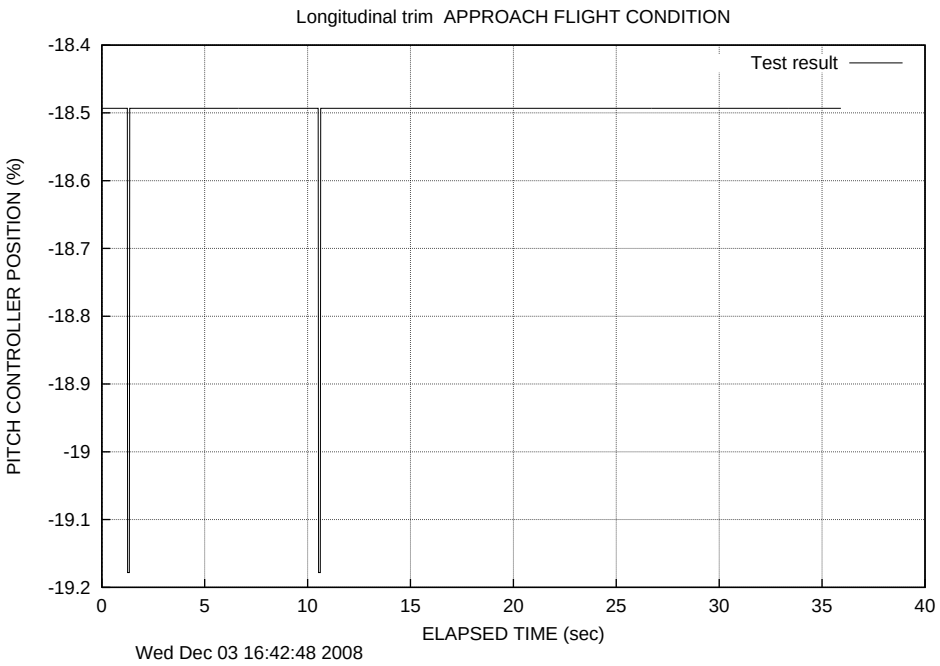

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2070
2065
2060
2055
2050
2045
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:46 2008

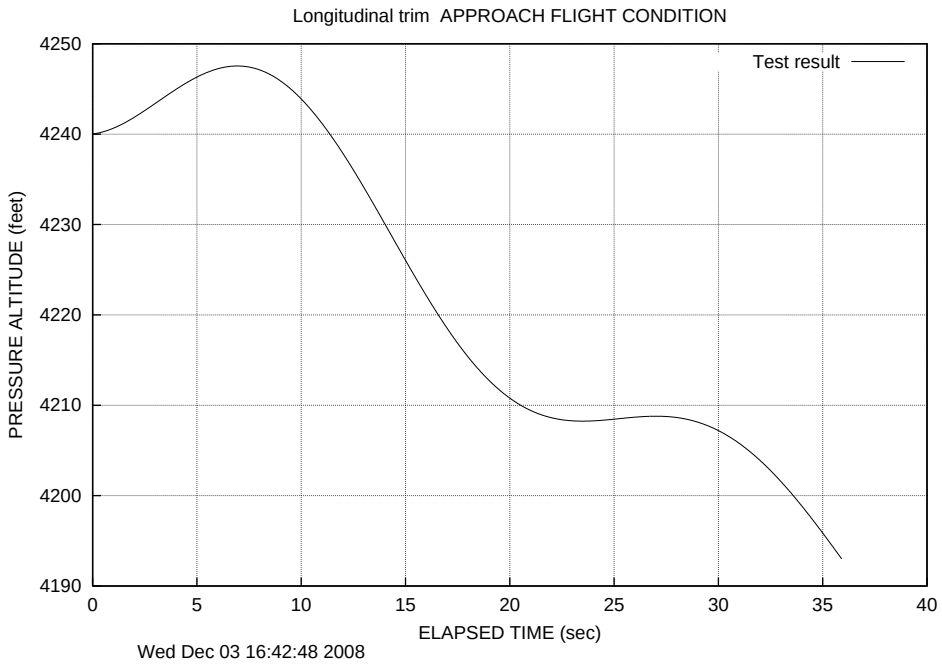

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
7.82
7.818
7.816
7.814
7.812
7.81
7.808
7.806
7.804
7.802
7.8
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:47 2008

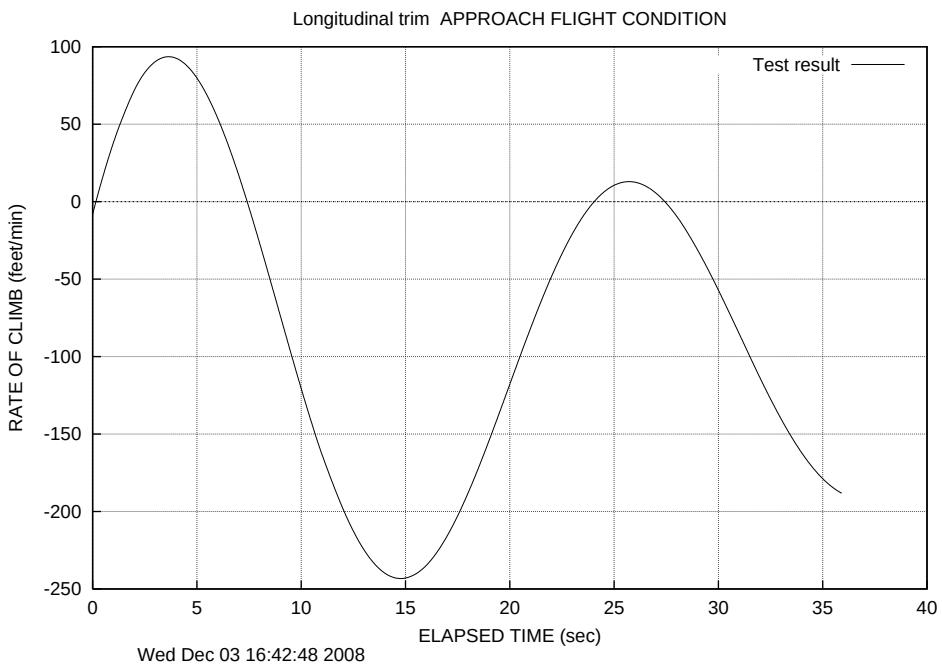

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
76.5
76
75.5
75
74.5
74
73.5
73
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:47 2008

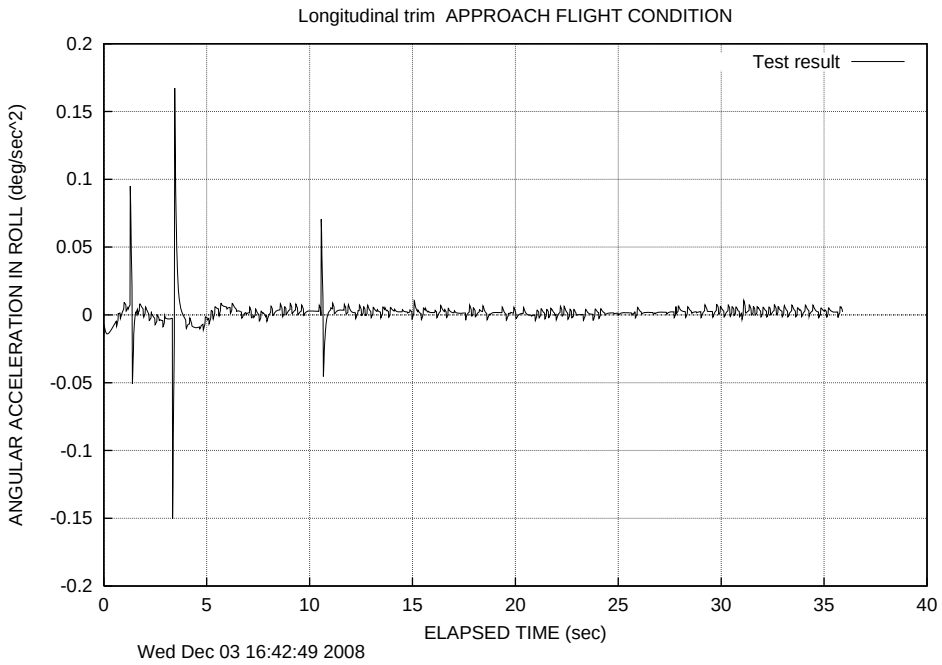

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
2
1.5
1
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:48 2008

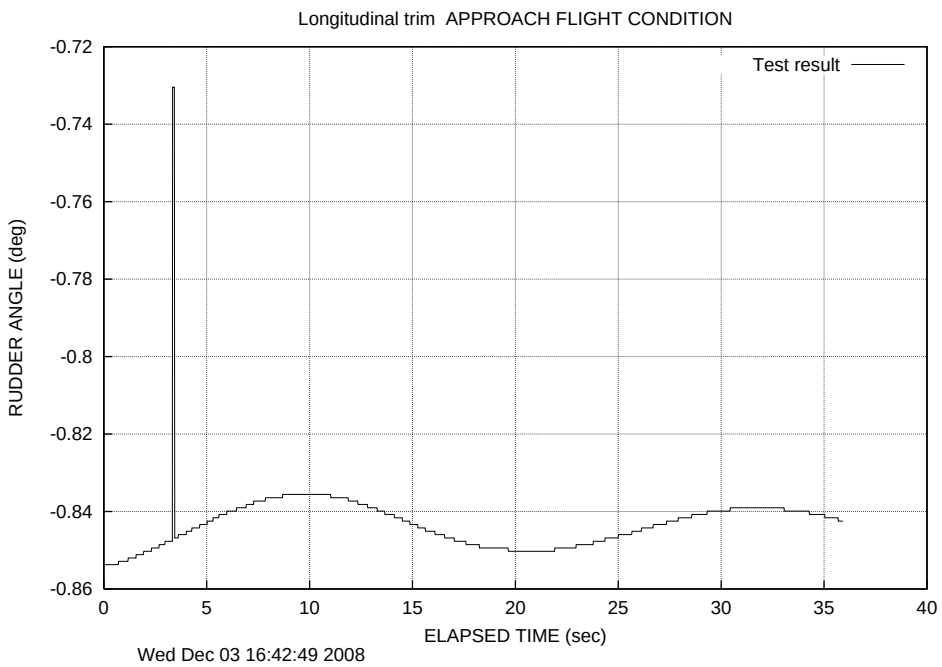

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ANGULAR ACCELERATION IN PITCH (deg/sec^2)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:48 2008

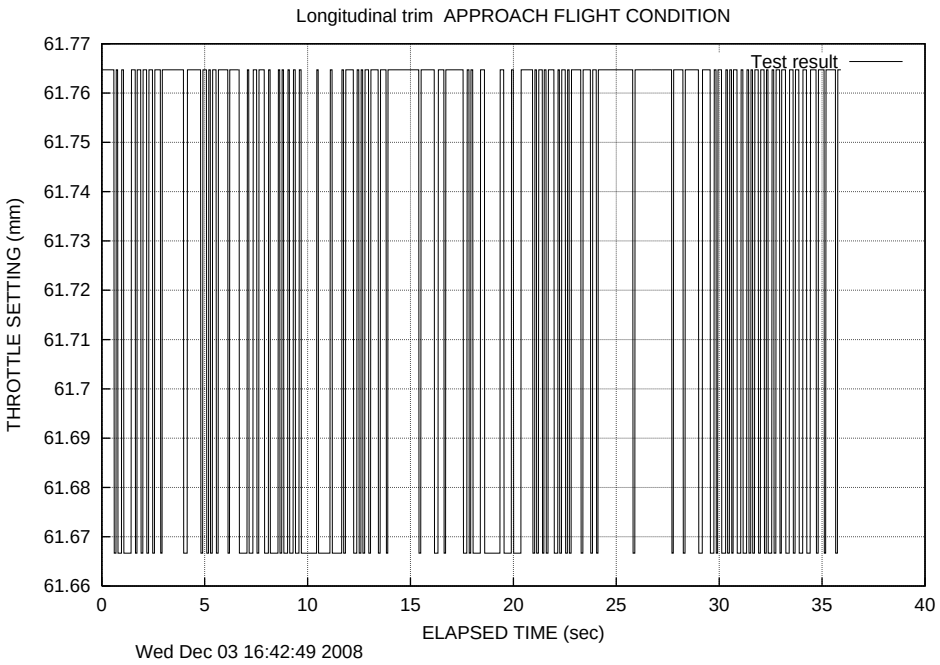

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
-18.4
-18.5
-18.6
-18.7
-18.8
-18.9
-19
-19.1
-19.2
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:48 2008

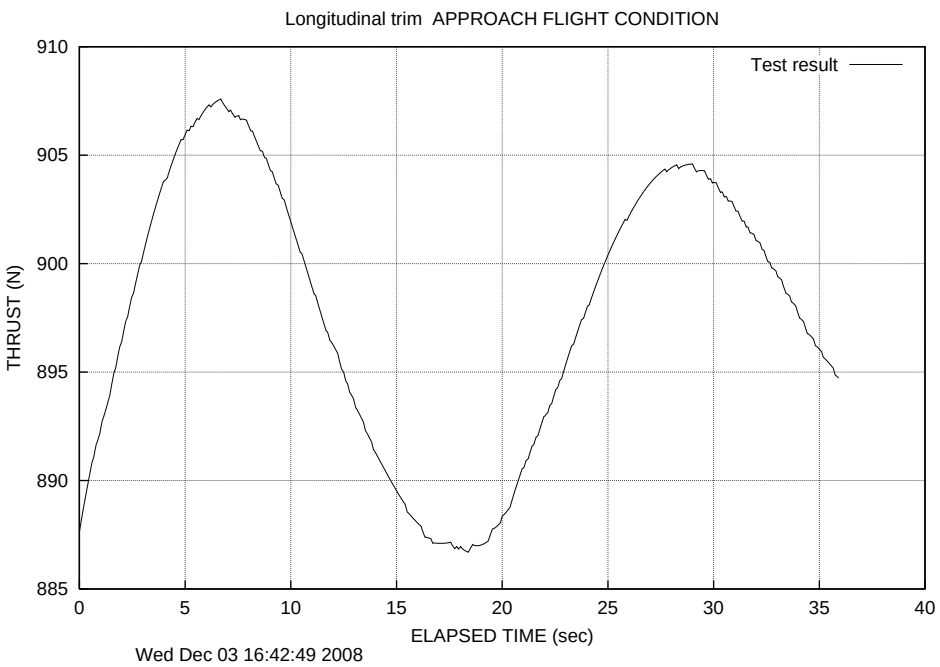

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4250
4240
4230
4220
4210
4200
4190
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:48 2008

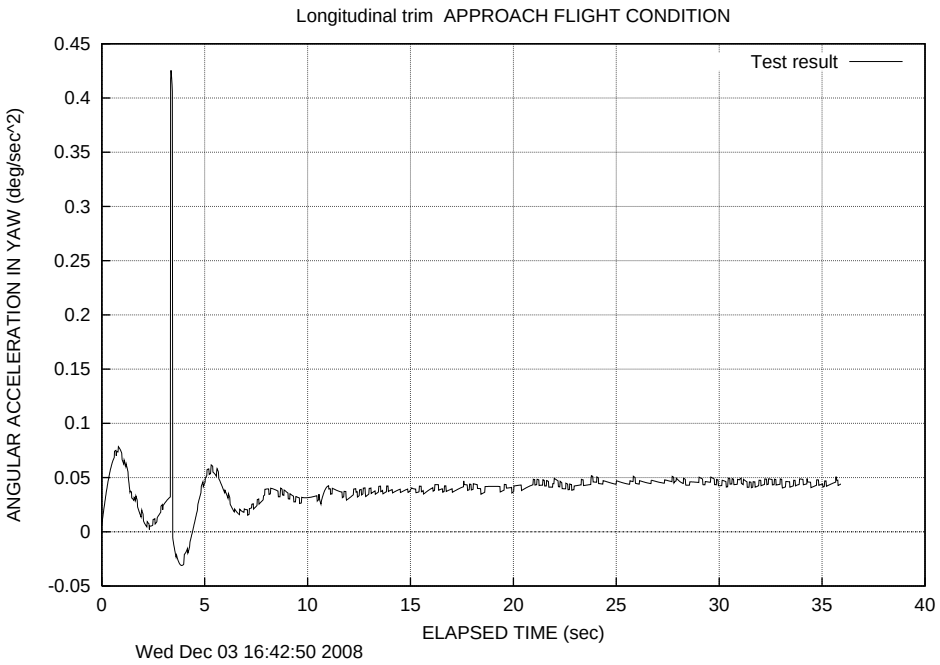

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
100
50
0
-50
-100
-150
-200
-250
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:48 2008


Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ANGULAR ACCELERATION IN ROLL (deg/sec^2)
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:49 2008

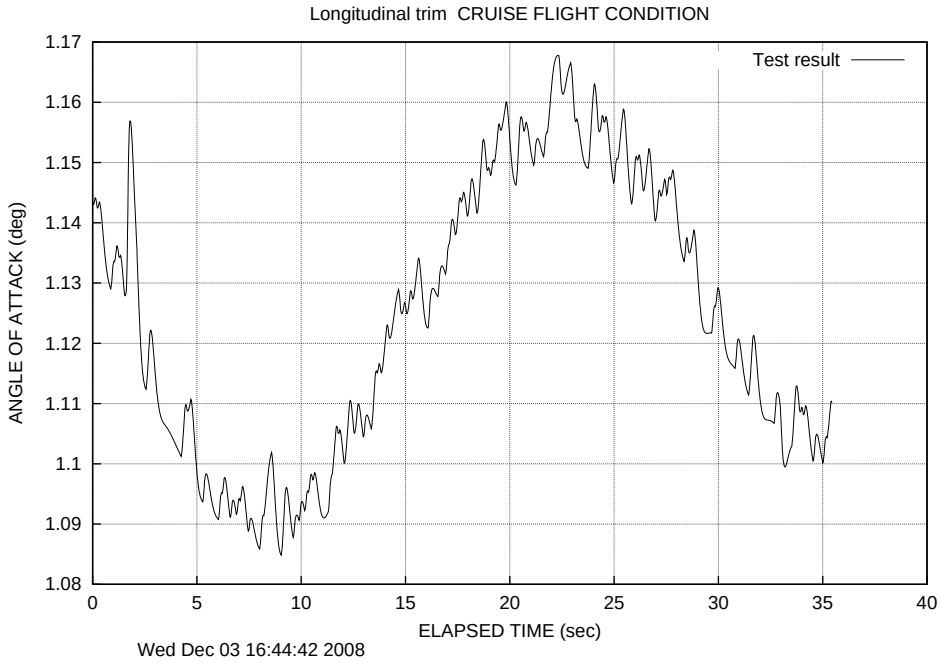

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
-0.72
-0.74
-0.76
-0.78
-0.8
-0.82
-0.84
-0.86
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:49 2008

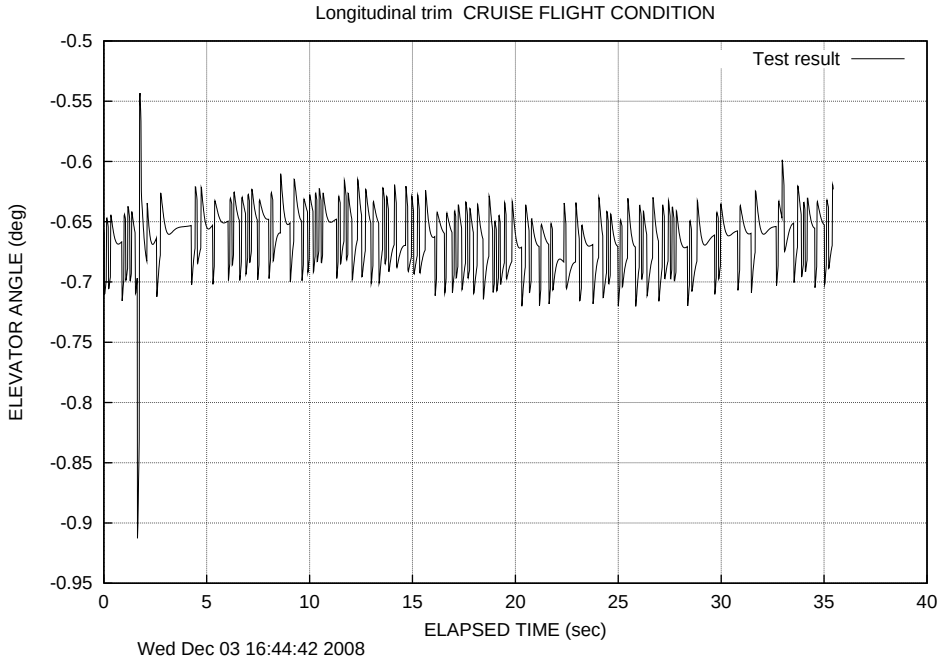

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
61.77
61.76
61.75
61.74
61.73
61.72
61.71
61.7
61.69
61.68
61.67
61.66
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:49 2008

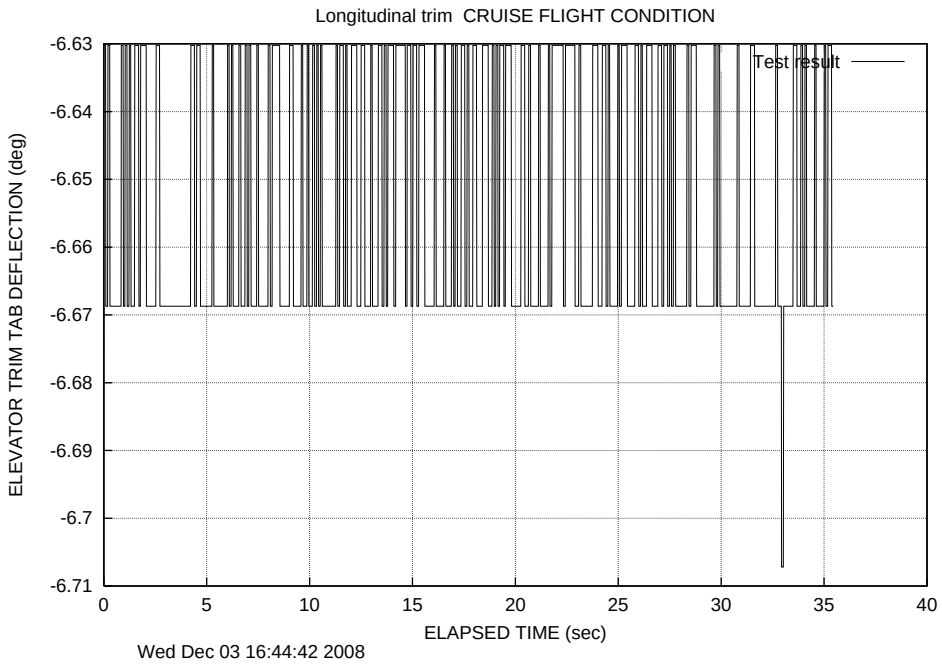

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
THRUST (N)
910
905
900
895
890
885
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:49 2008

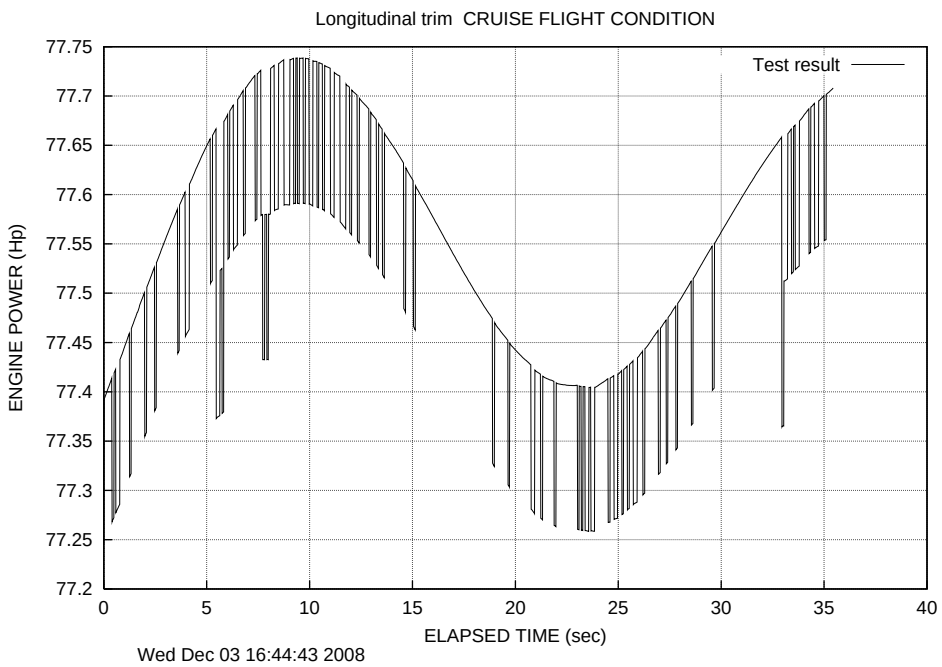

Longitudinal trim APPROACH FLIGHT CONDITION
Test result
ANGULAR ACCELERATION IN YAW (deg/sec^2)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:42:50 2008

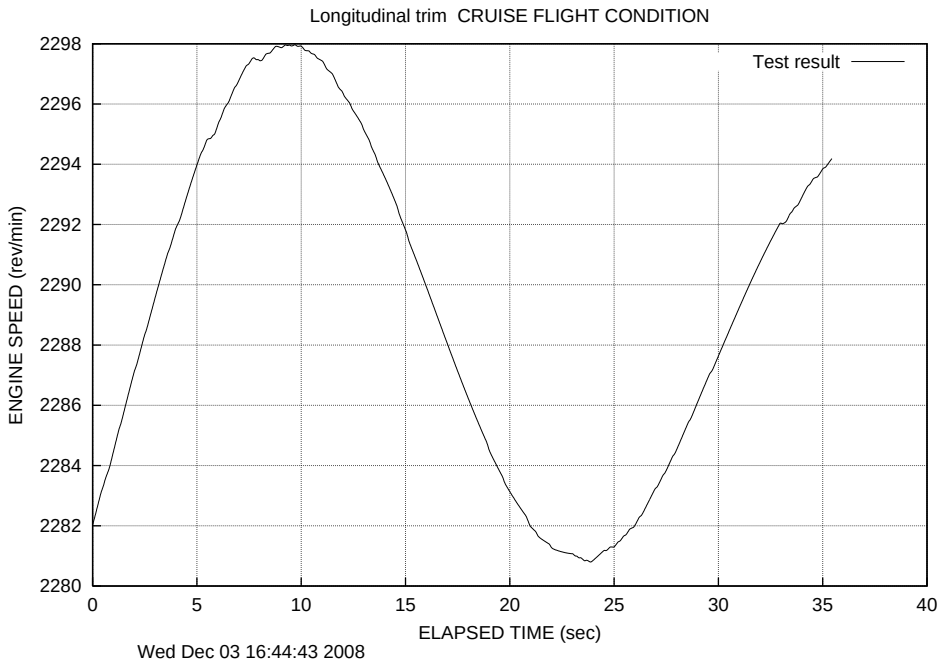
Cruise flight condition:

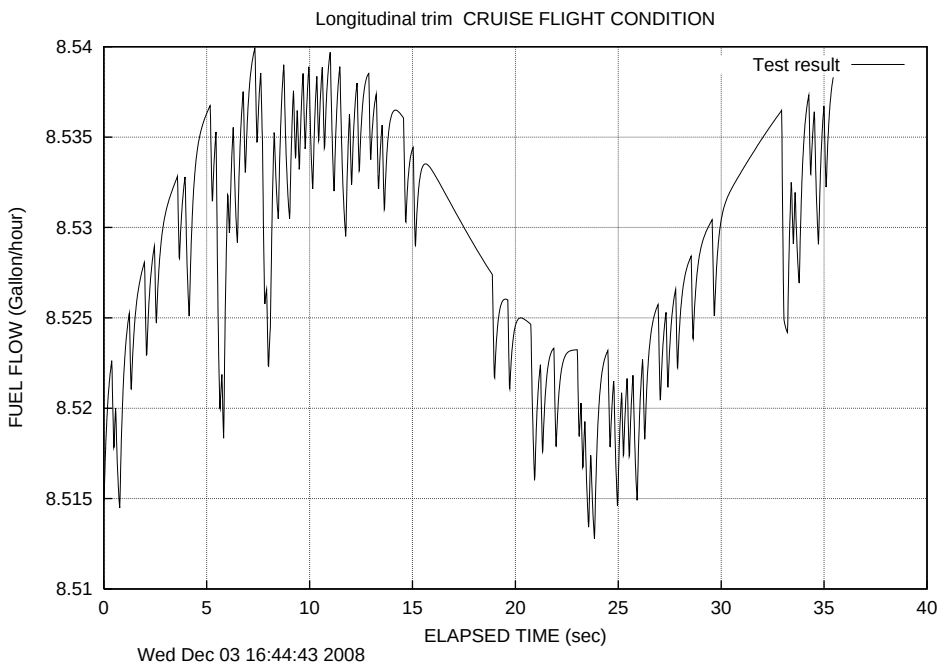


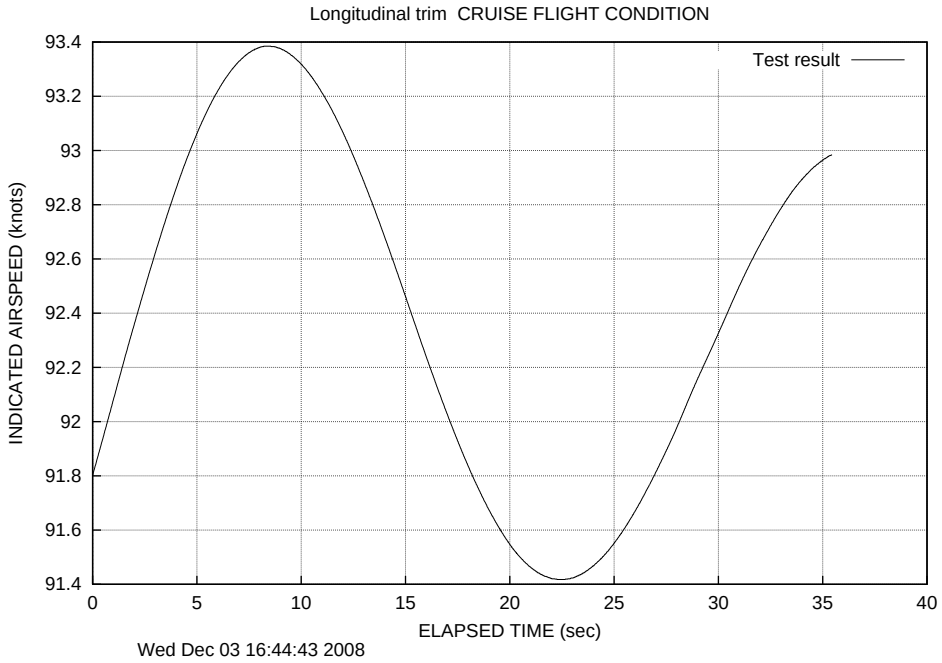


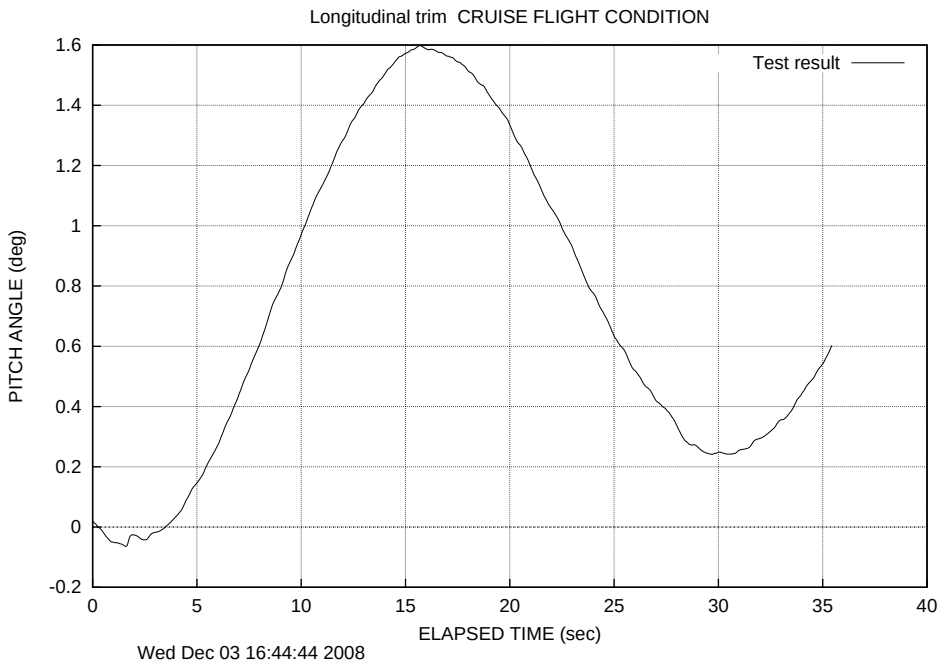

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-6.63
-6.64
-6.65
-6.66
-6.67
-6.68
-6.69
-6.7
-6.71
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:42 2008

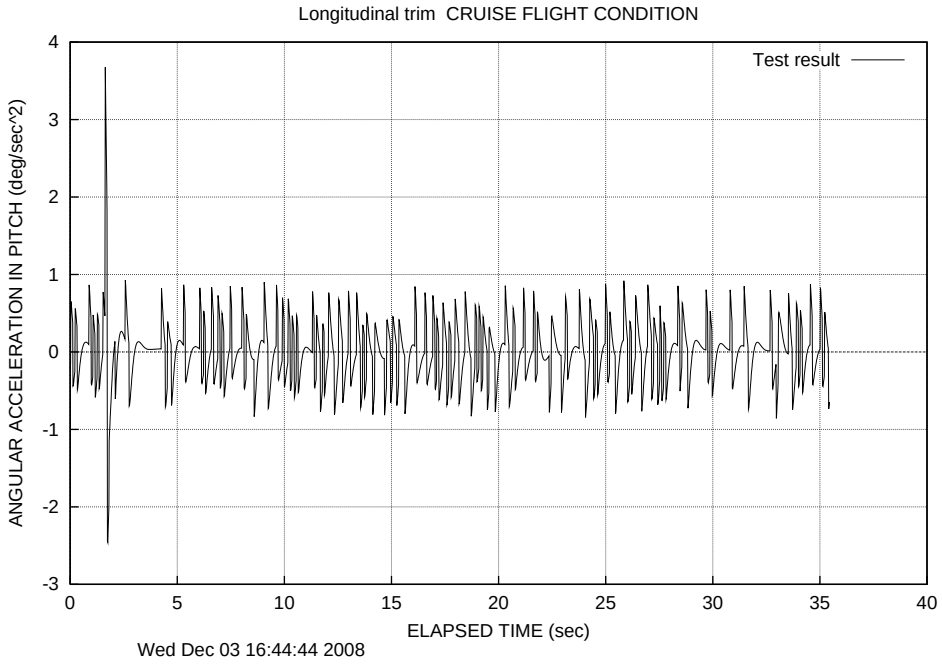

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
ENGINE POWER (Hp)
77.75
77.7
77.65
77.6
77.55
77.5
77.45
77.4
77.35
77.3
77.25
77.2
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:43 2008

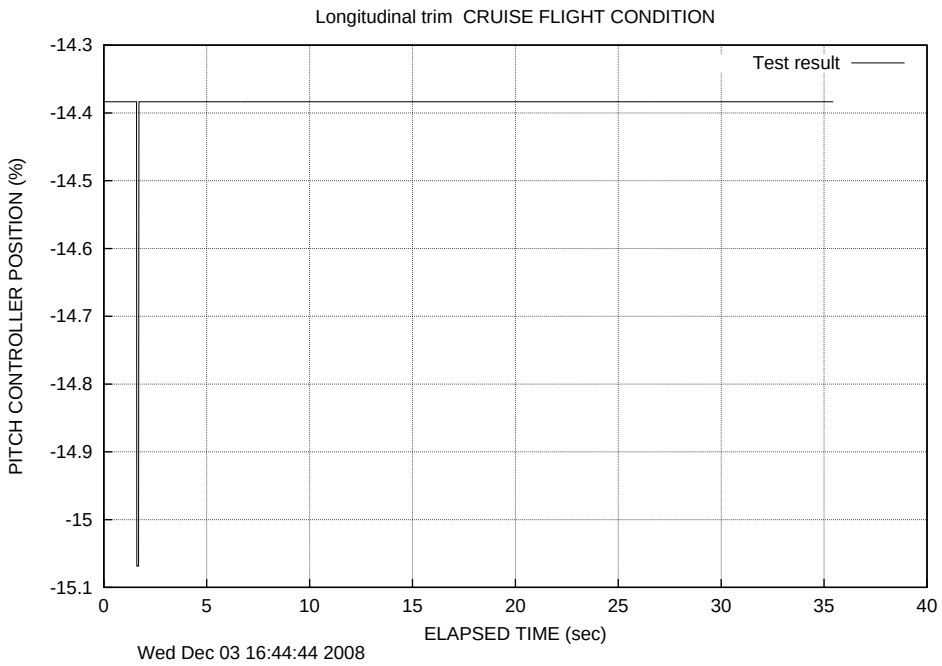

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2298
2296
2294
2292
2290
2288
2286
2284
2282
2280
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:43 2008

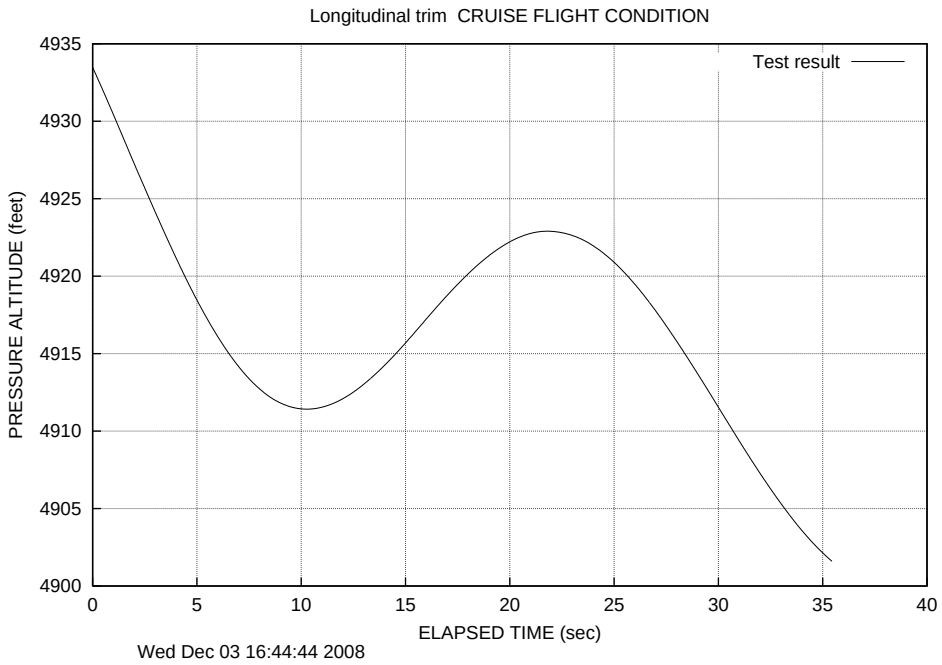

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.54
8.535
8.53
8.525
8.52
8.515
8.51
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:43 2008

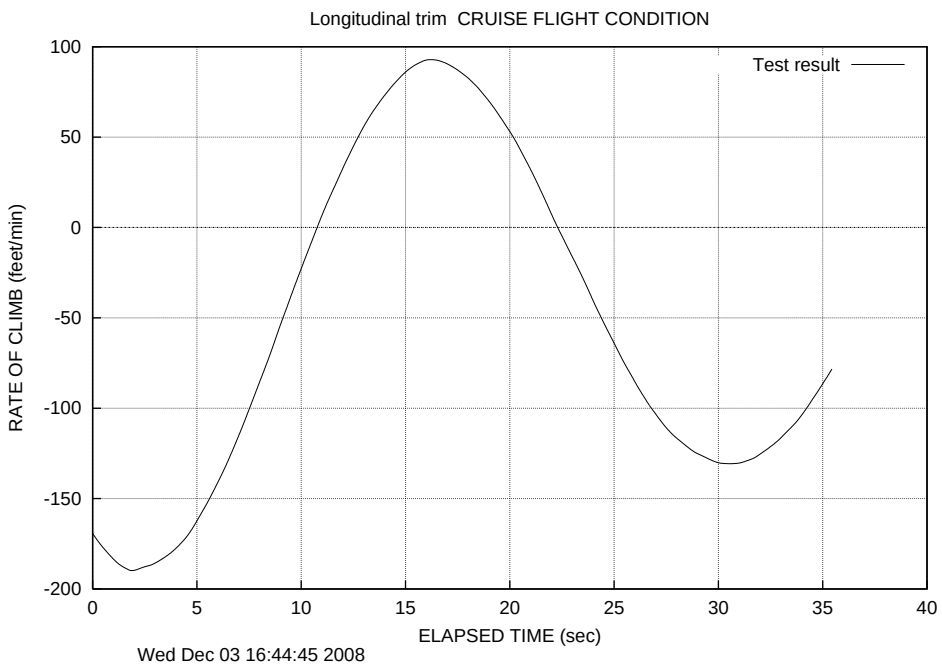

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
93.4
93.2
93
92.8
92.6
92.4
92.2
92
91.8
91.6
91.4
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:43 2008

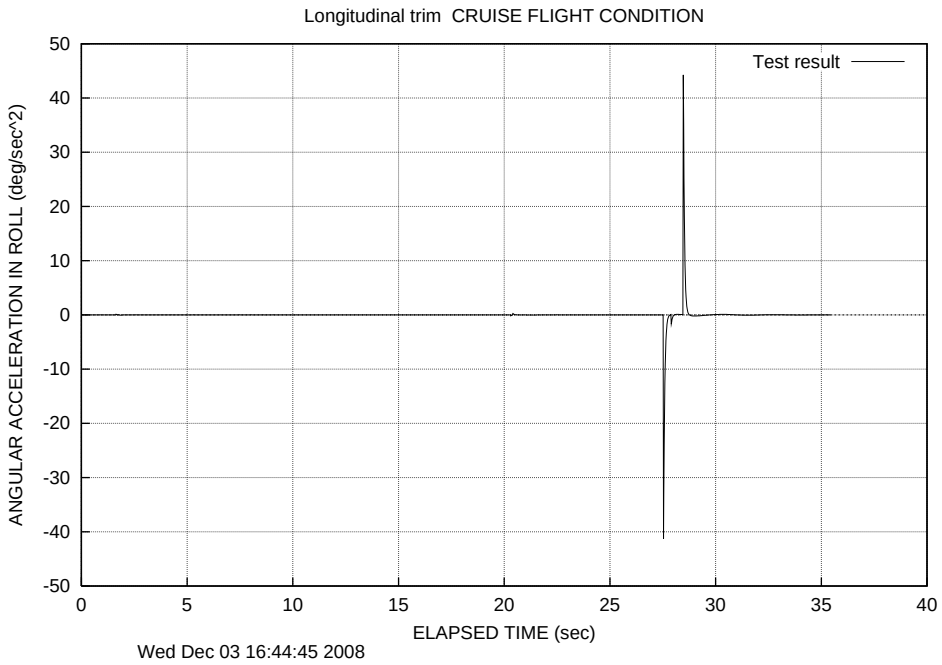

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:44 2008

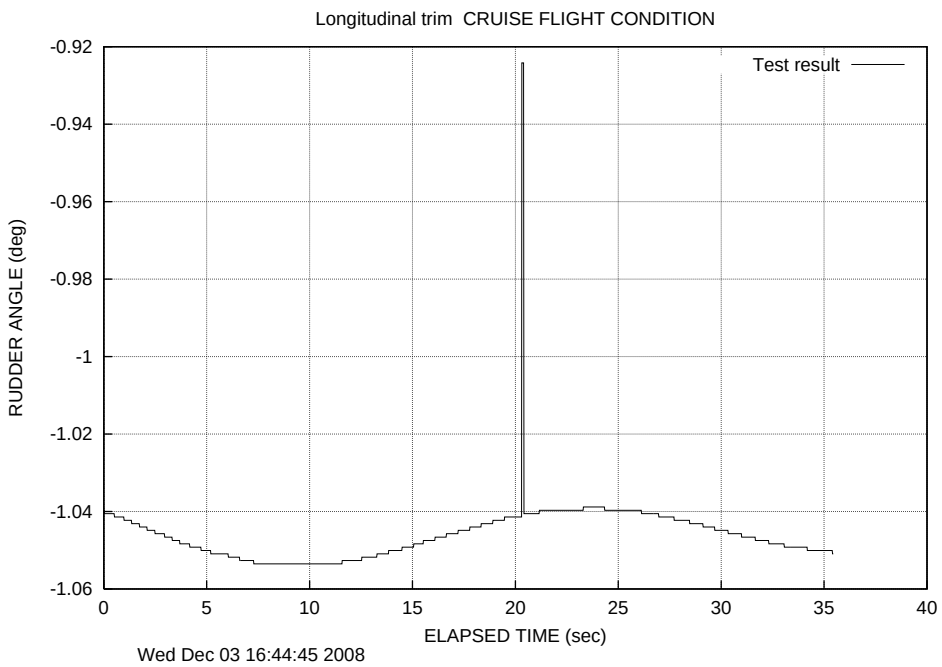

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
ANGULAR ACCELERATION IN PITCH (deg/sec^2)
4
3
2
1
0
-1
-2
-3
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:44 2008

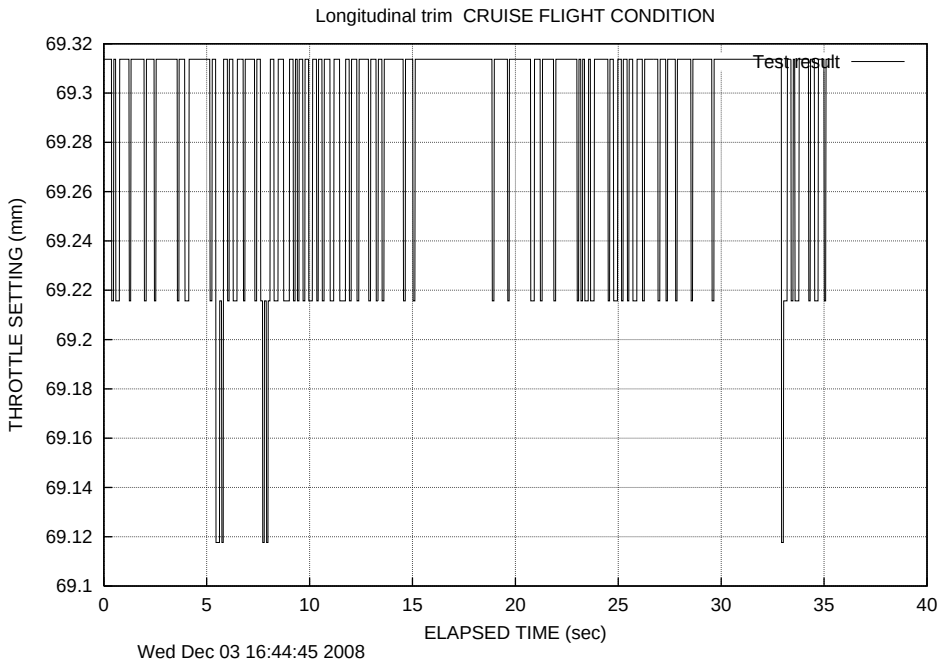

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
-14.3
-14.4
-14.5
-14.6
-14.7
-14.8
-14.9
-15
-15.1
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:44 2008

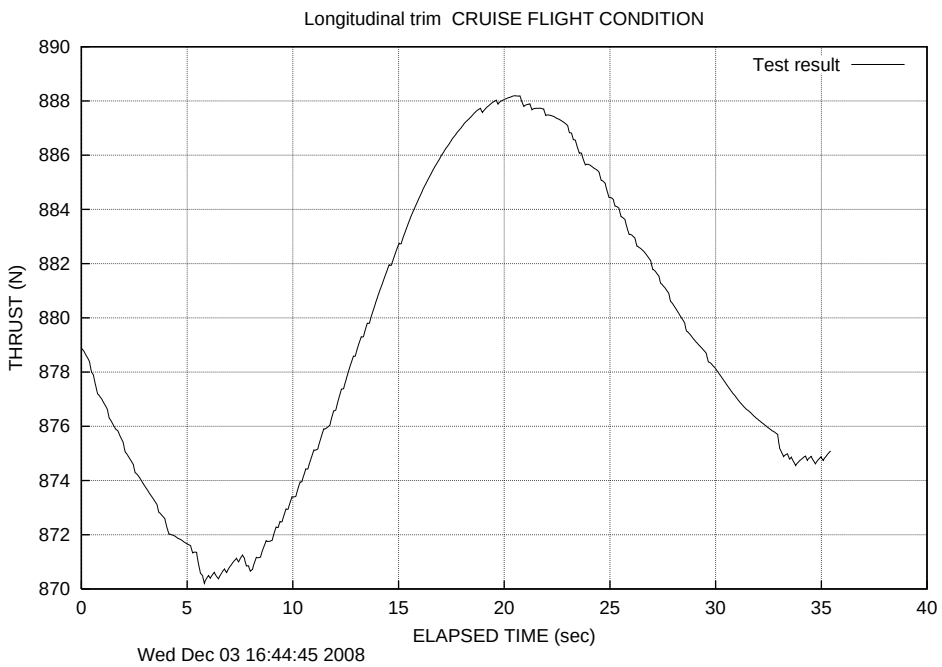

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4935
4930
4925
4920
4915
4910
4905
4900
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:44 2008

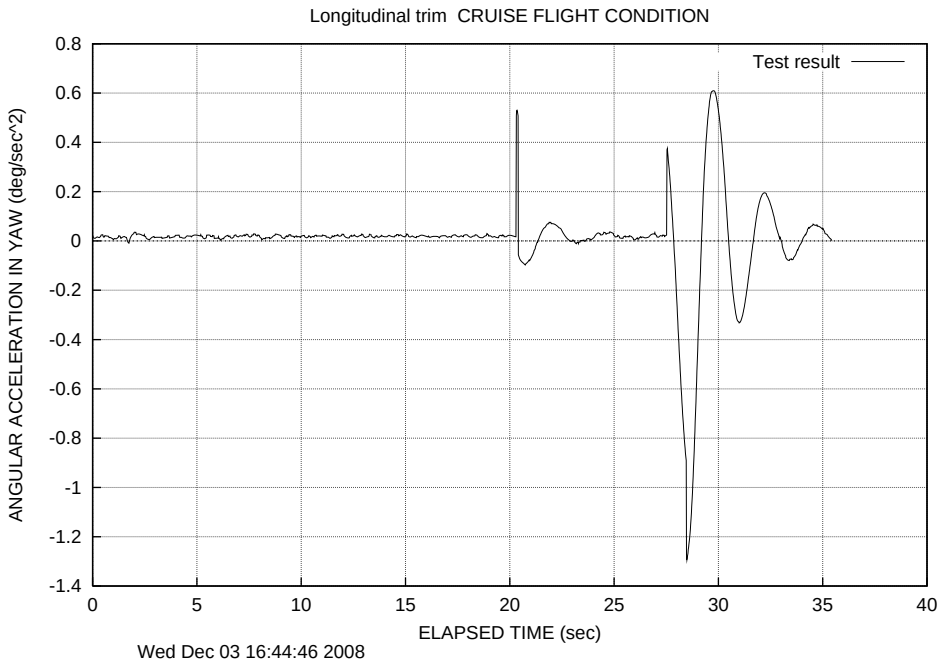

Longitudinal trim CRUISE FLIGHT CONDITION
Test result
RATE OF CLIMB (feet/min)
100
50
0
-50
-100
-150
-200
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:45 2008


Longitudinal trim CRUISE FLIGHT CONDITION
Test result
ANGULAR ACCELERATION IN ROLL (deg/sec^2)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:45 2008


Longitudinal trim CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
-0.92
-0.94
-0.96
-0.98
-1
-1.02
-1.04
-1.06
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:45 2008


Longitudinal trim CRUISE FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.32
69.3
69.28
69.26
69.24
69.22
69.2
69.18
69.16
69.14
69.12
69.1
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:45 2008


Longitudinal trim CRUISE FLIGHT CONDITION
Test result
THRUST (N)
890
888
886
884
882
880
878
876
874
872
870
0
5
10
15
20
25
30
35
40
ELAPSED TIME (sec)
Wed Dec 03 16:44:45 2008



Source data	Section 3.11 of [1]
Comparison of results	The longitudinal trim test shows compliance towards the Validation Reference Data result as described in Section 3.11 of [1].

6.18 Longitudinal static stability (2b8)

Test objective

To demonstrate that the simulator static longitudinal stability characteristics conform to the class of aeroplane.

Demonstration procedure

From the prescribed trim condition apply a longitudinal control command to achieve a deviation from the trimmed airspeed whilst maintaining wings level. Use longitudinal control force to maintain a steady-state condition of at least two speeds above and below the trim speed.

References

[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	38.39	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.346	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-6.667	(%)
ROLL CONTROLLER POSITION	=	9.794	(%)
RUDDER PEDAL POSITION	=	-4.727	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	70.1	(kts)
RATE OF CLIMB	=	11.8	(fpm)
PRESSURE ALTITUDE	=	4458	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.4	(deg)
BANK ANGLE	=	3.5	(deg)
ANGLE OF ATTACK	=	1.3	(deg)
SIDESLIP ANGLE	=	0.0	(deg)
PITCH RATE	=	-1.5	(deg/sec)
ROLL RATE	=	0.4	(deg/sec)
YAW RATE	=	1.0	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2668	(rpm)
EXHAUST GAS TEMPERATURE	=	1073	(deg F)
FUEL FLOW	=	8.20	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	2.0	(deg)
LEFT AILERON ANGLE	=	-0.3	(deg)
RIGHT AILERON ANGLE	=	0.3	(deg)
RUDDER ANGLE	=	-0.7	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `613_FSTD_2c7_Approach.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Approach flight condition:

From the trimmed flight condition, starting after 5 seconds have elapsed, move the pitch controller such that the indicated airspeed reaches 55, 65, 85 and 95 knots respectively. As a target speed is obtained, keep hold of this speed for at least 5 seconds. The rudder pedal position, the flap setting, the throttle setting, the mixture setting and the trimwheel position must remain constant over the course of this test. Only small roll controller inputs may be given for keeping wings level.

Cruise flight condition:

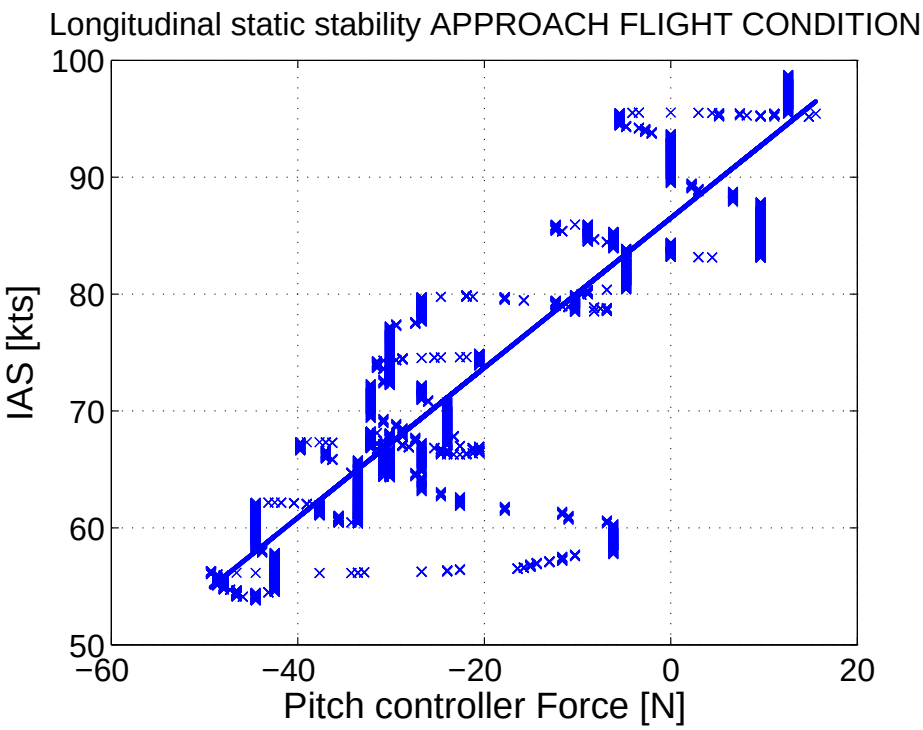
From the trimmed flight condition, starting after 5 seconds have elapsed, move the pitch controller such that the indicated airspeed reaches 80, 70, 100 and 110 knots respectively. As a target speed is obtained, keep hold of this speed for at least 5 seconds. The rudder pedal position, the flap setting, the throttle setting, the mixture setting and the trimwheel position must remain constant over the course of this test. Only small roll controller inputs may be given for keeping wings level.

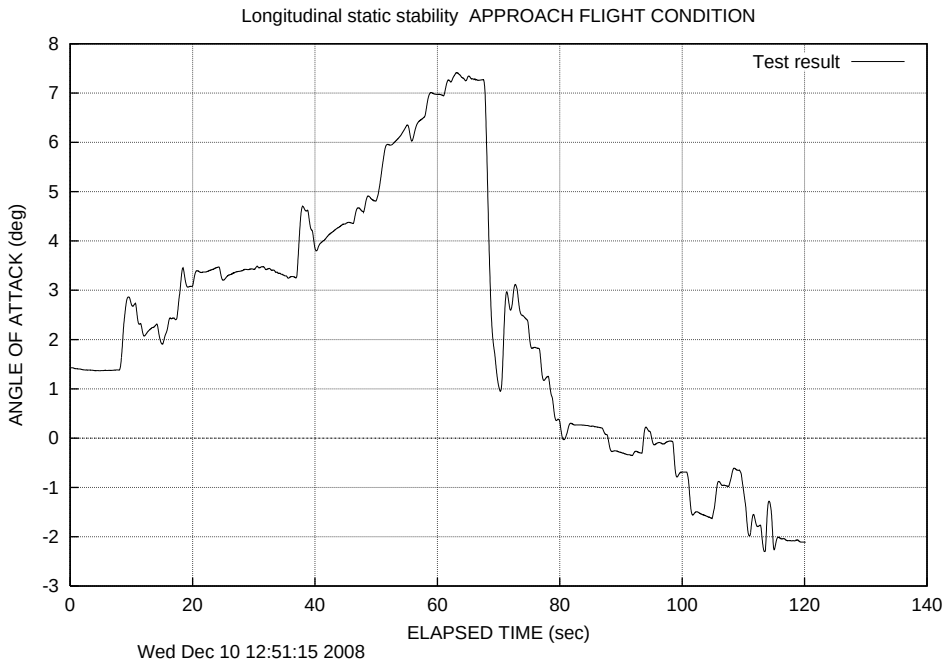
Evaluated parameters

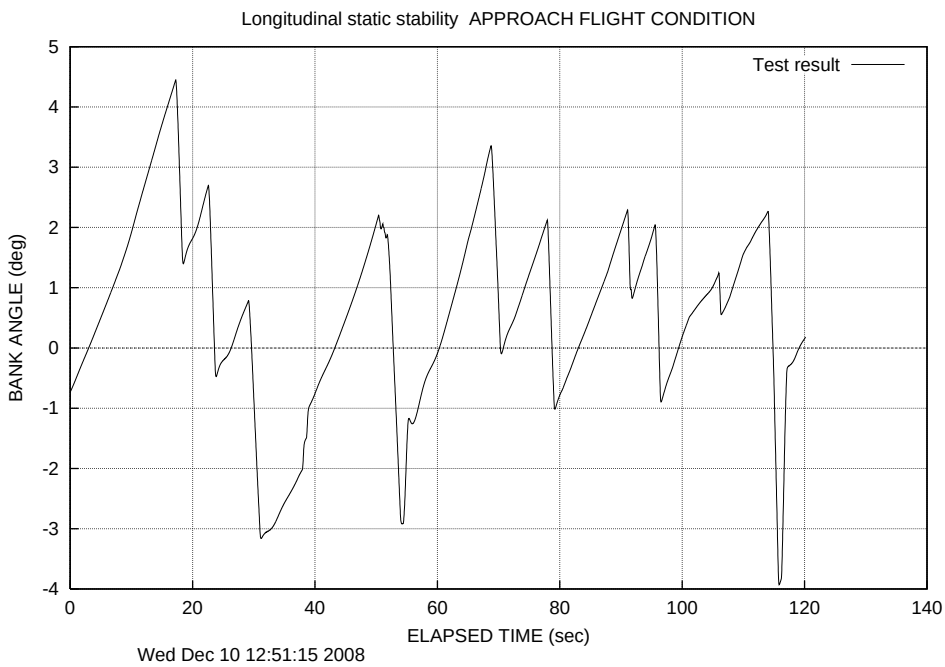
ANGLE OF ATTACK
BANK ANGLE
ELEVATOR ANGLE
ELEVATOR TRIM TAB ANGLE
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED
NORMAL LOADFACTOR
PITCH ANGLE
PITCH CONTROLLER FORCE
PITCH CONTROLLER POSITION
PITCH RATE
PRESSURE ALTITUDE
RUDDER ANGLE

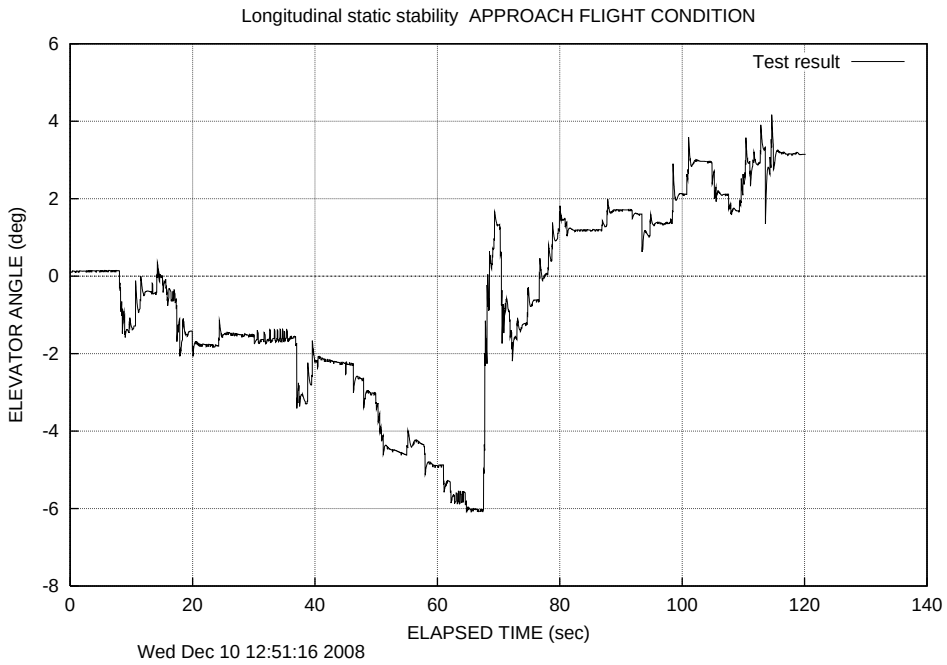
Expected results	The gradient of the pitch controller force versus indicated airspeed is expected to have a positive sign. See section 3.13 of [1].	
Tolerances	ELEVATOR ANGLE	±1° or ±10% OR
	PITCH CONTROLLER FORCE	±22 daN (5 lb) or ±10%

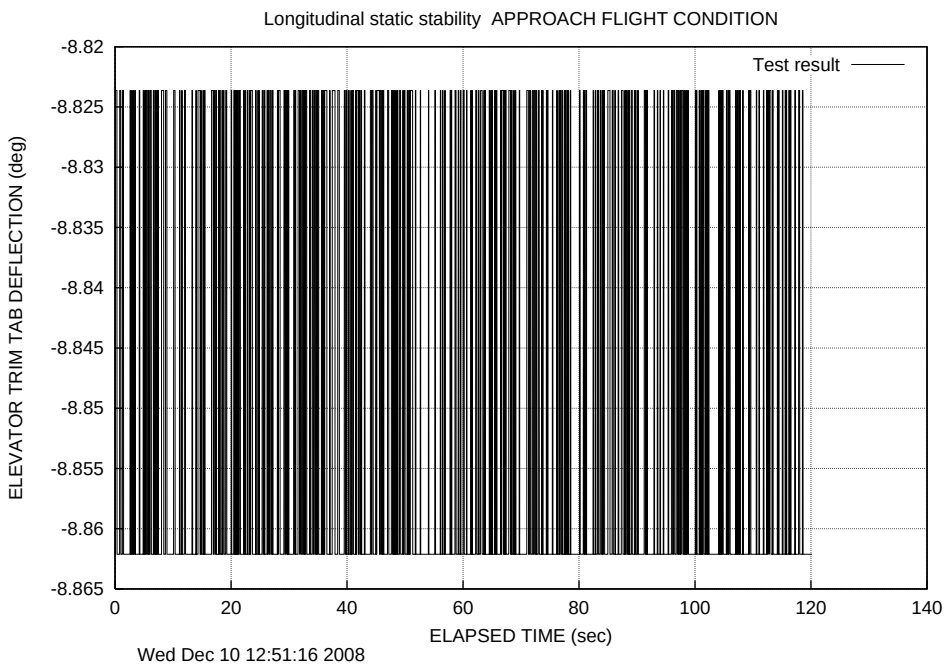
Approach flight condition:

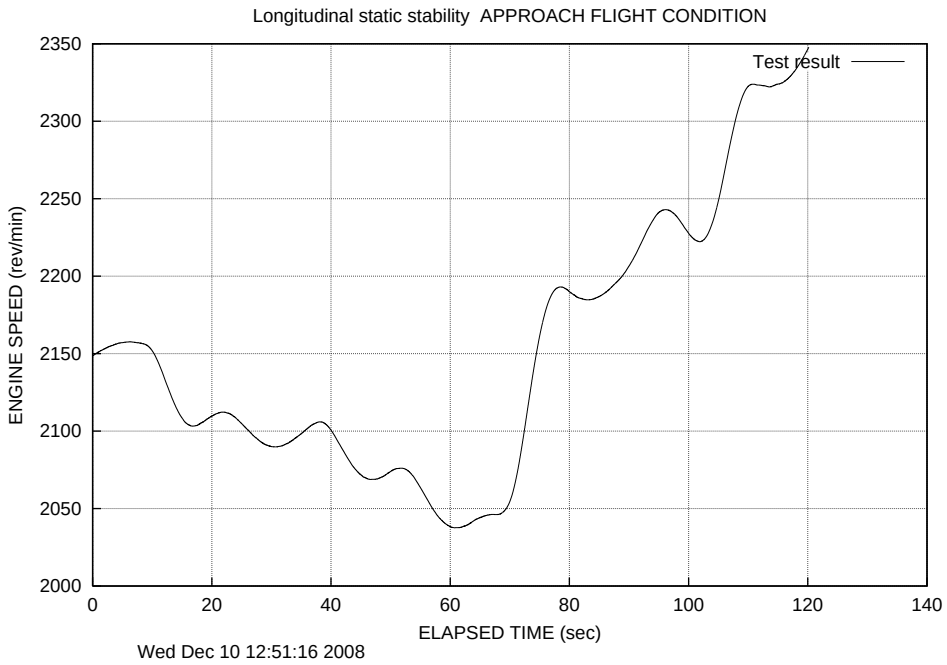


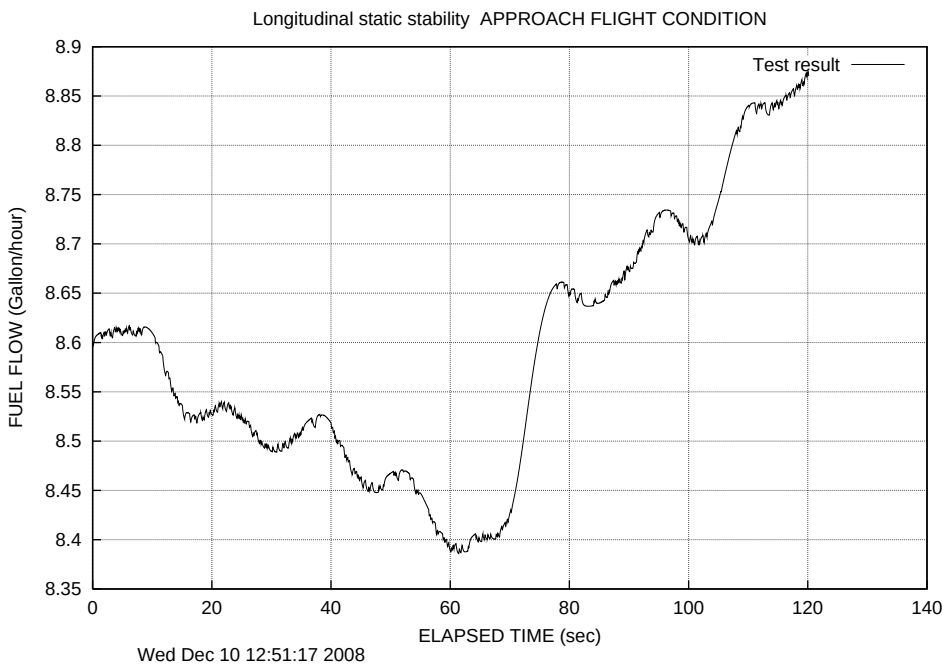

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
ELAPSED TIME (sec)
Wed Dec 10 12:51:15 2008

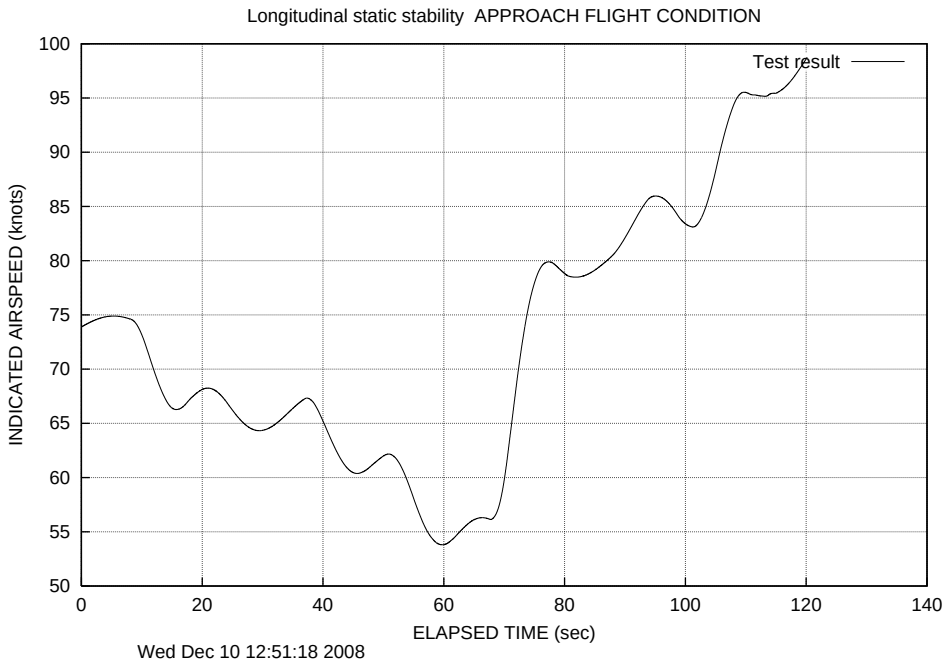

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 10 12:51:15 2008

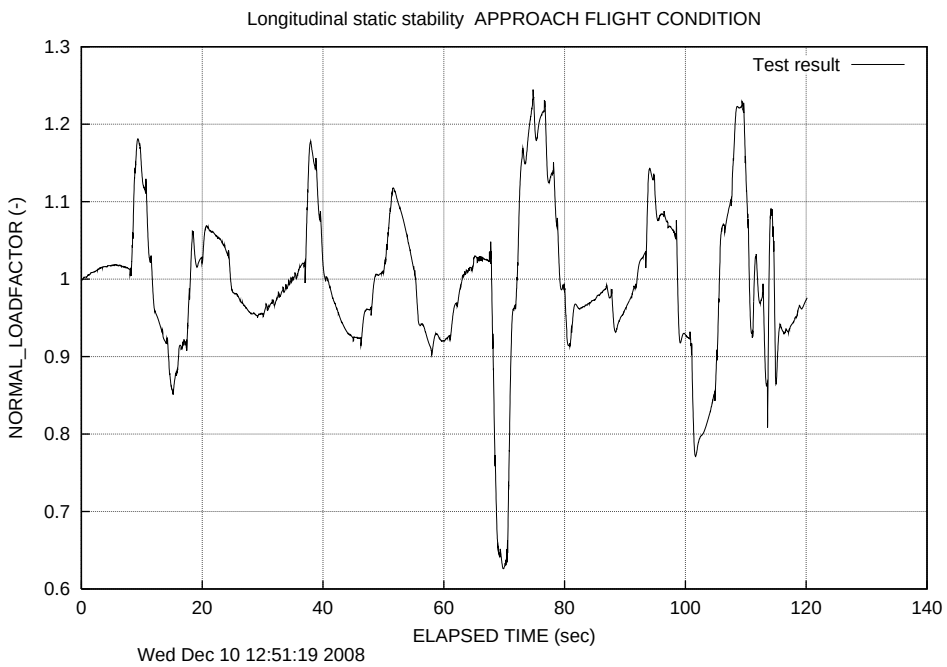

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
6
4
2
0
-2
-4
-6
-8
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:16 2008

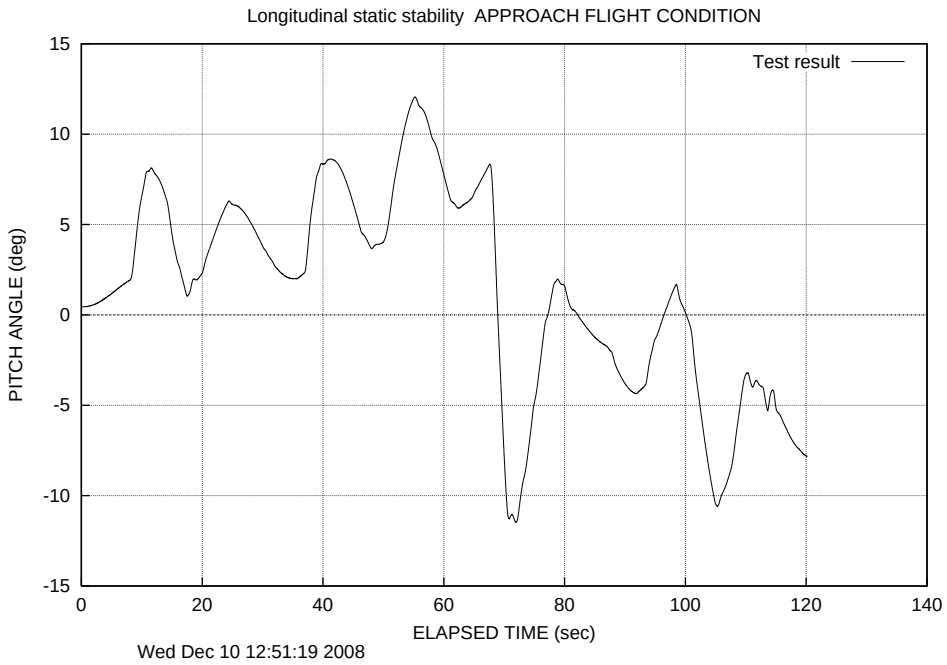

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-8.82
-8.825
-8.83
-8.835
-8.84
-8.845
-8.85
-8.855
-8.86
-8.865
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:16 2008

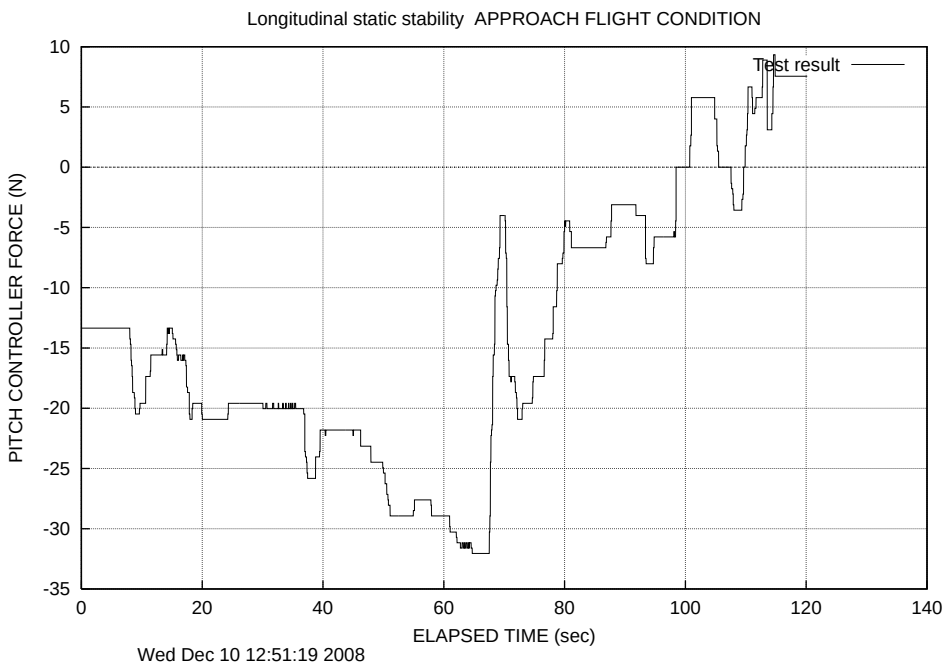

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2350
2300
2250
2200
2150
2100
2050
2000
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:16 2008

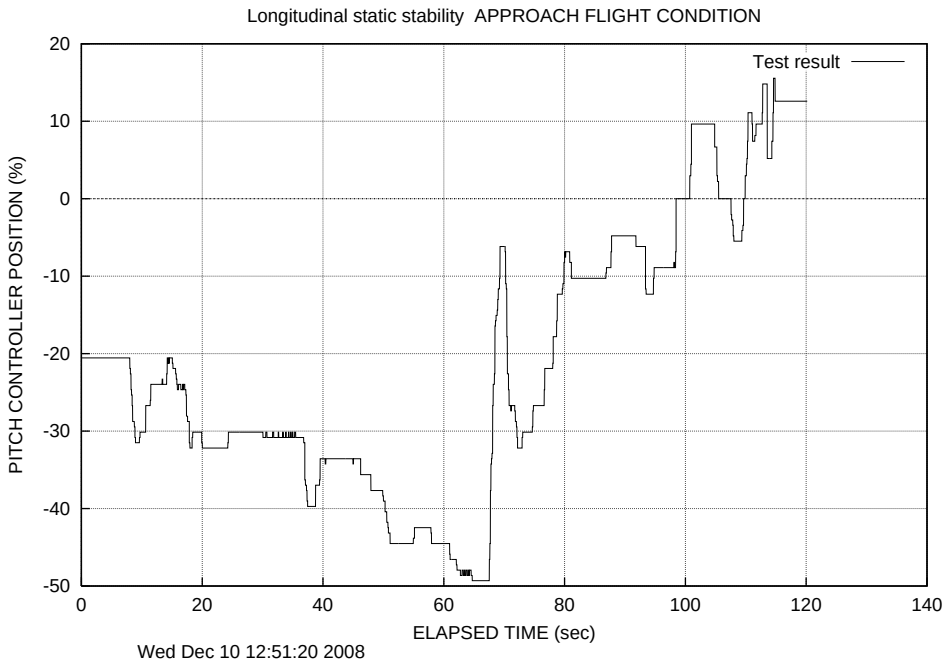

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.9
8.85
8.8
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:17 2008

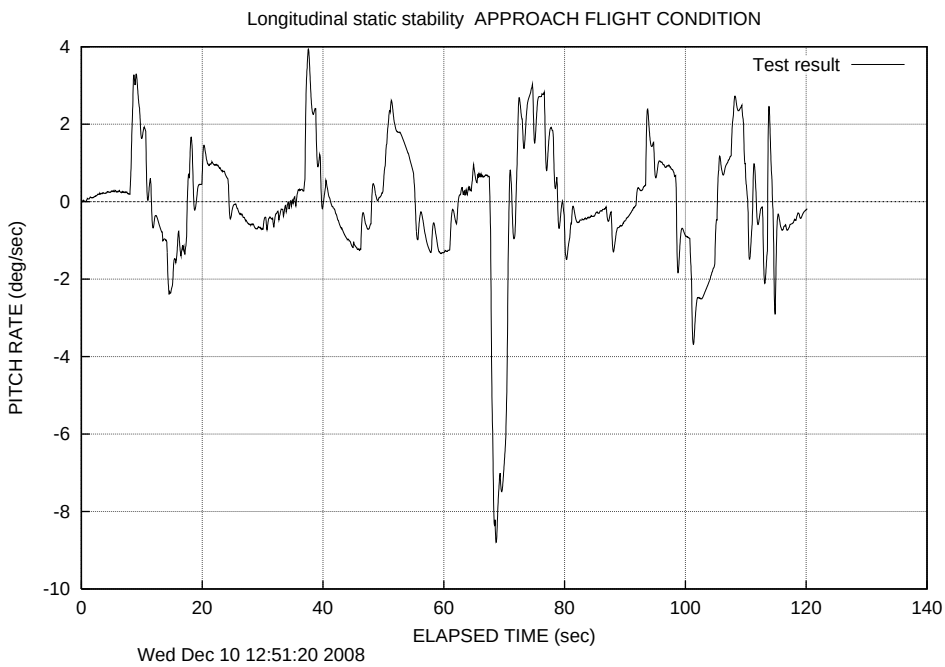

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
100
95
90
85
80
75
70
65
60
55
50
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:18 2008

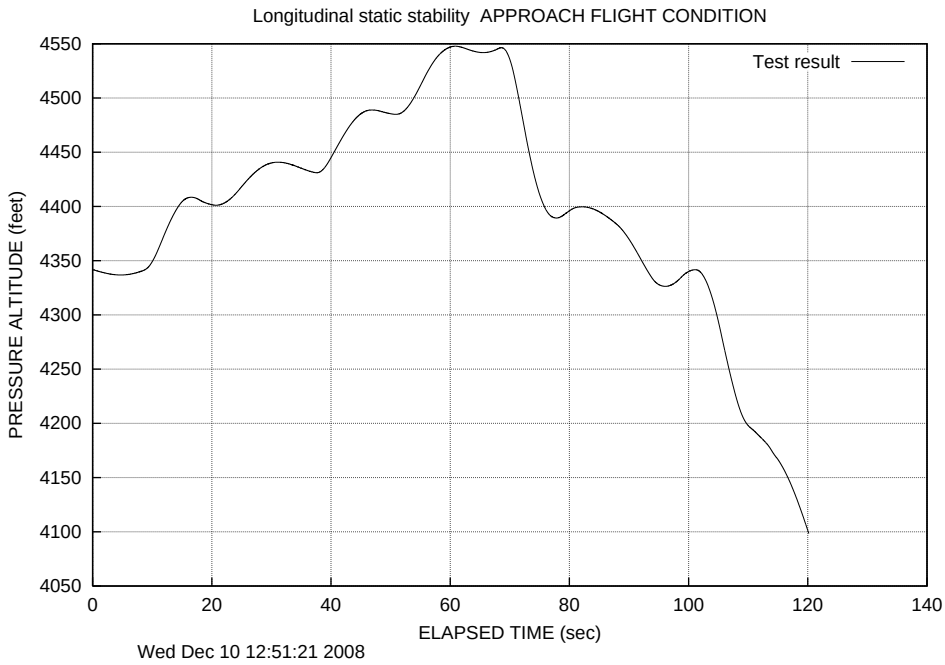

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
NORMAL_LOADFACTOR (-)
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:19 2008

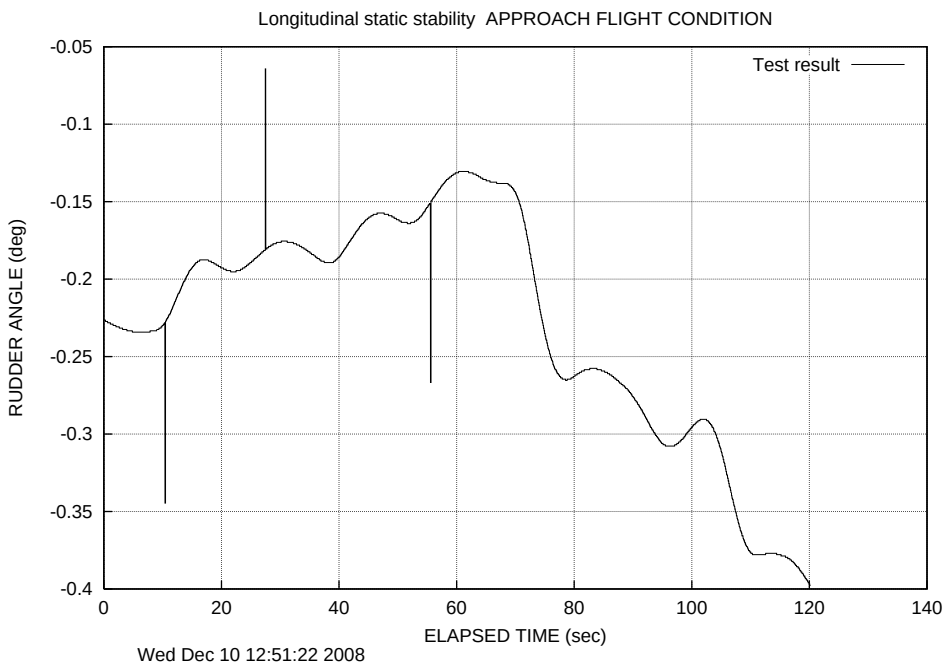

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
15
10
5
0
-5
-10
-15
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:19 2008


Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER FORCE (N)
10
5
0
-5
-10
-15
-20
-25
-30
-35
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:19 2008

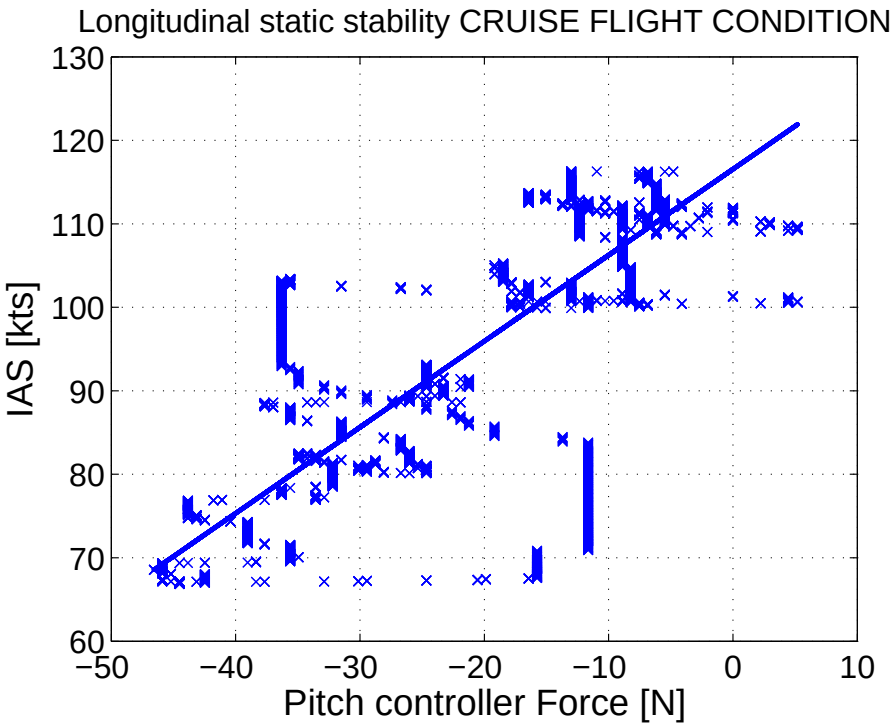

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:20 2008

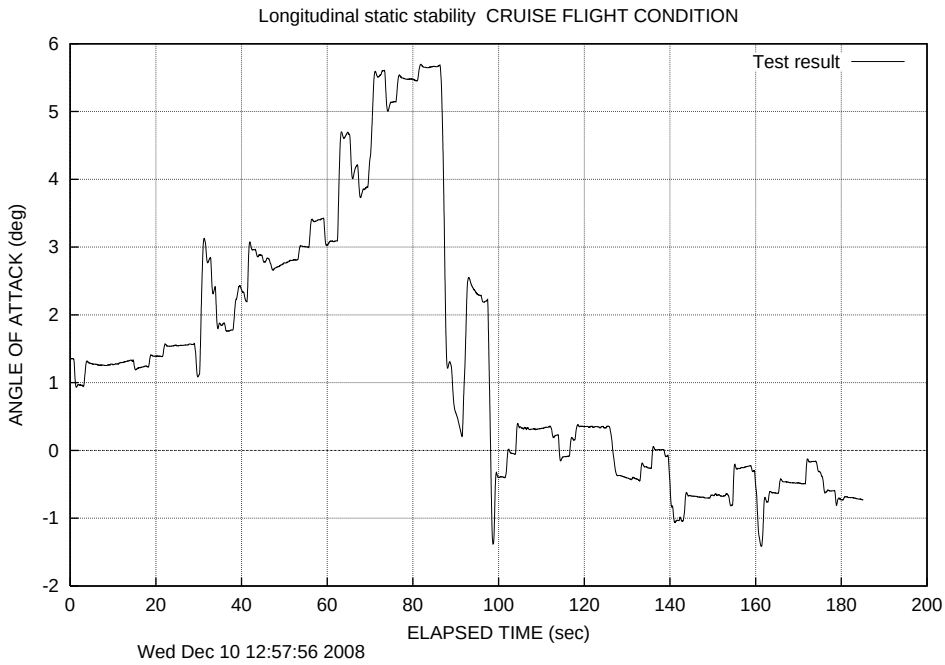

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
4
2
0
-2
-4
-6
-8
-10
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:20 2008

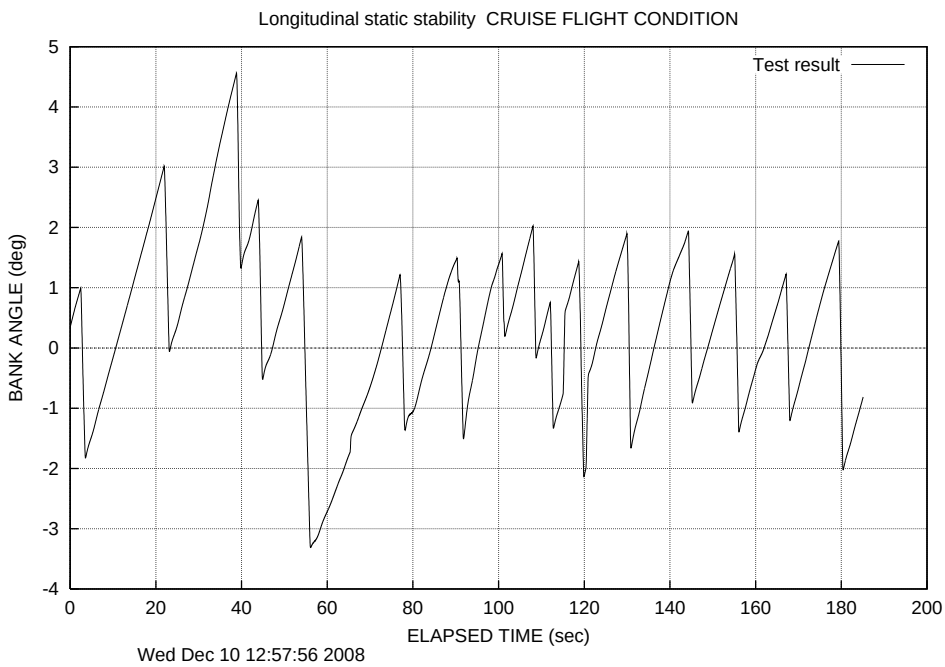

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4550
4500
4450
4400
4350
4300
4250
4200
4150
4100
4050
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:21 2008

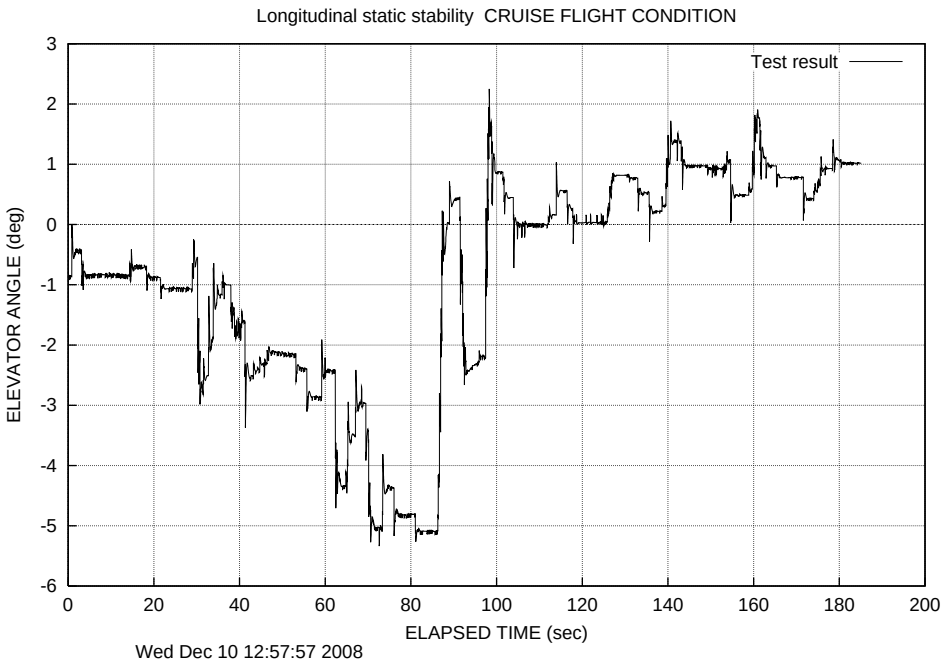

Longitudinal static stability APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Wed Dec 10 12:51:22 2008

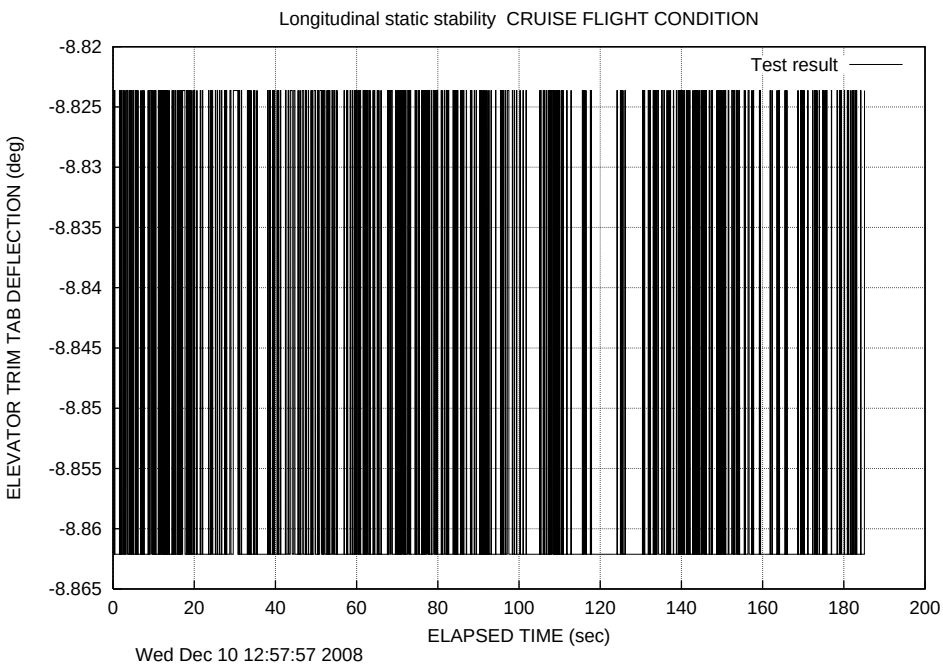
Cruise flight condition:

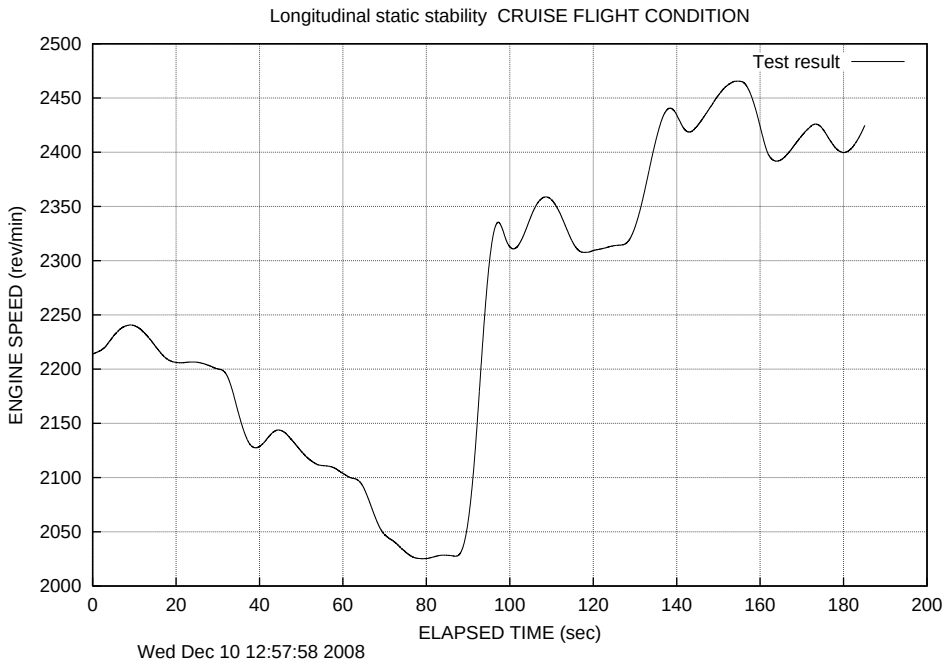


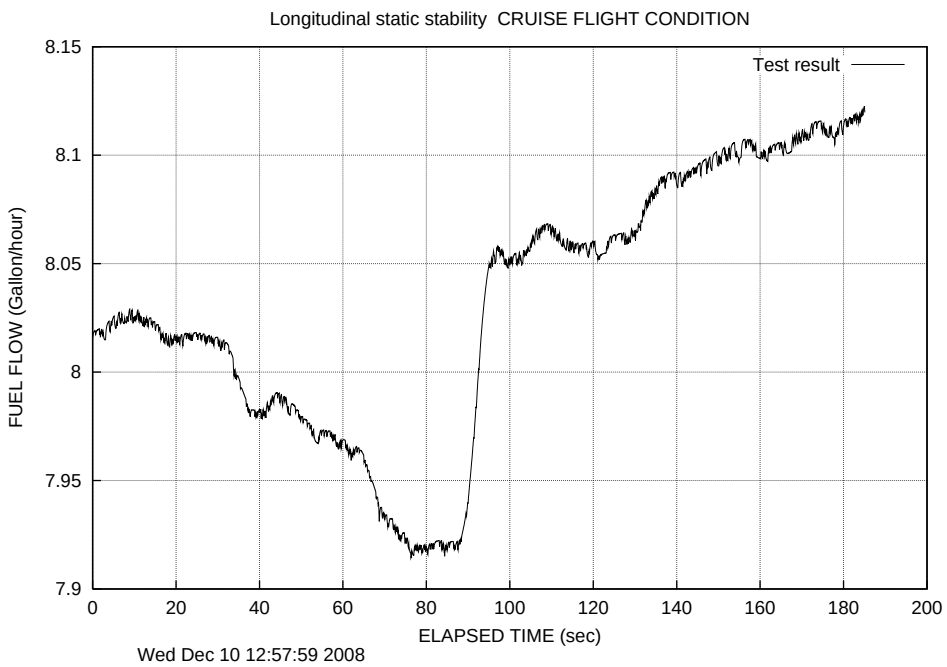

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
ELAPSED TIME (sec)
Wed Dec 10 12:57:56 2008

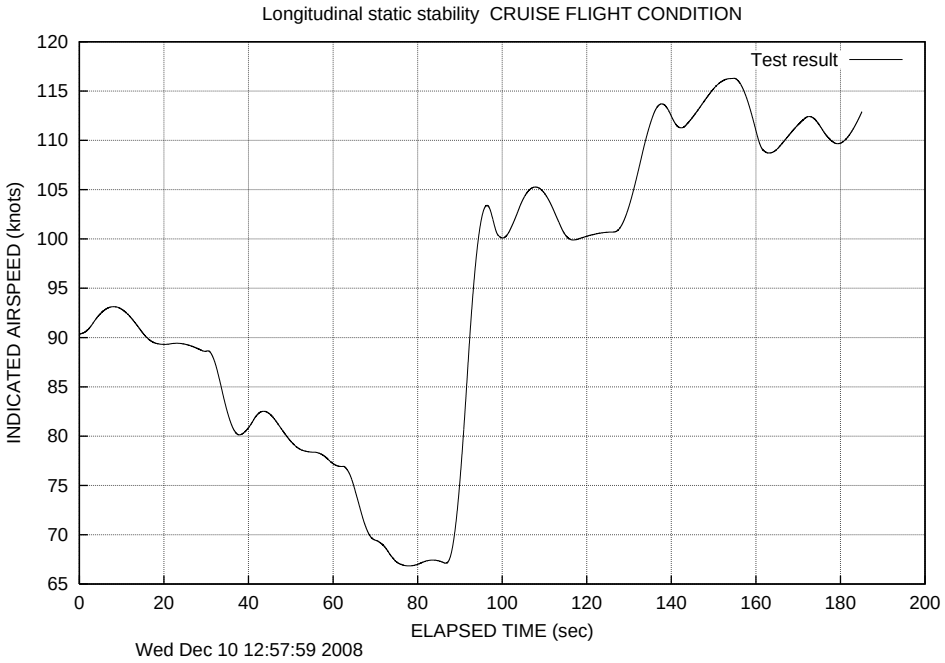

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 10 12:57:56 2008

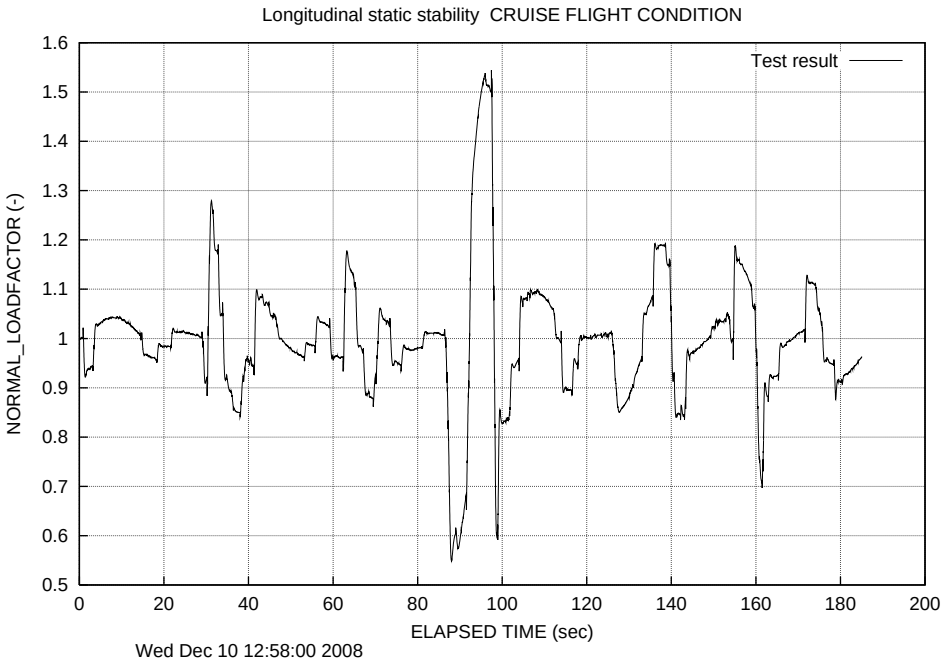

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
3
2
1
0
-1
-2
-3
-4
-5
-6
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:57:57 2008

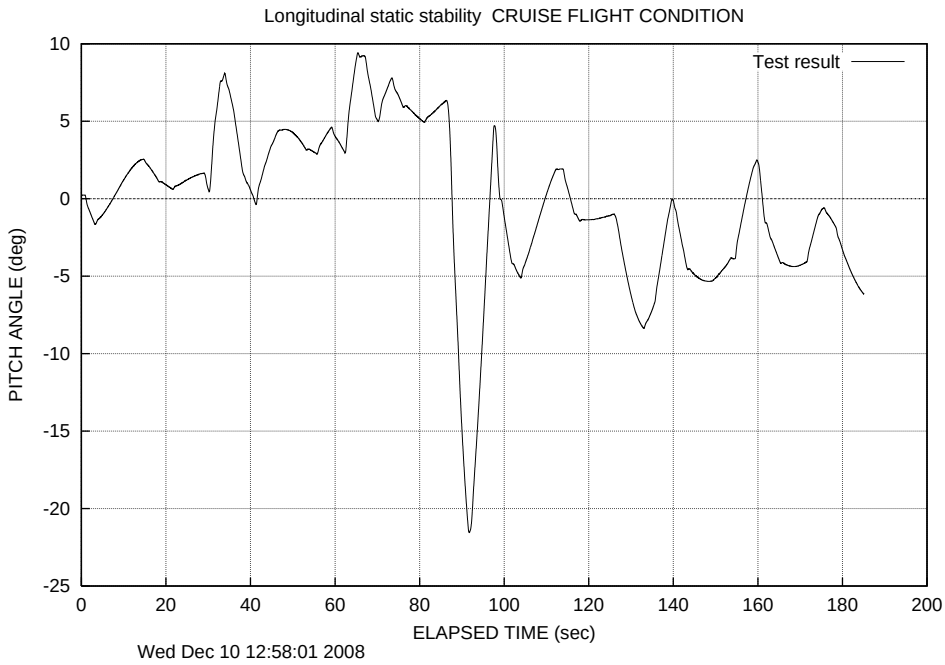

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
ELEVATOR TRIM TAB DEFLECTION (deg)
-8.82
-8.825
-8.83
-8.835
-8.84
-8.845
-8.85
-8.855
-8.86
-8.865
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:57:57 2008

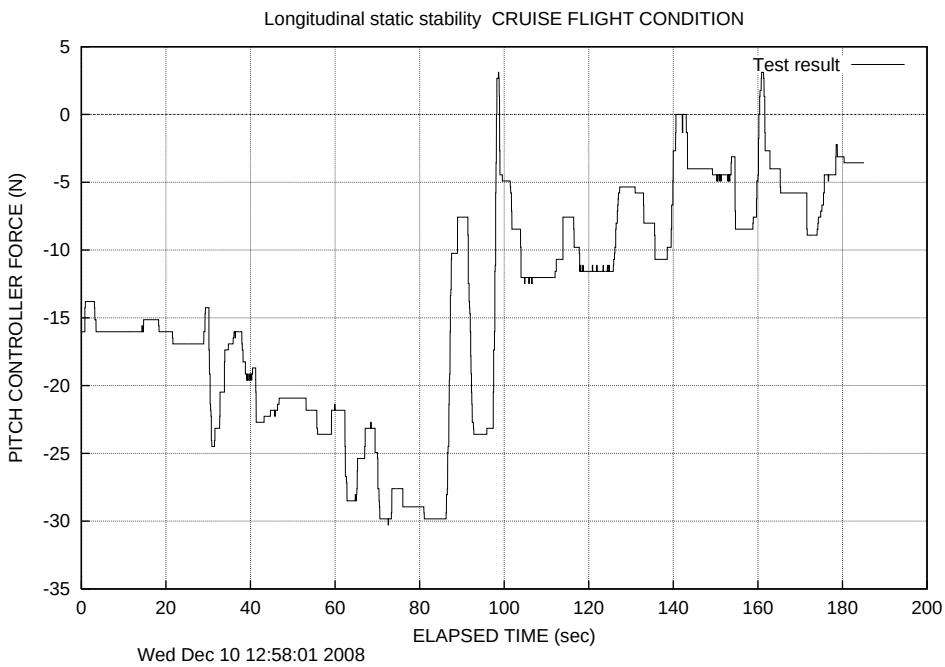

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2500
2450
2400
2350
2300
2250
2200
2150
2100
2050
2000
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:57:58 2008

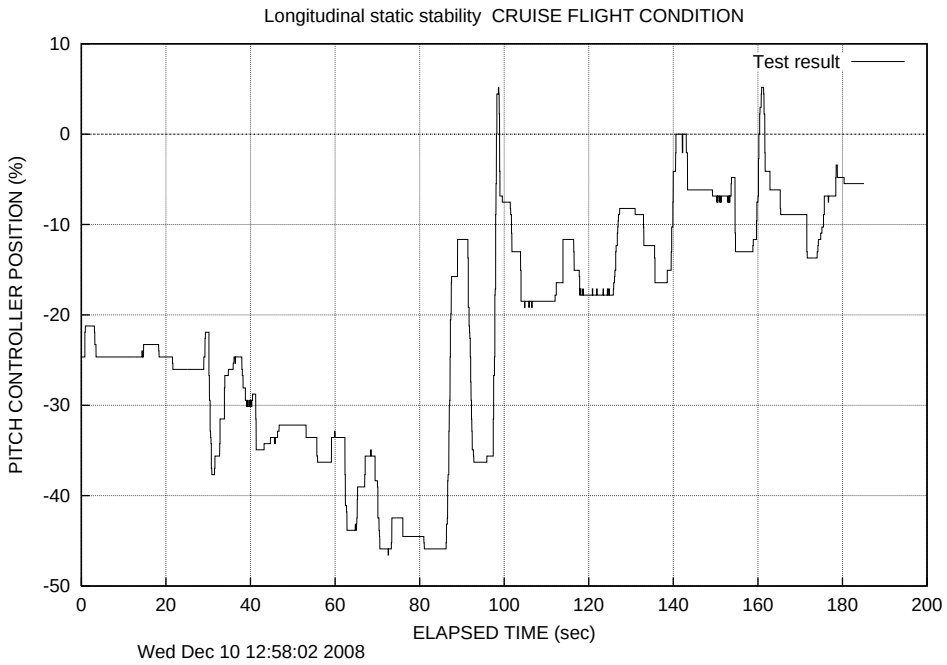

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.15
8.1
8.05
8
7.95
7.9
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:57:59 2008

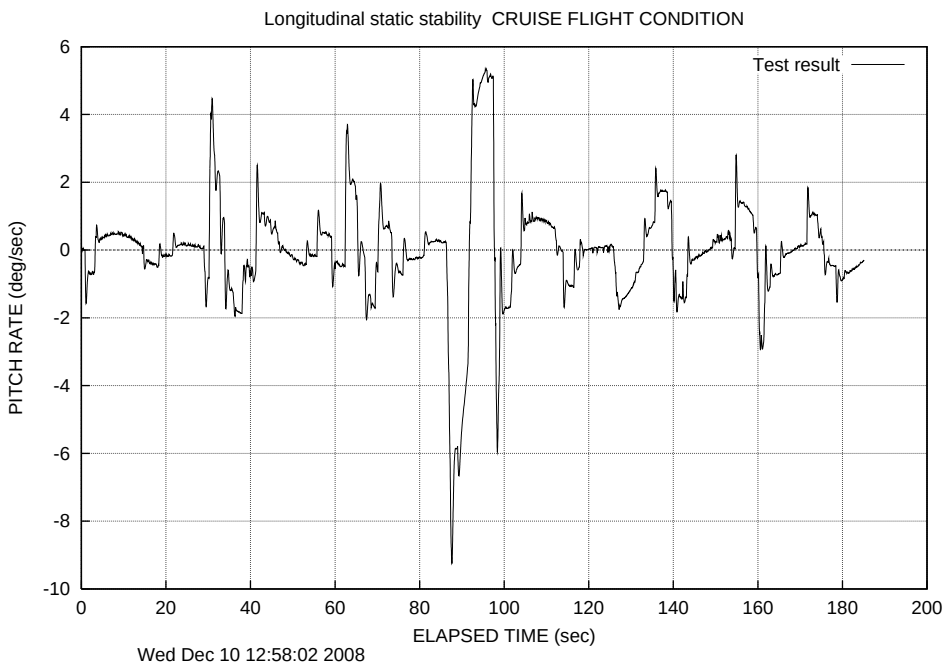

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
120
115
110
105
100
95
90
85
80
75
70
65
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:57:59 2008

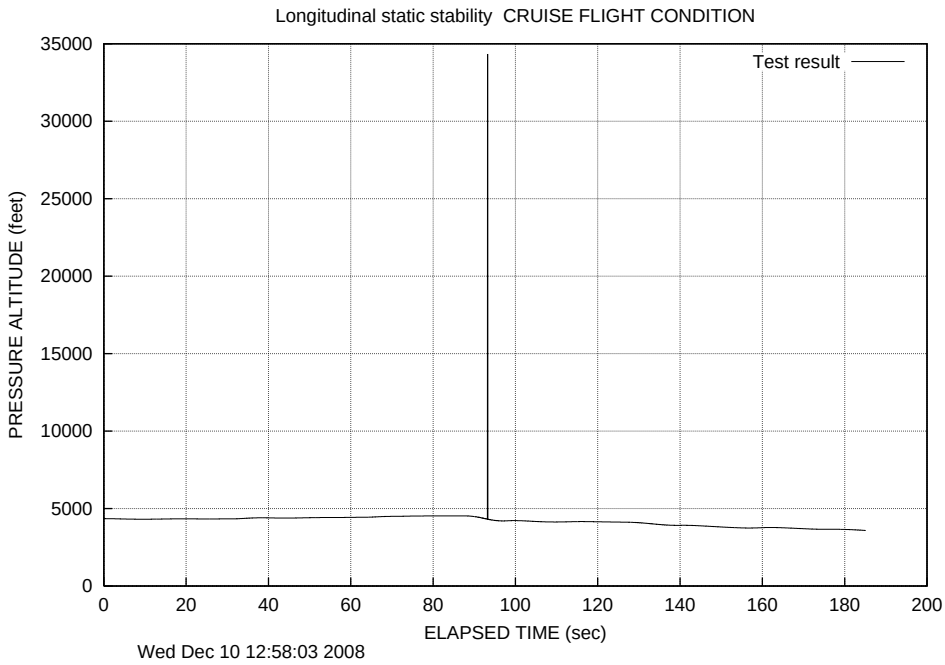

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
NORMAL_LOADFACTOR (-)
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:58:00 2008

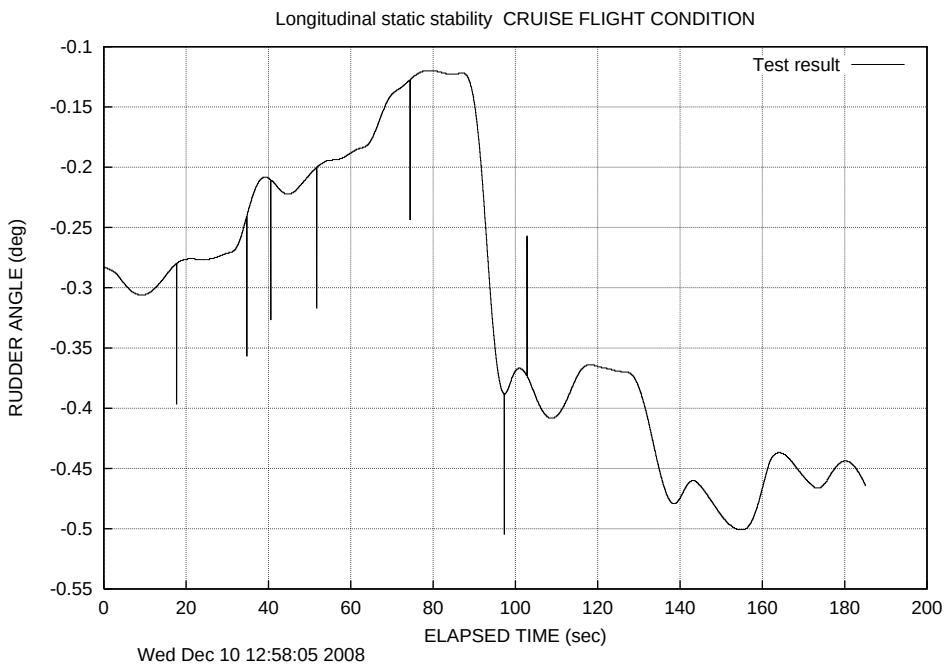

Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
10
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:58:01 2008


Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
PITCH CONTROLLER FORCE (N)
5
0
-5
-10
-15
-20
-25
-30
-35
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:58:01 2008


Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:58:02 2008


Longitudinal static stability CRUISE FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
6
4
2
0
-2
-4
-6
-8
-10
0
20
40
60
80
100
120
140
160
180
200
ELAPSED TIME (sec)
Wed Dec 10 12:58:02 2008





Source data Section 3.13 of [1].

Comparison of results	The longitudinal static stability test shows compliance towards the Validation Reference Data result as described in Section 3.13 of [1].

6.19 Phugoid dynamics (2b9)

Test objective

To demonstrate that the simulator phugoid dynamics conform to the class of aeroplane.

Demonstration procedure

From the prescribed trimmed condition, excite the phugoid mode by applying longitudinal control in one direction in order to change airspeed by approximately 10 kt and the releasing. Record the pertinent longitudinal parameters to enable a mathematical analysis of the oscillations to be carried out for comparison with data that conforms to the class of aeroplane. The test should proceed hands-off for three full cycles or long enough to determine the time to one-half or double amplitude.

References

[2], [3], [4]

Initial conditions

Cruise flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	38.66	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.039	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-8.667	(%)
ROLL CONTROLLER POSITION	=	1.289	(%)
RUDDER PEDAL POSITION	=	0.022	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	39.5	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	13	(deg C)
BARO PRESSURE AT SEALEVEL	=	1029	(mbar)

WIND SPEED	=	4	(kt)
WIND SPEED DIRECTION	=	010	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	90.2	(kts)
RATE OF CLIMB	=	177	(fpm)
PRESSURE ALTITUDE	=	3974	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	3.1	(deg)
BANK ANGLE	=	-8.3	(deg)
ANGLE OF ATTACK	=	1.6	(deg)
SIDESLIP ANGLE	=	0.1	(deg)
PITCH RATE	=	0.4	(deg/sec)
ROLL RATE	=	-1.8	(deg/sec)
YAW RATE	=	-1.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2346	(rpm)
EXHAUST GAS TEMPERATURE	=	1107	(deg F)
FUEL FLOW	=	9.06	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.0	(deg)
LEFT AILERON ANGLE	=	-0.7	(deg)
RIGHT AILERON ANGLE	=	0.7	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON

AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `615_FSTD_2c9_Cruise.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the pitch controller position in the neutral position:
1. From the neutral position, pull the Yoke to a setting away such that the aeroplane pitches up around 10 degrees.
2. Release the Yoke such that the pitch controller position comes back in its neutral position.
3. Let the aircraft respond freely. Only the roll controller may be used to keep the wings level during the course of this test.
4. Stop recording after the aeroplane has carried out three full cycles or after the time to half amplitude has been reached, whichever is less.

Evaluated parameters

ANGLE OF ATTACK
BANK ANGLE
ELEVATOR ANGLE
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED
NORMAL LOADFACTOR
PITCH ANGLE
PITCH CONTROLLER POSITION
PITCH RATE
PRESSURE ALTITUDE
RUDDER ANGLE

Expected results

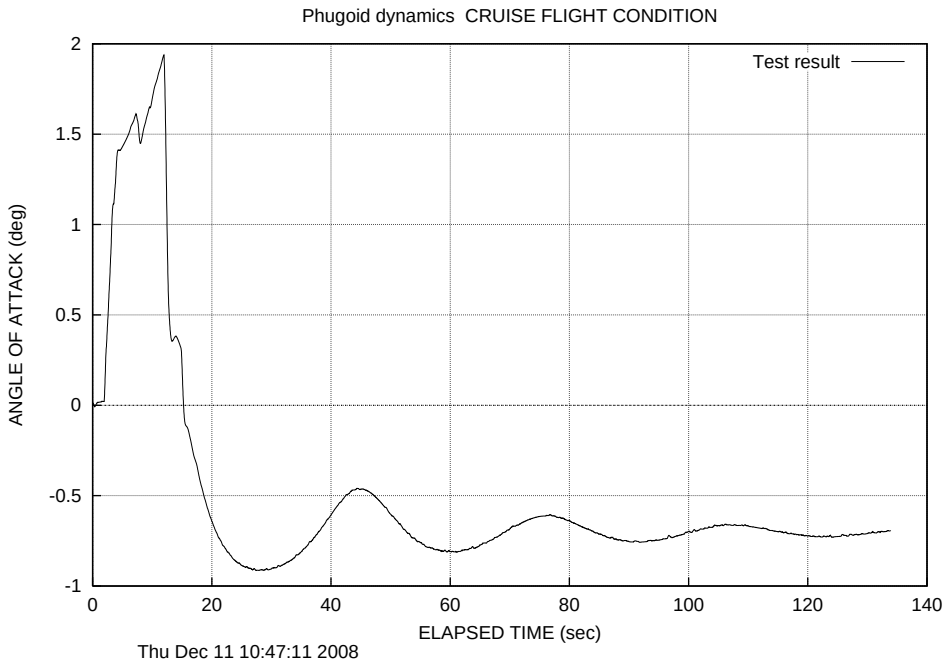
The period of eigenmotion is expected to be around 29 seconds. See section 3.15 of [1].

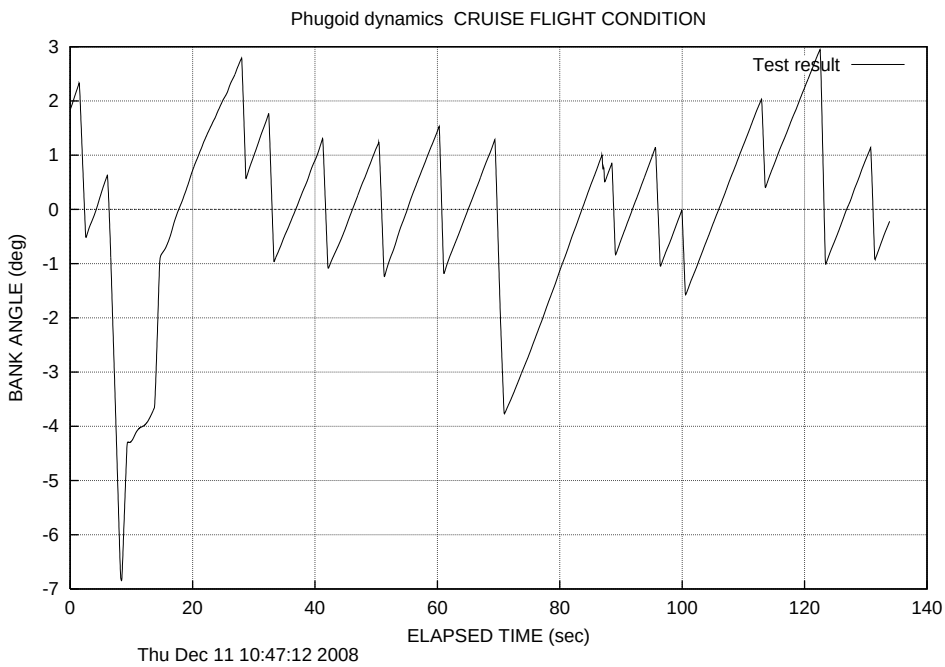
Tolerances

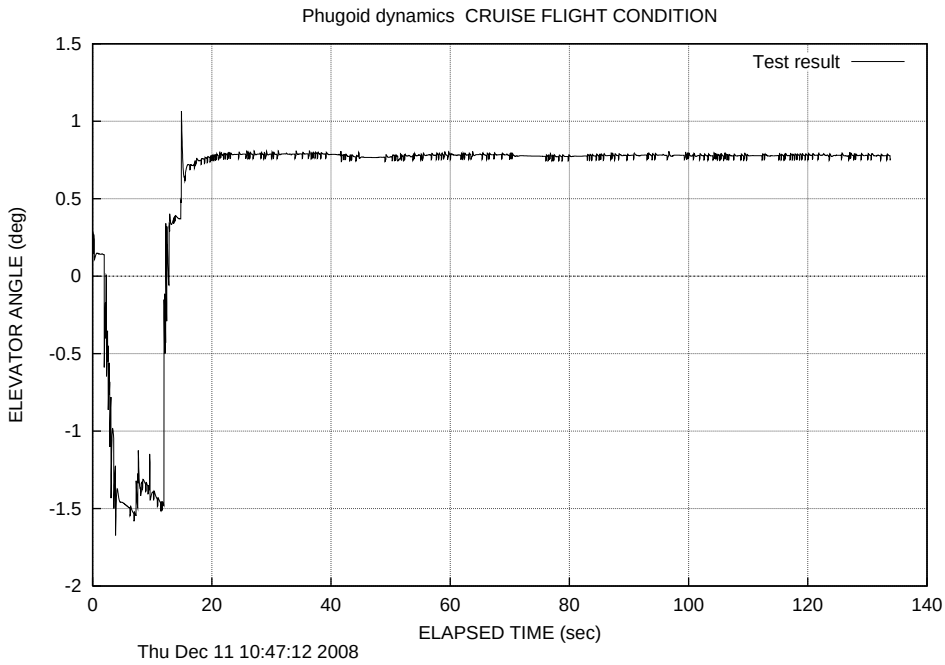
10% period with representative damping

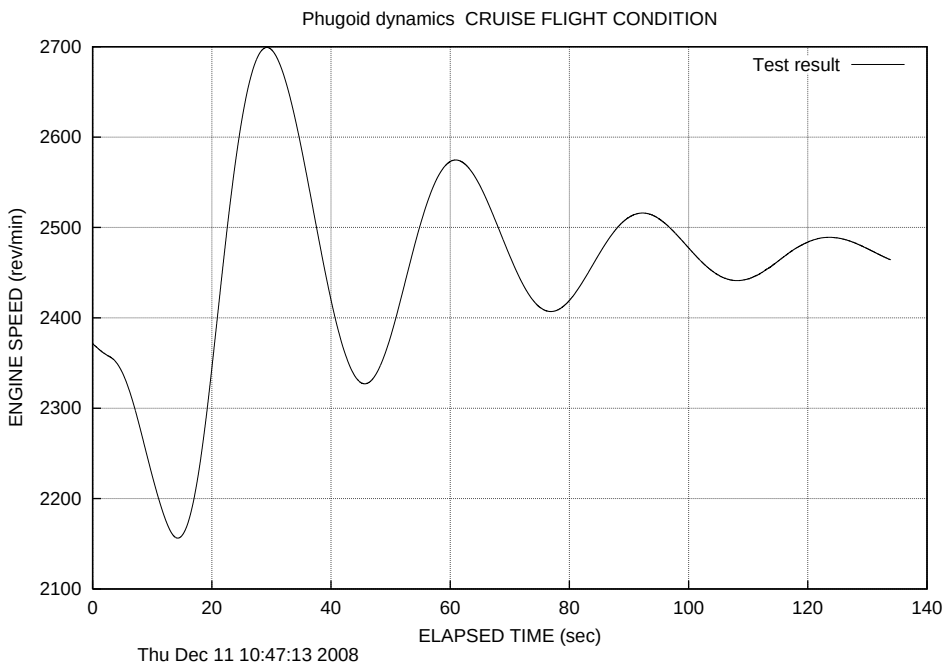
Test result

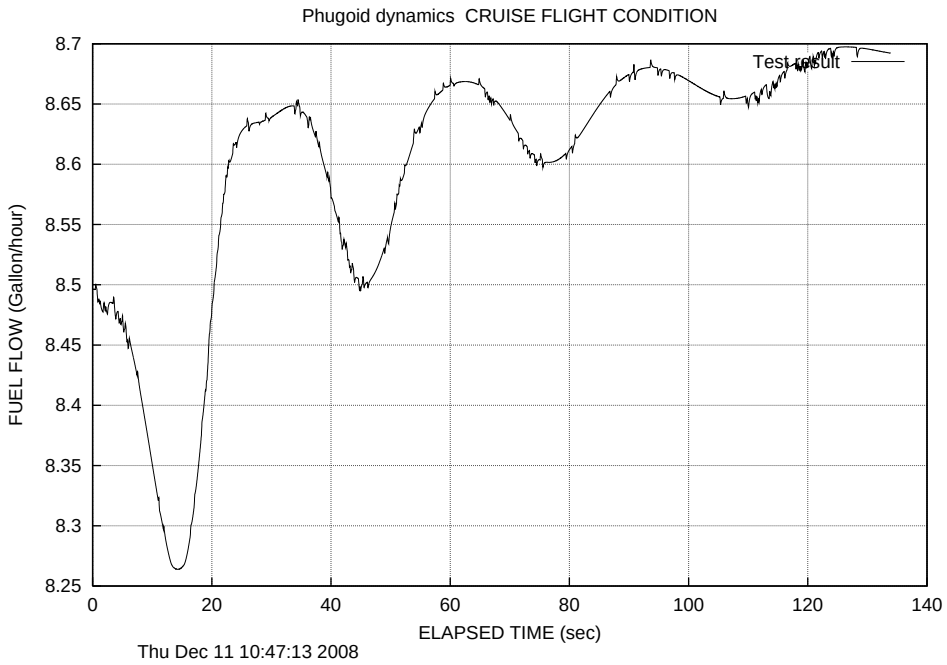
PERIOD OF EIGENMOTION = {(44.6-16.5)+(73.4-44.6)+(101.9-73.4)}/3 = 28.5 seconds.

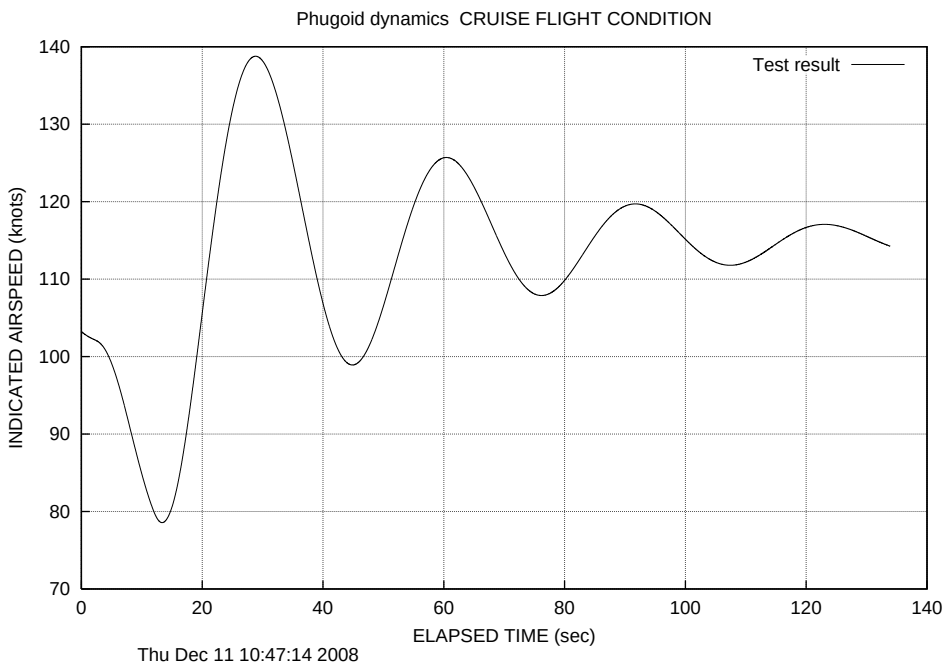

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
ANGLE OF ATTACK (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:47:11 2008
2
1.5
1
0.5
0
-0.5
-1
0
20
40
60
80
100
120
140

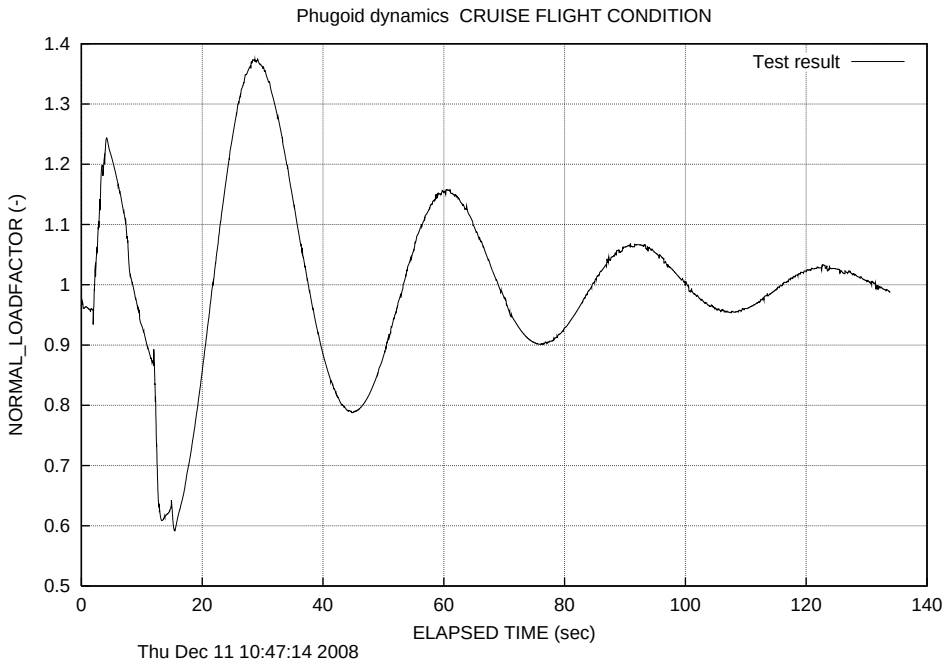

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:47:12 2008
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
0
20
40
60
80
100
120
140

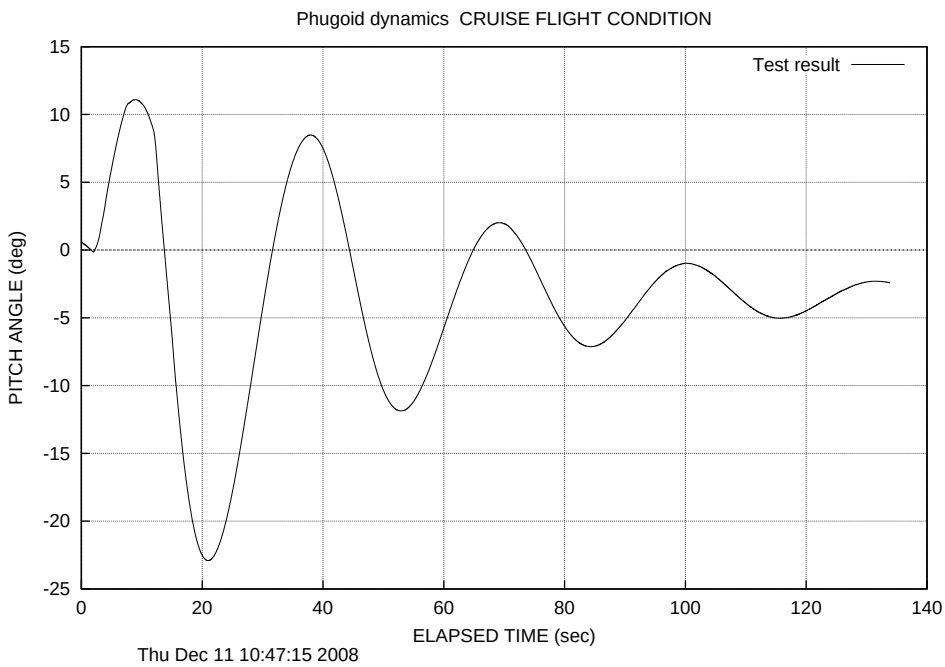

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:12 2008

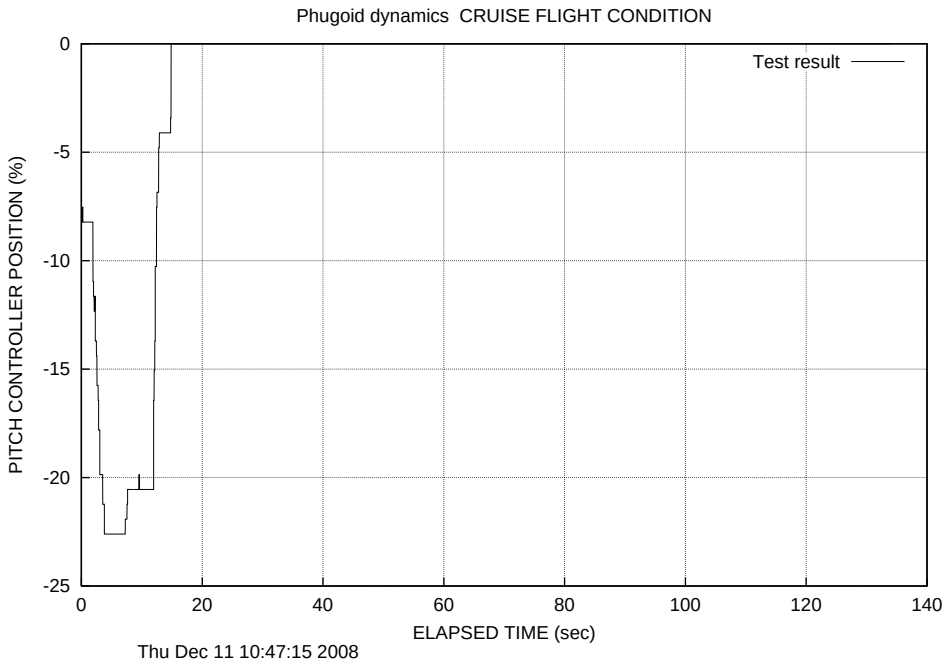

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2700
2600
2500
2400
2300
2200
2100
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:13 2008

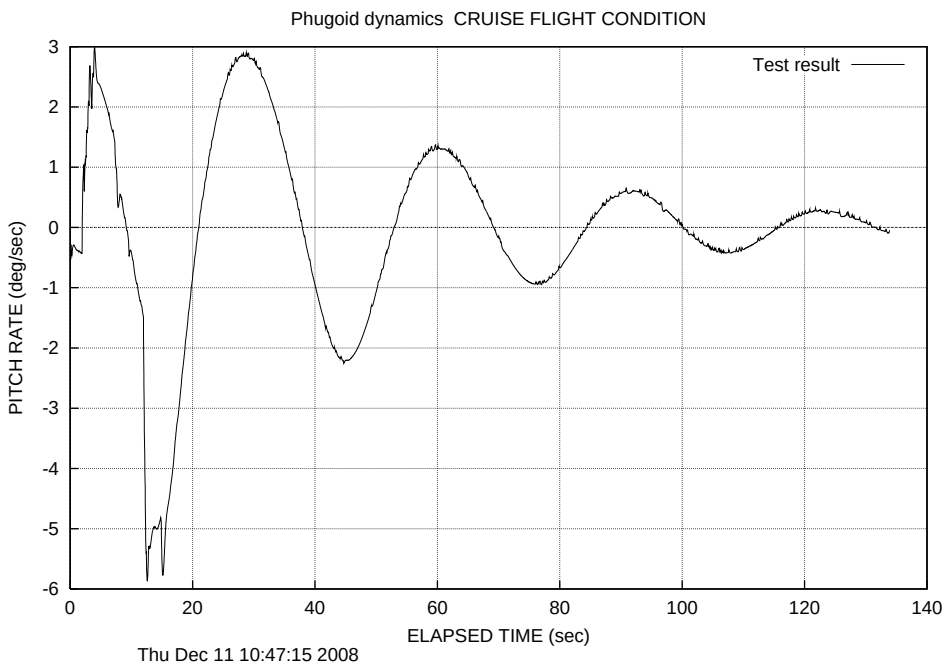

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
8.25
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:13 2008

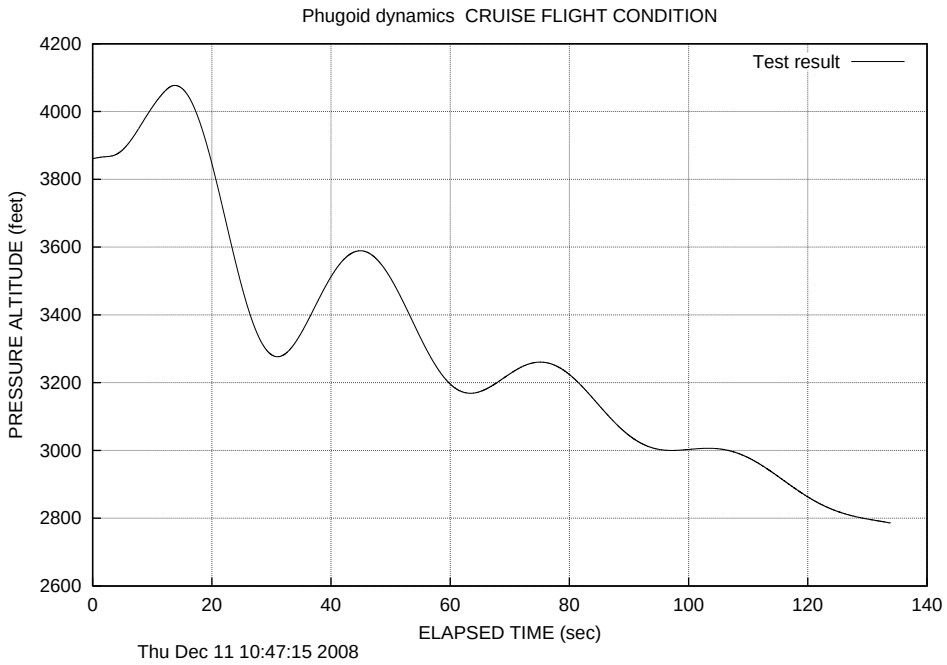

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
140
130
120
110
100
90
80
70
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:14 2008

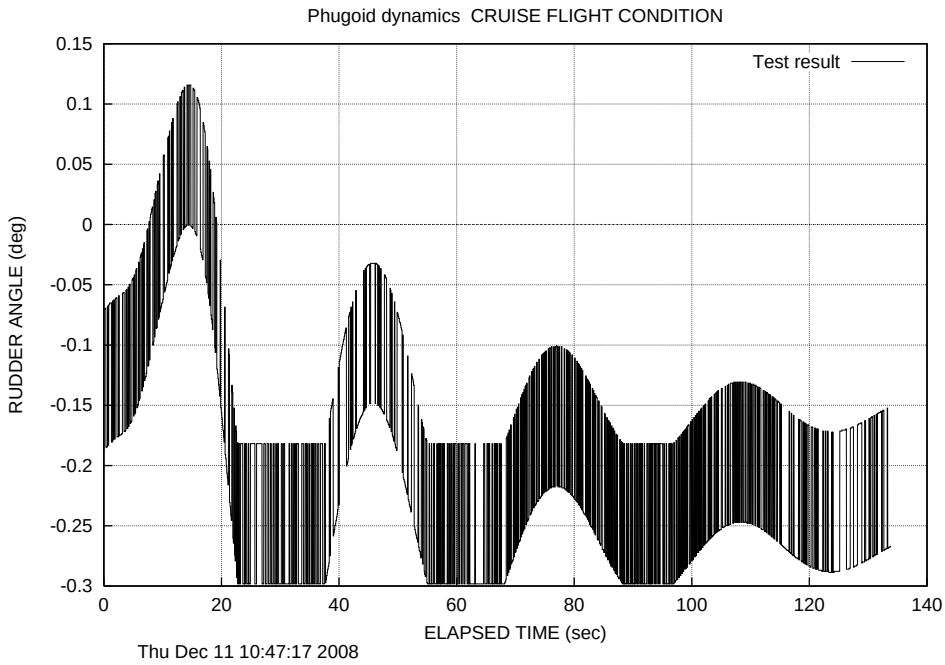

Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
NORMAL_LOADFACTOR (-)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:14 2008


Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
15
10
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:15 2008


Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
PITCH CONTROLLER POSITION (%)
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:15 2008


Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
PITCH RATE (deg/sec)
3
2
1
0
-1
-2
-3
-4
-5
-6
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:15 2008


Phugoid dynamics CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4200
4000
3800
3600
3400
3200
3000
2800
2600
0
20
40
60
80
100
120
140
ELAPSED TIME (sec)
Thu Dec 11 10:47:15 2008



Source data	Section 3.15 of [1].
Comparison of results	The phugoid dynamics test shows compliance towards the Validation Reference Data result as described in Section 3.15 of [1].

6.20 Roll response (rate) (2c2)

Test objective	To demonstrate that the simulator roll rate response to roll control input conforms to the class of aeroplane.
Demonstration procedure	From a wings-level trim condition, execute a roll manoeuvre using lateral control. The lateral control input should consist of a rapid displacement to approximately one-third of maximum roll controller travel, holding this value at least until steady roll rate is established.
References	[2], [3], [4]

Initial conditions

Approach flight condition (Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.01	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-7.333	(%)
ROLL CONTROLLER POSITION	=	3.866	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	70.1	(kts)
RATE OF CLIMB	=	11.8	(fpm)
PRESSURE ALTITUDE	=	4458	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.0	(deg)
BANK ANGLE	=	3.5	(deg)
ANGLE OF ATTACK	=	1.3	(deg)
SIDESLIP ANGLE	=	-0.4	(deg)
PITCH RATE	=	0.0	(deg/sec)
ROLL RATE	=	0.0	(deg/sec)
YAW RATE	=	0.0	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2324	(rpm)
EXHAUST GAS TEMPERATURE	=	1073	(deg F)
FUEL FLOW	=	8.20	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-0.6	(deg)
LEFT AILERON ANGLE	=	0.6	(deg)
RIGHT AILERON ANGLE	=	-0.6	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON

FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Approach flight condition (Right):

CONTROL INPUTS:

THROTTLE SETTING	=	38.180	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-7.333	(%)
ROLL CONTROLLER POSITION	=	8.763	(%)
RUDDER PEDAL POSITION	=	9.091	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.6	(kts)
RATE OF CLIMB	=	-129	(fpm)
PRESSURE ALTITUDE	=	3955	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	0.1	(deg)

BANK ANGLE	=	0.2	(deg)
ANGLE OF ATTACK	=	1.6	(deg)
SIDESLIP ANGLE	=	-0.2	(deg)
PITCH RATE	=	-0.7	(deg/sec)
ROLL RATE	=	-2.1	(deg/sec)
YAW RATE	=	0.7	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2845	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.68	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.0	(deg)
LEFT AILERON ANGLE	=	1.4	(deg)
RIGHT AILERON ANGLE	=	-1.4	(deg)
RUDDER ANGLE	=	-1.3	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Cruise flight condition (Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.01	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.080	(-)
FLAP LEVER POSITION	=	0	(deg)

FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-15.33	(%)
ROLL CONTROLLER POSITION	=	5.923	(%)
RUDDER PEDAL POSITION	=	-0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	92.6	(kts)
RATE OF CLIMB	=	247	(fpm)
PRESSURE ALTITUDE	=	4457	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	4.0	(deg)
BANK ANGLE	=	0.9	(deg)
ANGLE OF ATTACK	=	2.1	(deg)
SIDESLIP ANGLE	=	-0.2	(deg)
PITCH RATE	=	4.3	(deg/sec)
ROLL RATE	=	0.9	(deg/sec)
YAW RATE	=	0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2981	(rpm)

EXHAUST GAS TEMPERATURE	=	1095	(deg F)
FUEL FLOW	=	8.87	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-2.7	(deg)
LEFT AILERON ANGLE	=	0.9	(deg)
RIGHT AILERON ANGLE	=	-0.9	(deg)
RUDDER ANGLE	=	0.1	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions **Cruise flight condition (Right):**

CONTROL INPUTS:

THROTTLE SETTING	=	37.96	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.080	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-12.00	(%)
ROLL CONTROLLER POSITION	=	0.0	(%)
RUDDER PEDAL POSITION	=	-1.818	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)

TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	92.6	(kts)
RATE OF CLIMB	=	247	(fpm)
PRESSURE ALTITUDE	=	4457	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	4.0	(deg)
BANK ANGLE	=	0.9	(deg)
ANGLE OF ATTACK	=	2.1	(deg)
SIDESLIP ANGLE	=	-0.2	(deg)
PITCH RATE	=	4.3	(deg/sec)
ROLL RATE	=	0.9	(deg/sec)
YAW RATE	=	0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2490	(rpm)
EXHAUST GAS TEMPERATURE	=	1095	(deg F)
FUEL FLOW	=	8.87	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.5	(deg)
LEFT AILERON ANGLE	=	-0.8	(deg)
RIGHT AILERON ANGLE	=	0.8	(deg)
RUDDER ANGLE	=	0.1	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `616_FSTD_2d2_Approach.sit` or `616_FSTD_2d2_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

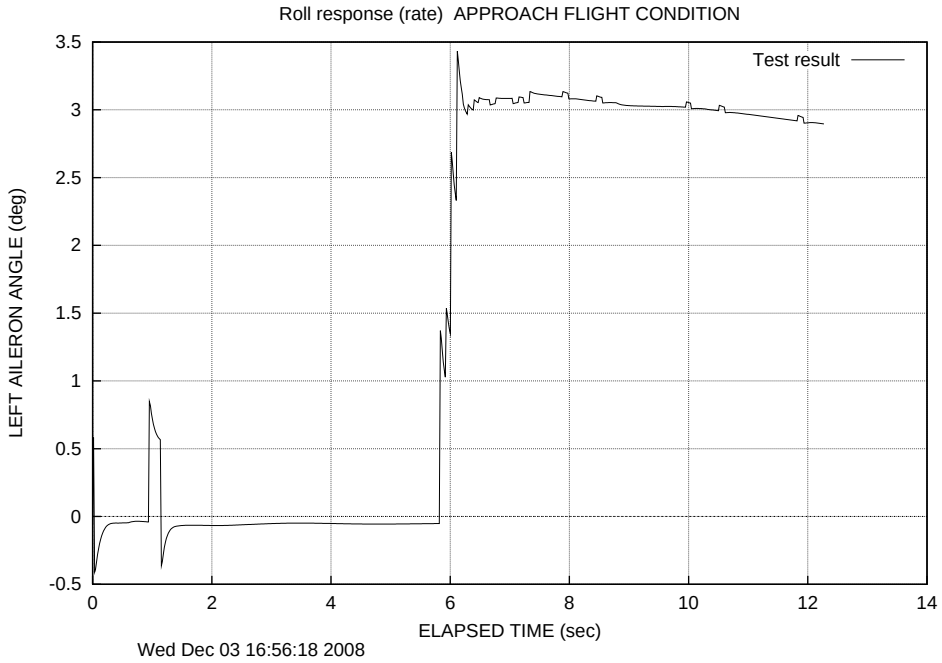
Starting after 5 seconds with the Yoke in roll position at the prescribed trimmed initial condition:
1. From the initial roll controller position, rotate the the Yoke such that the roll controller position is 30%.
2. Hold this roll controller position of 30% until steady roll rate is established. Then stop recording.

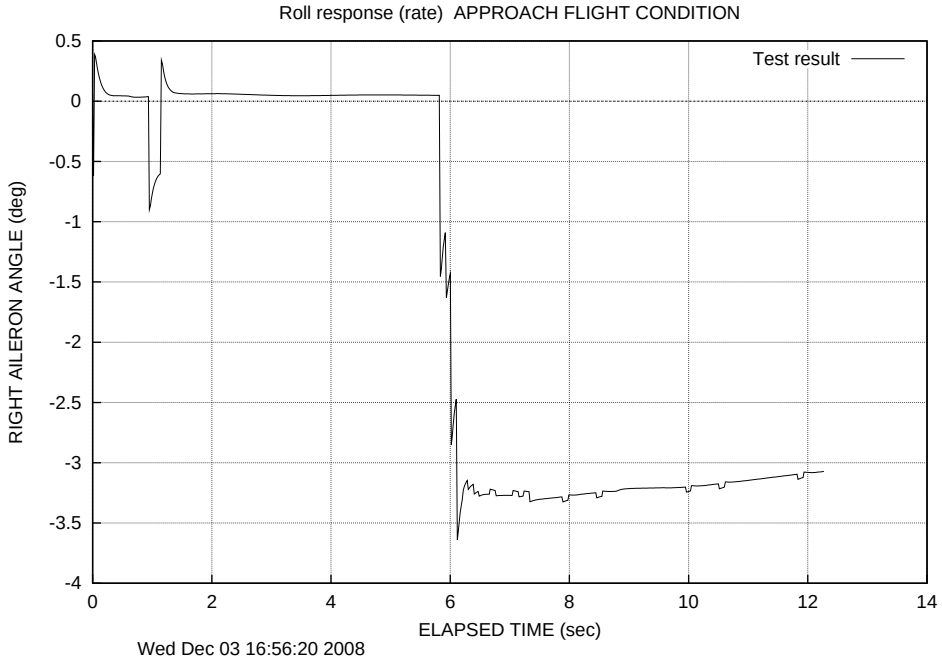
Evaluated parameters

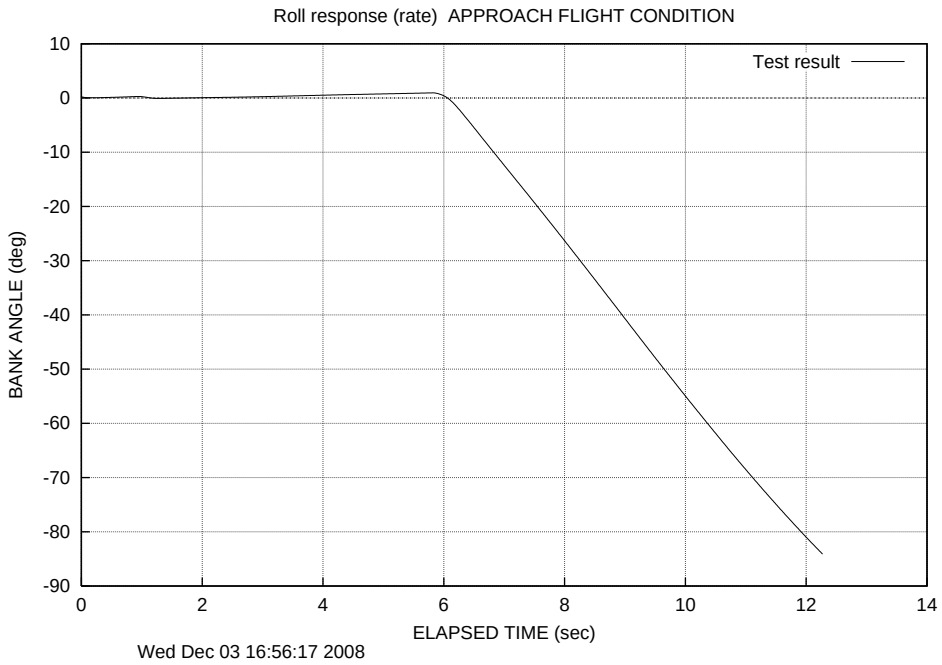
AILERON ANGLE
BANK ANGLE
ELEVATOR ANGLE
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED
PITCH ANGLE
PRESSURE ALTITUDE
ROLL CONTROLLER FORCE
ROLL CONTROLLER POSITION
RUDDER ANGLE
RUDDER PEDAL POSITION
ROLL RATE
RUDDER ANGLE
SIDESLIP ANGLE
YAW RATE

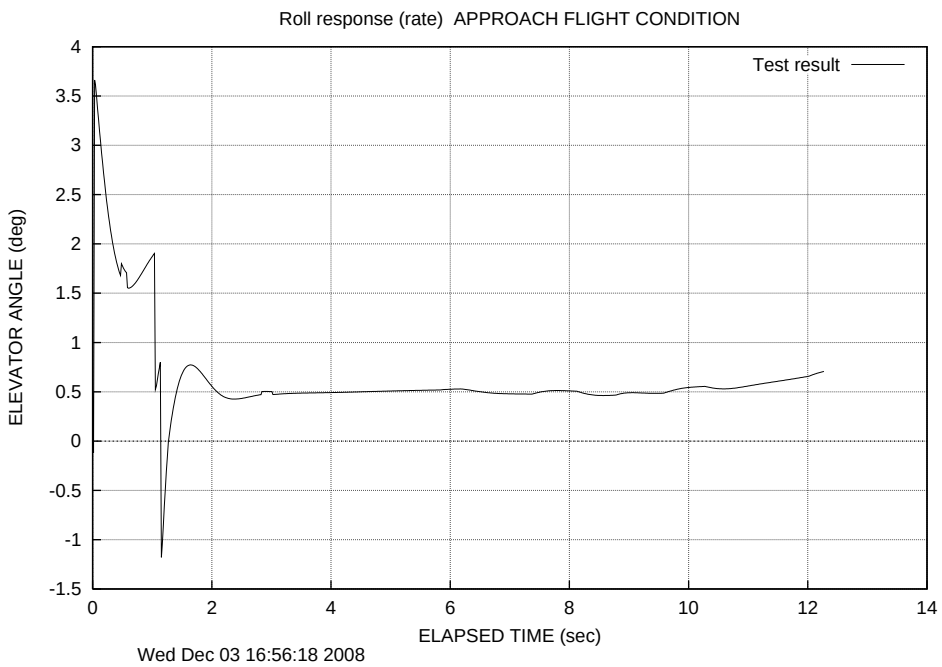
Expected results	The steady roll rate (left and right roll) of 12°/s is expected to establish without any large time delay after the roll controller position of 30% is reached. See section 3.16 of [1].
Tolerances	ROLL RATE ±10% or ±2°/sec
Test result	A steady roll rate (left and right roll) in cruise of approximately 25∘/sec-30∘/sec and 20∘/sec establishes without any large time delay after the roll controller position of 30% is reached.

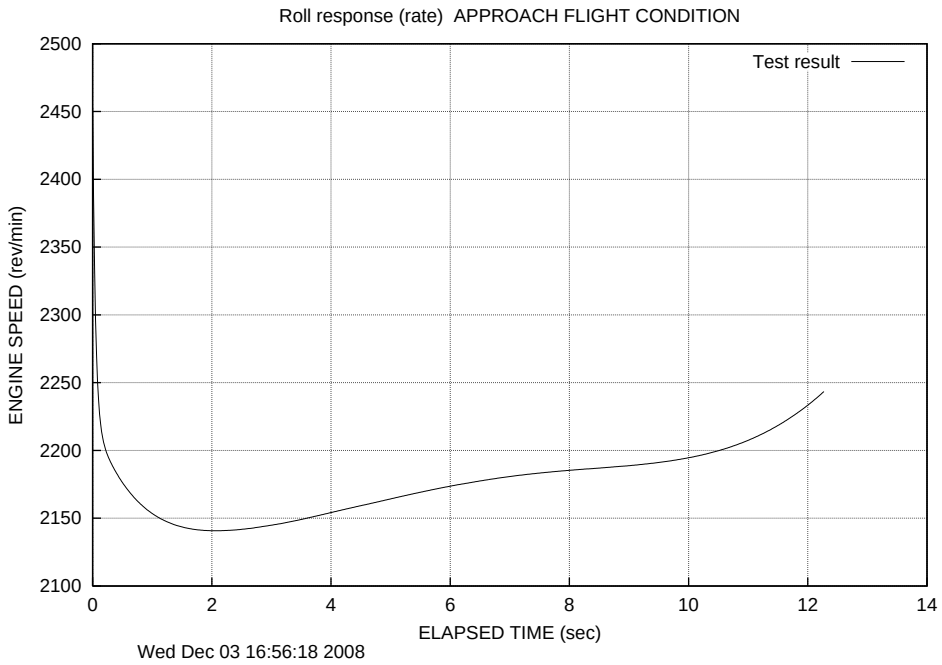
Approach flight condition (Left):

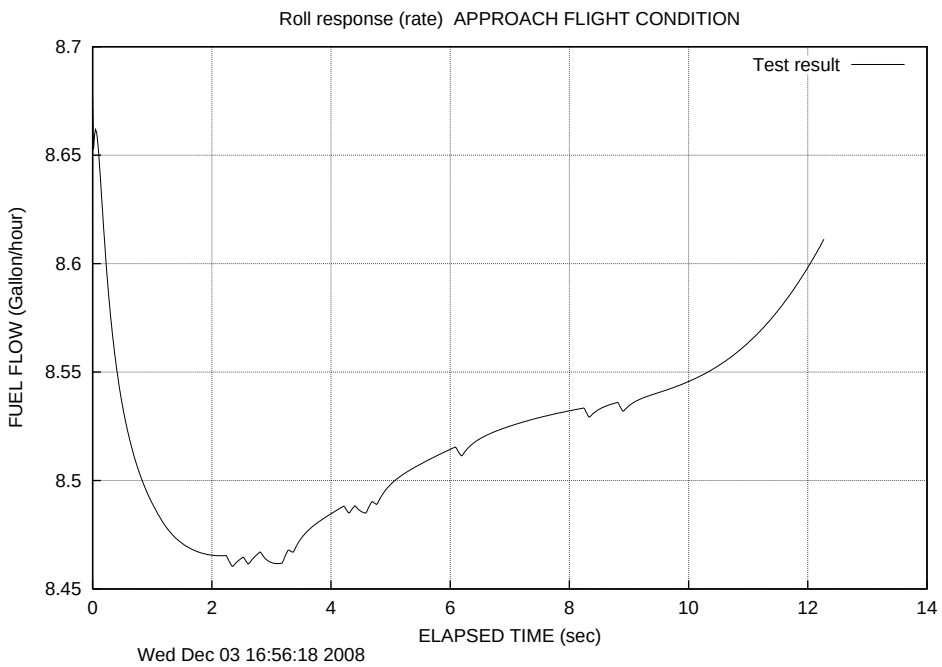


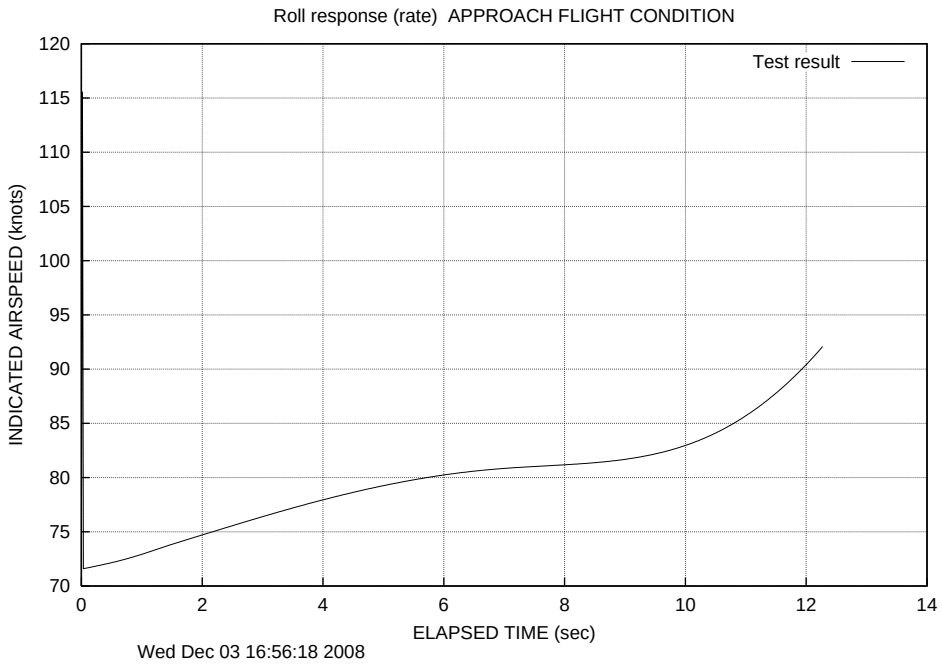


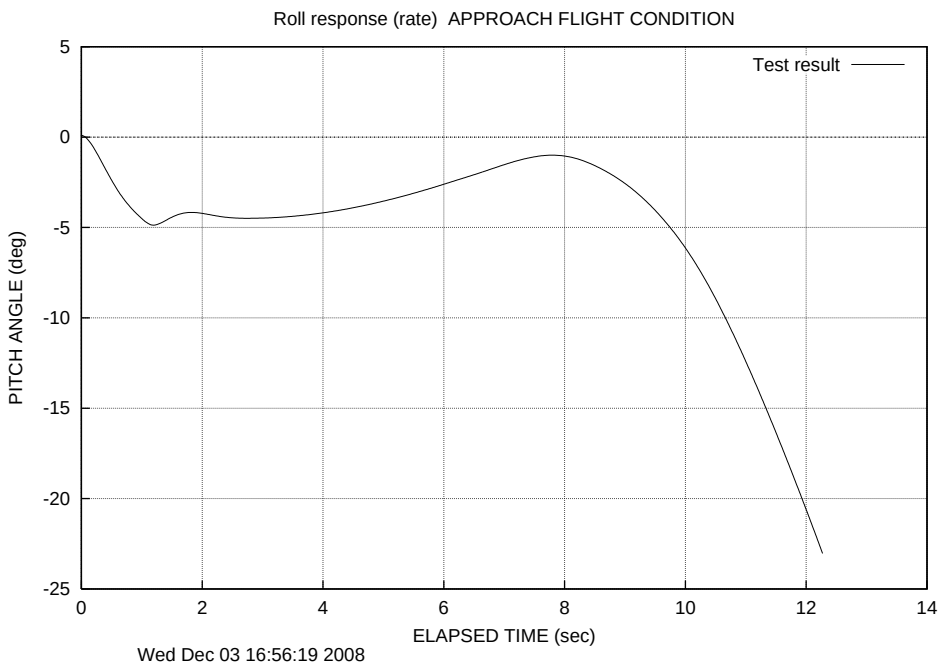

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:17 2008

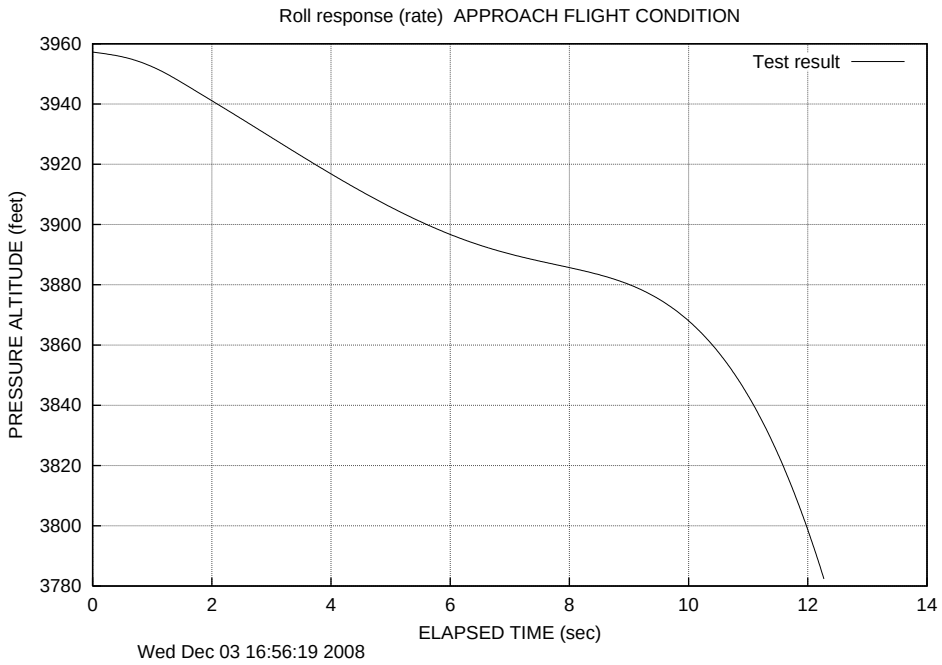

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:18 2008

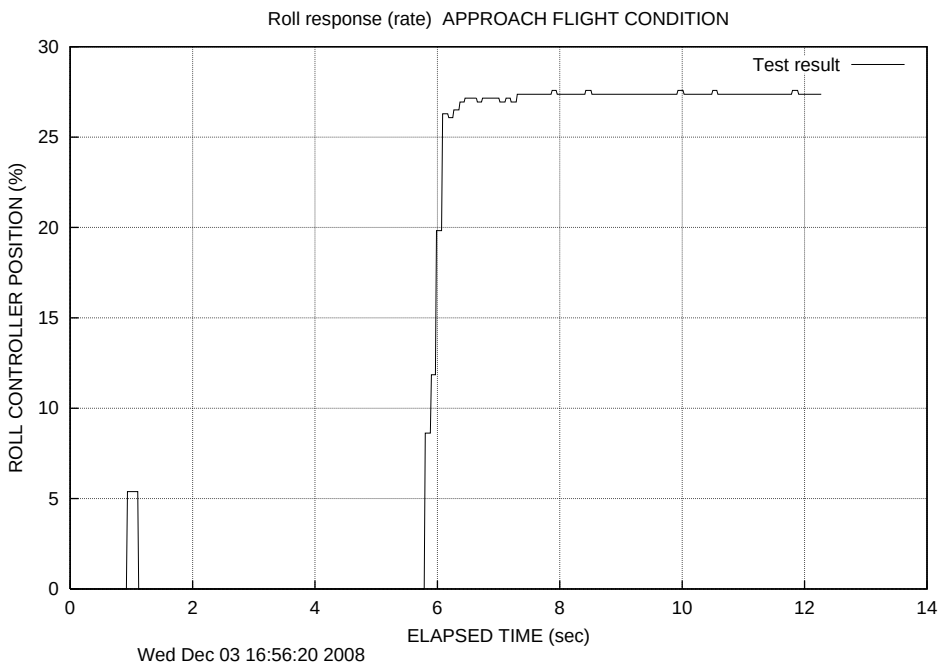

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2500
2450
2400
2350
2300
2250
2200
2150
2100
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:18 2008

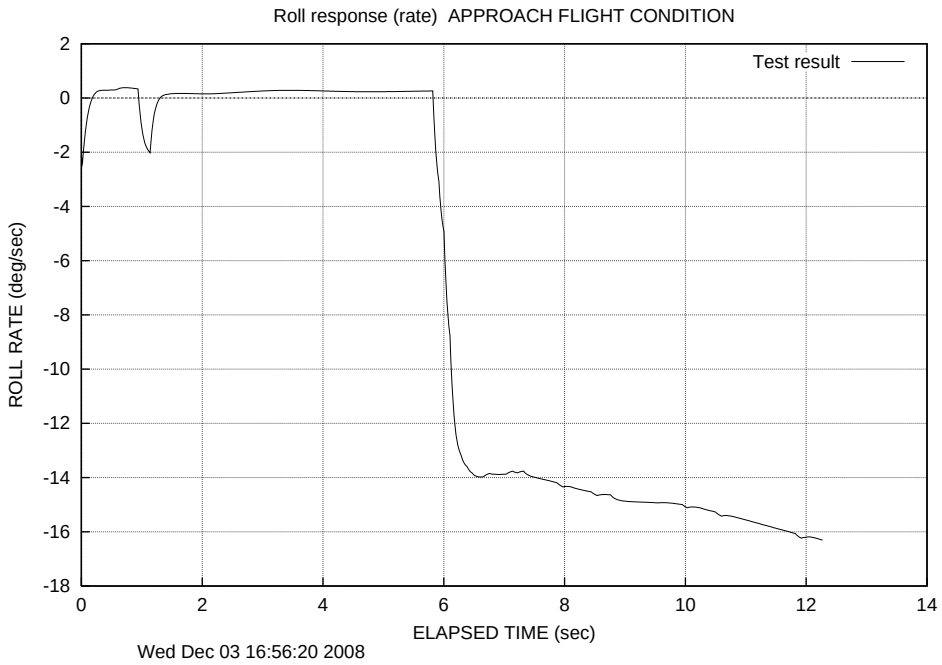

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.7
8.65
8.6
8.55
8.5
8.45
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:18 2008

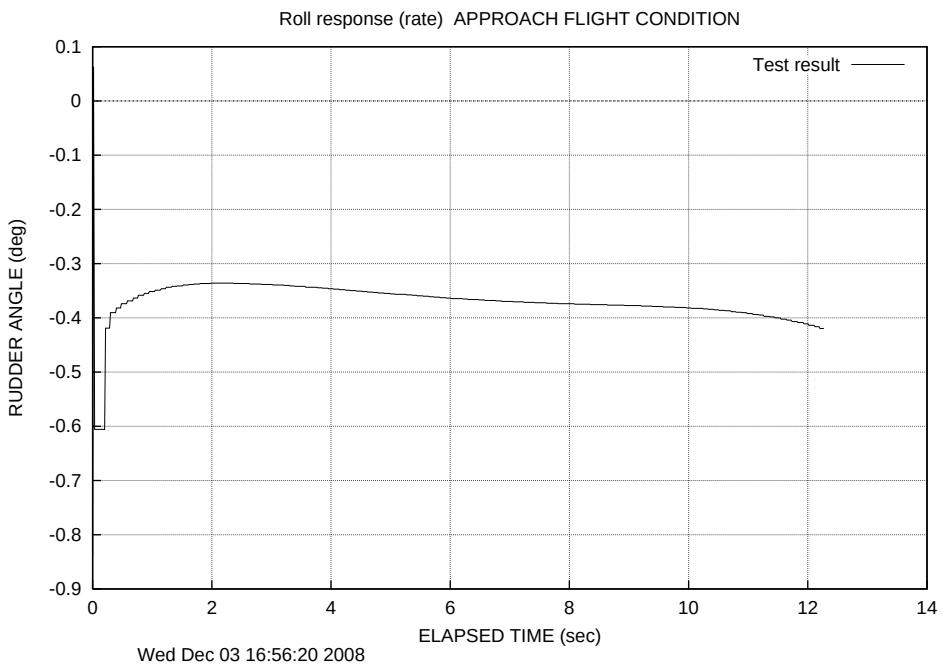

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
120
115
110
105
100
95
90
85
80
75
70
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:18 2008

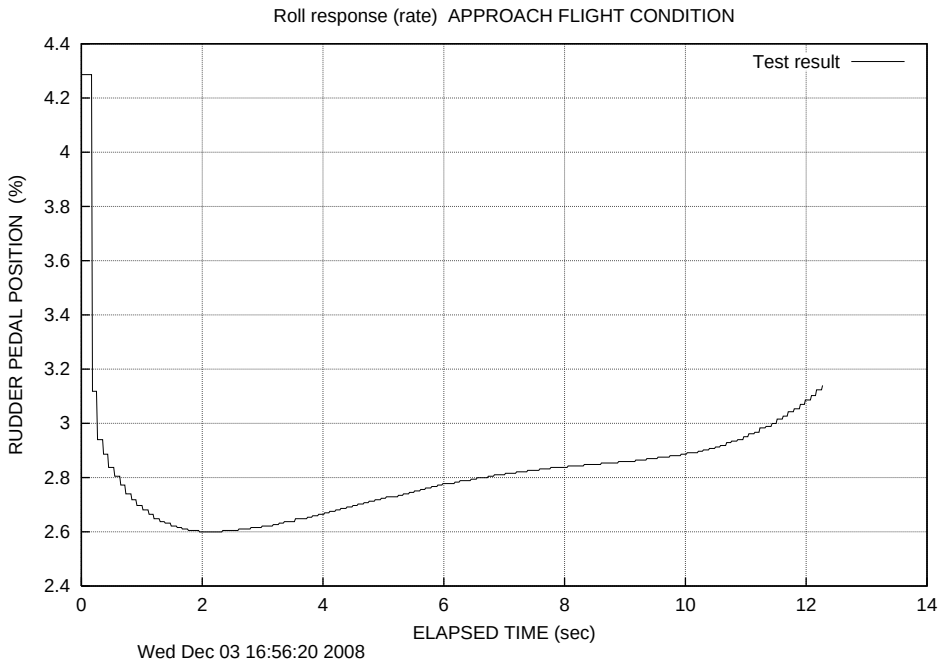

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
5
0
-5
-10
-15
-20
-25
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:19 2008

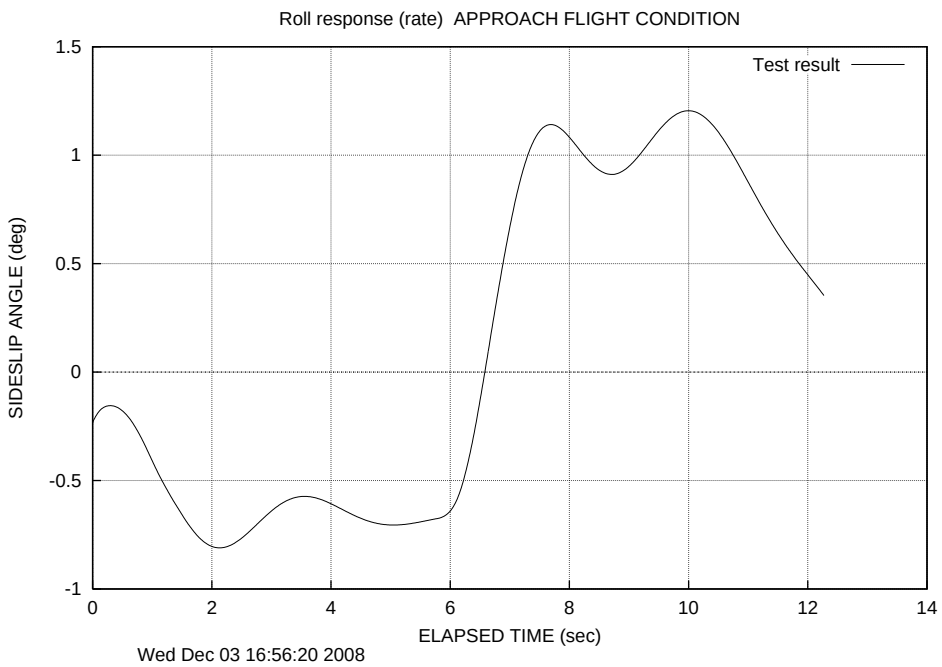

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3960
3940
3920
3900
3880
3860
3840
3820
3800
3780
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:19 2008

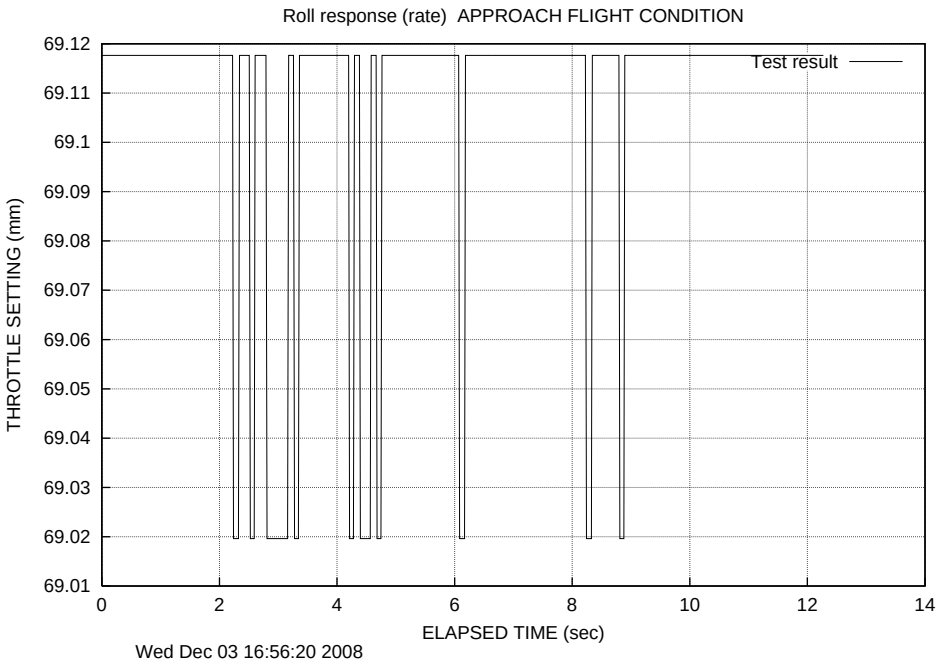

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008


Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008

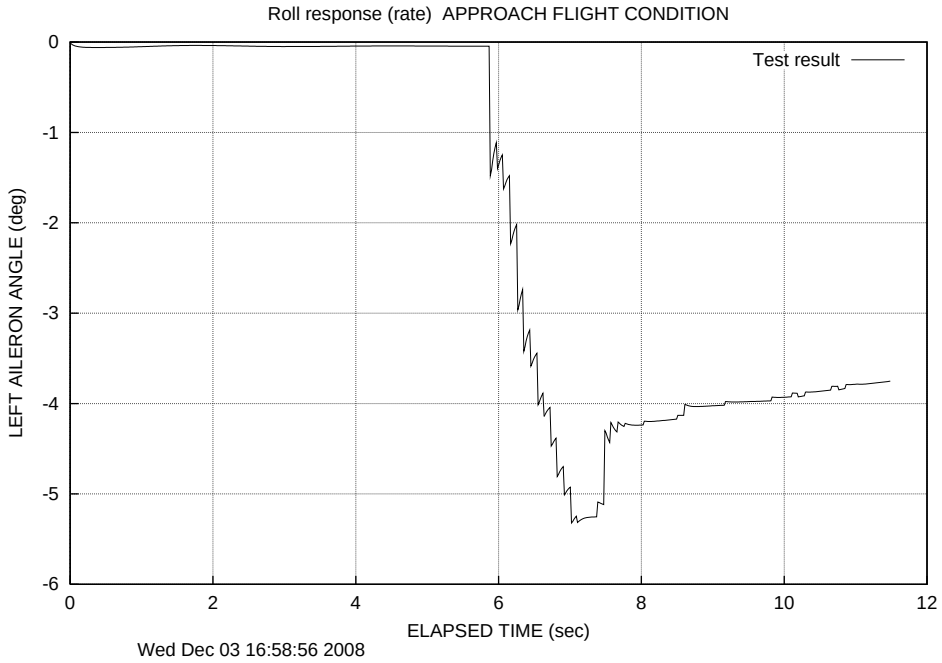

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008

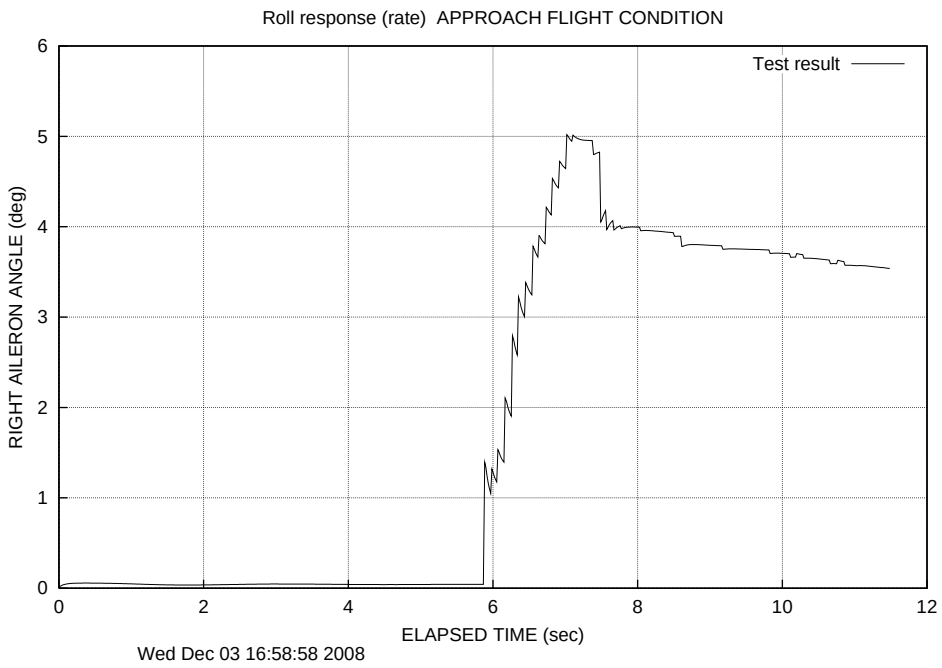

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
4.4
4.2
4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008

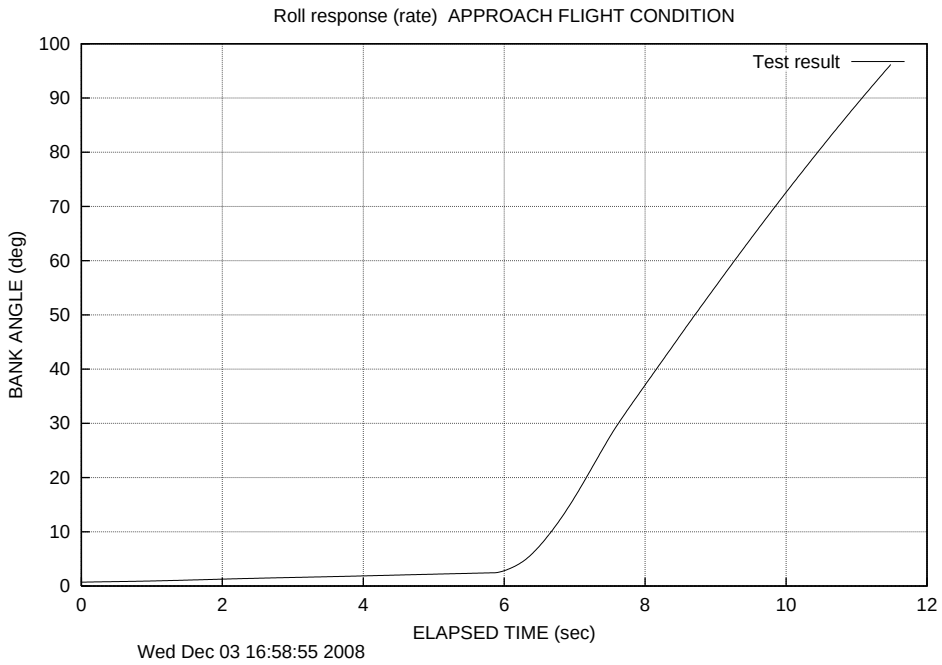

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
1.5
1
0.5
0
-0.5
-1
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008

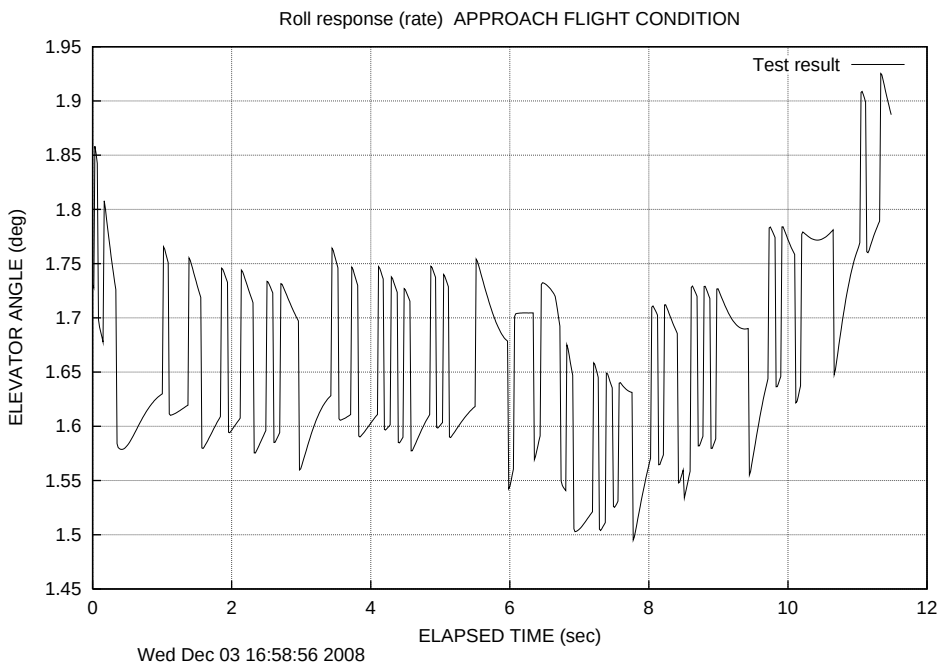

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.12
69.11
69.1
69.09
69.08
69.07
69.06
69.05
69.04
69.03
69.02
69.01
0
2
4
6
8
10
12
14
ELAPSED TIME (sec)
Wed Dec 03 16:56:20 2008

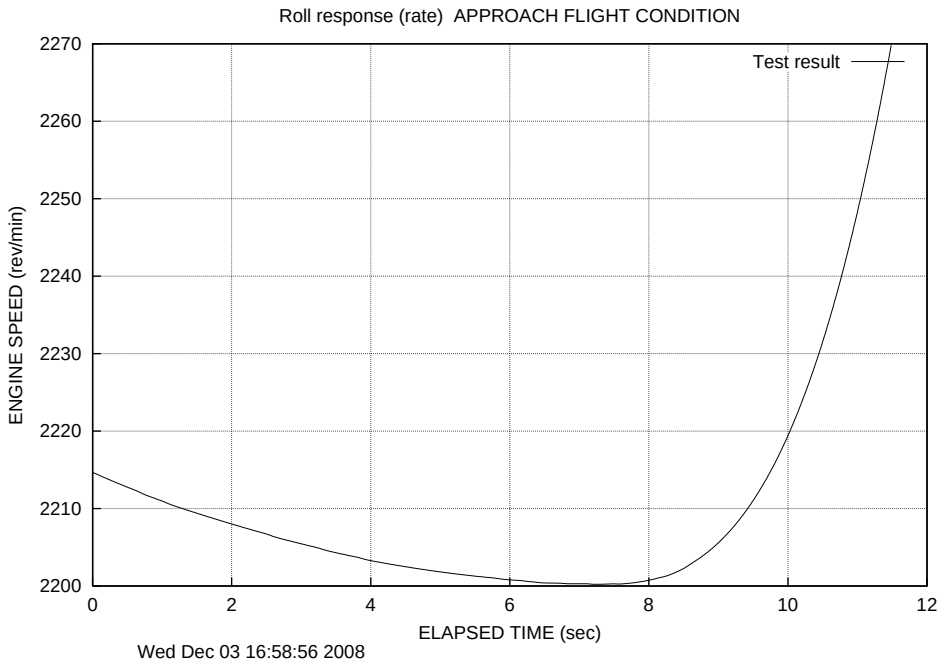
Approach flight condition (Right):

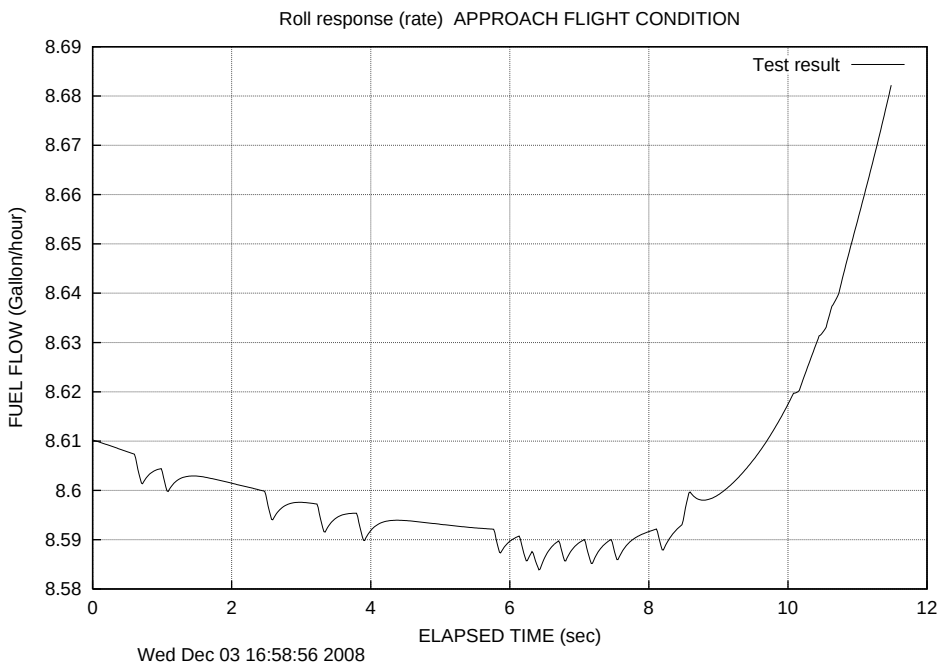


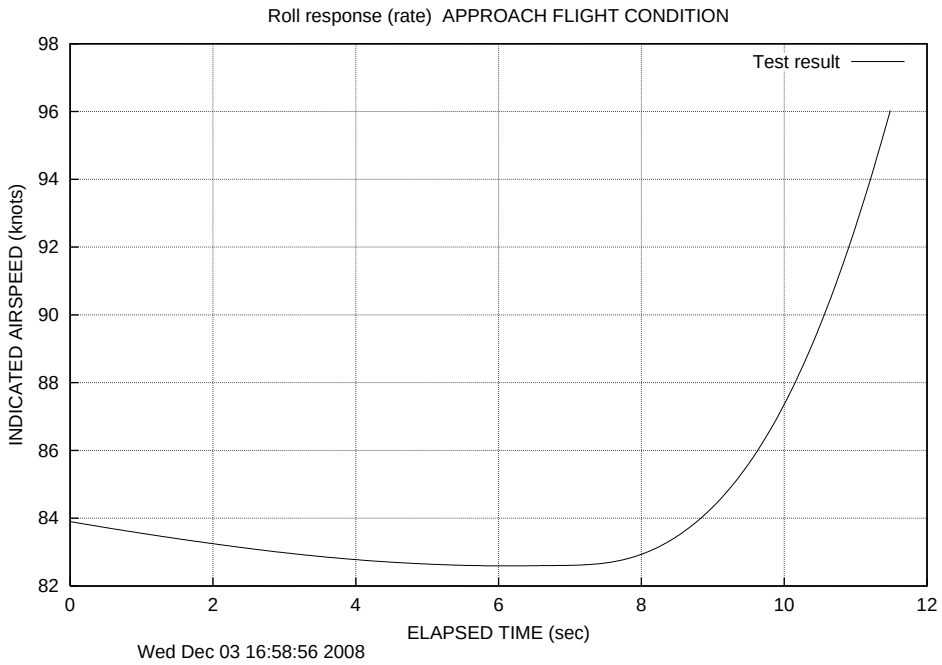


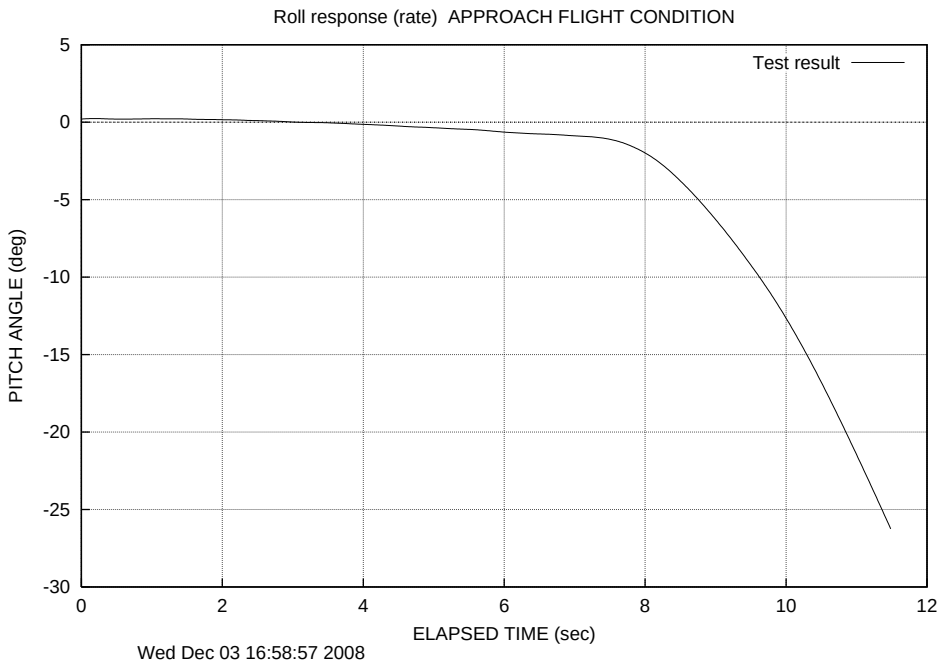

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 16:58:55 2008
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12

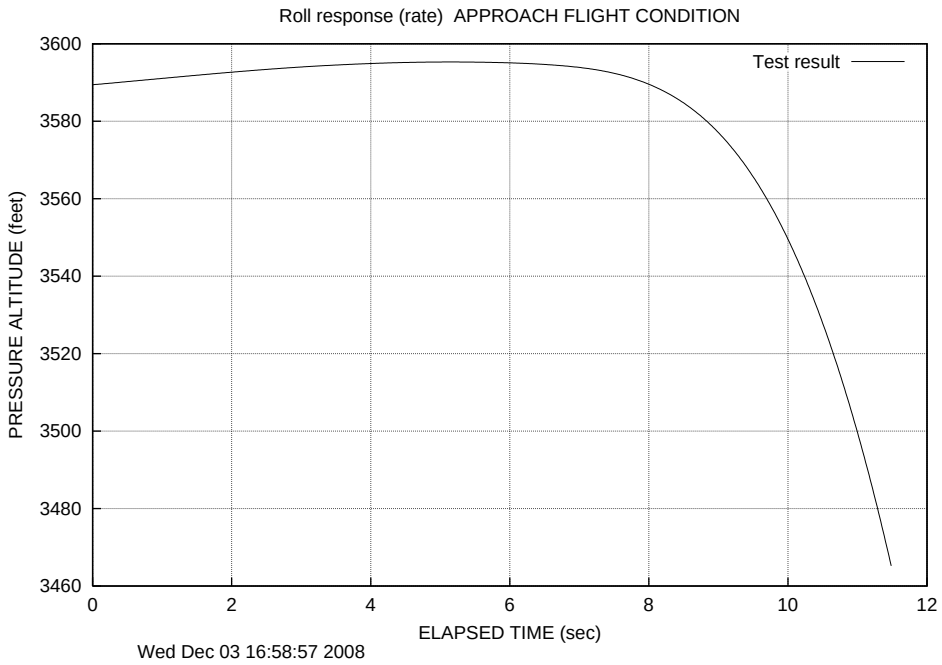

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 16:58:56 2008
1.45
1.5
1.55
1.6
1.65
1.7
1.75
1.8
1.85
1.9
1.95
0
2
4
6
8
10
12

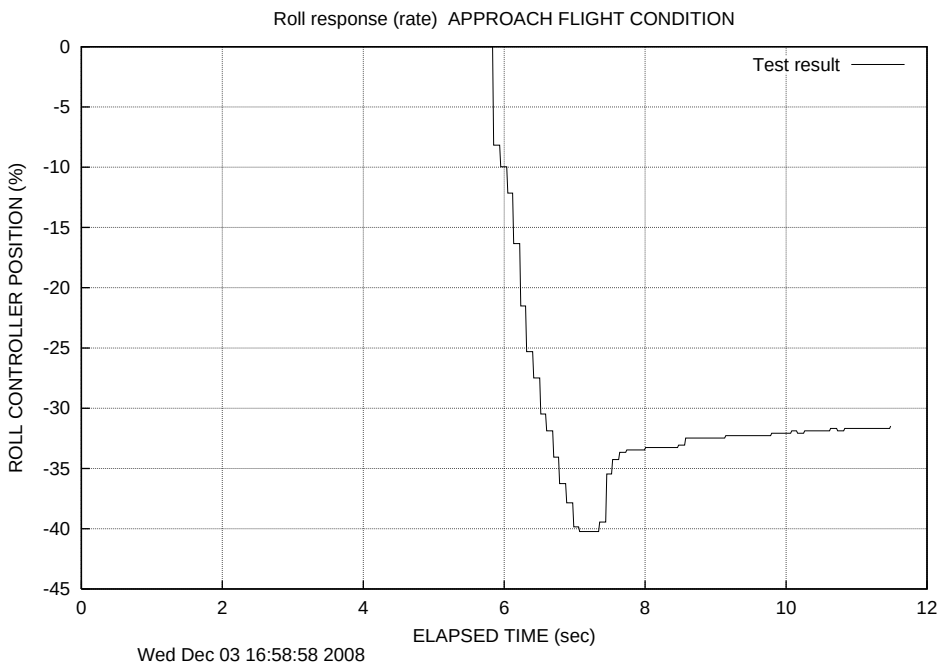

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2270
2260
2250
2240
2230
2220
2210
2200
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:56 2008

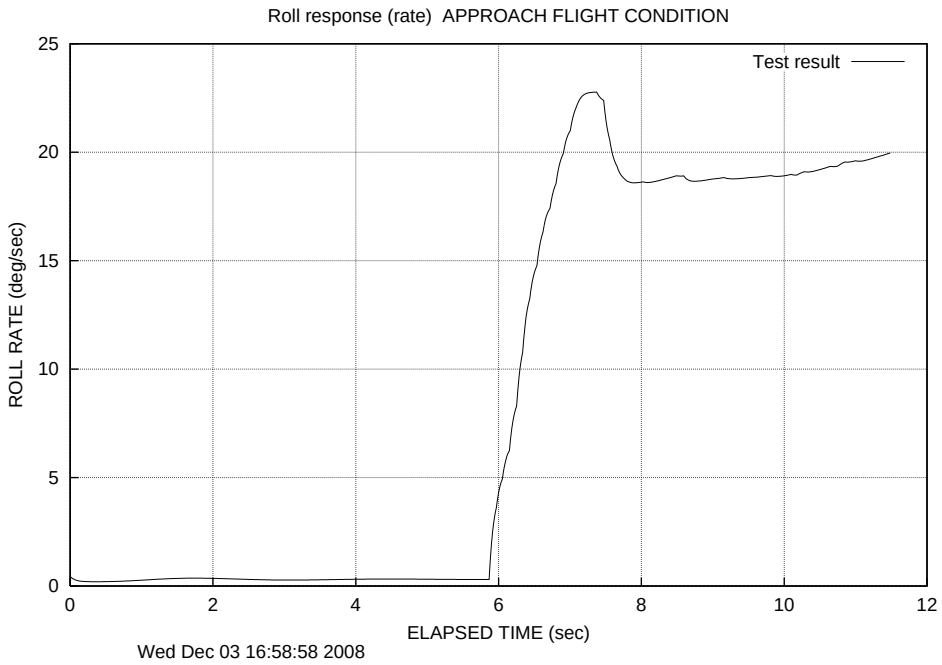

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.69
8.68
8.67
8.66
8.65
8.64
8.63
8.62
8.61
8.6
8.59
8.58
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:56 2008

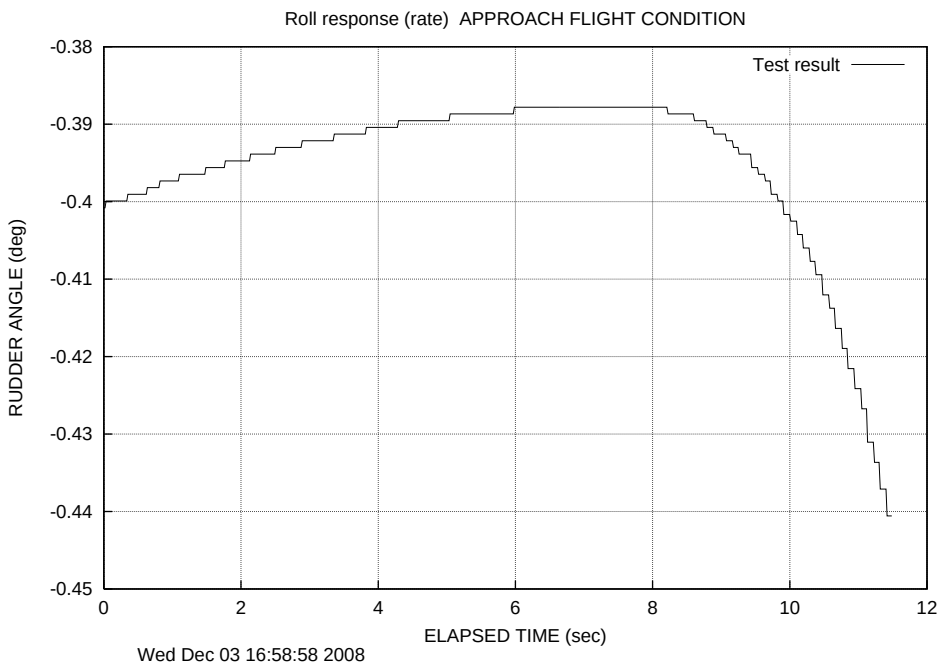

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
98
96
94
92
90
88
86
84
82
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:56 2008

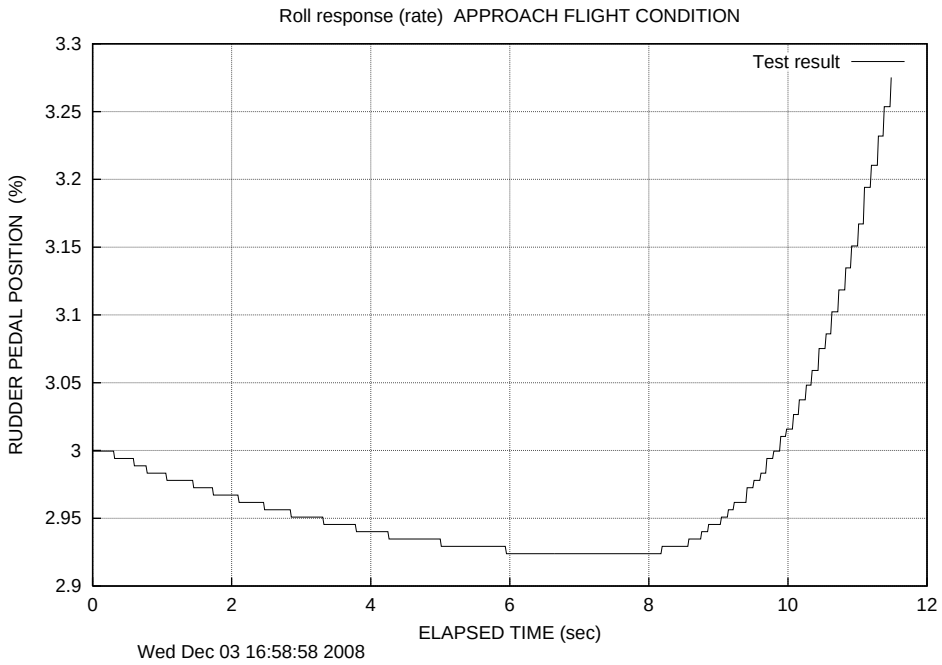

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
5
0
-5
-10
-15
-20
-25
-30
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:57 2008

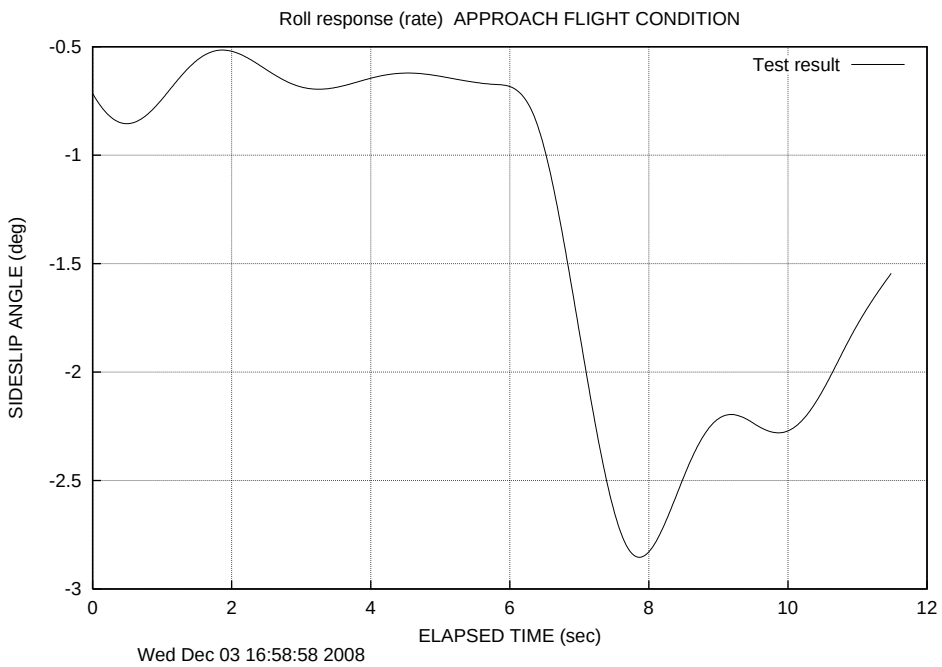

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3600
3580
3560
3540
3520
3500
3480
3460
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:57 2008

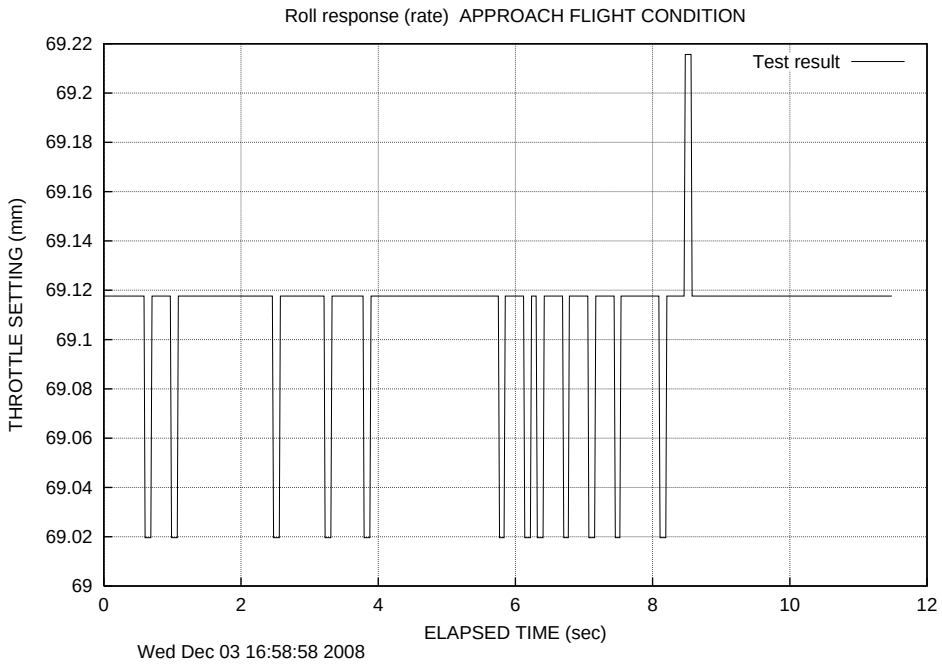

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008


Roll response (rate) APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008
0
5
10
15
20
25
0
2
4
6
8
10
12

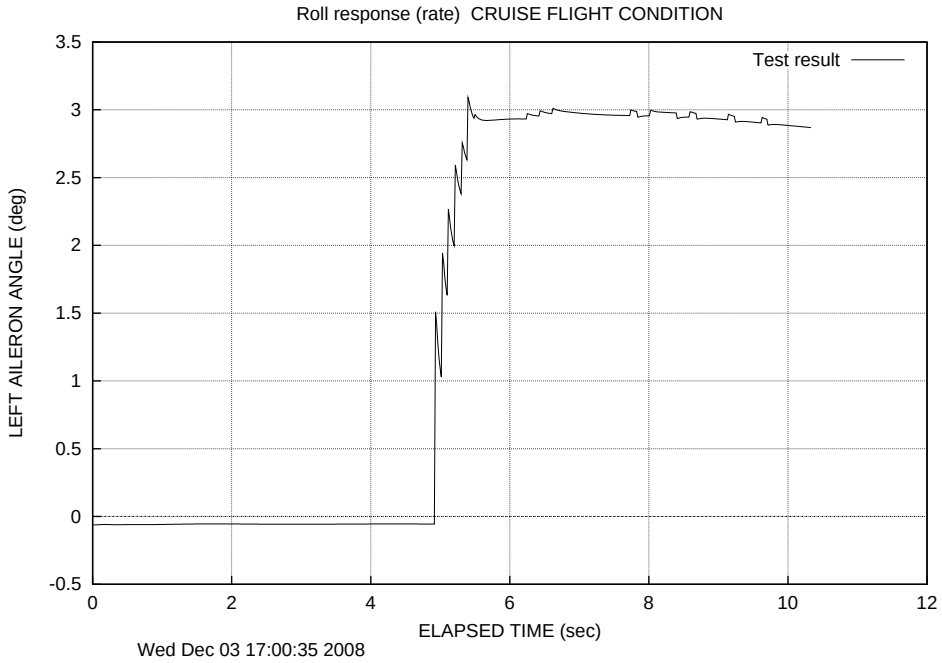

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008
-0.38
-0.39
-0.4
-0.41
-0.42
-0.43
-0.44
-0.45
0
2
4
6
8
10
12

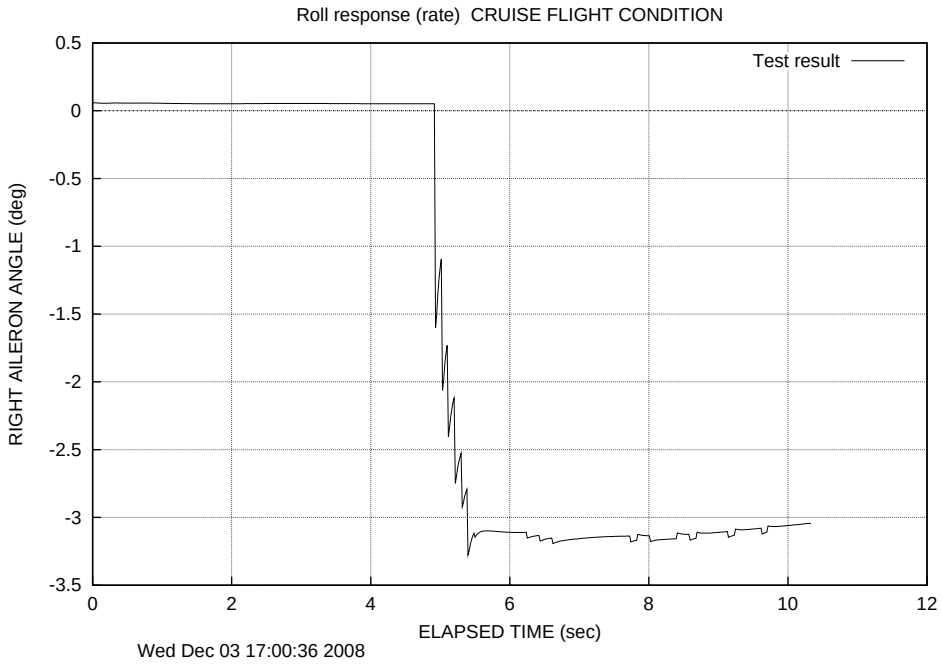

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
3.3
3.25
3.2
3.15
3.1
3.05
3
2.95
2.9
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008

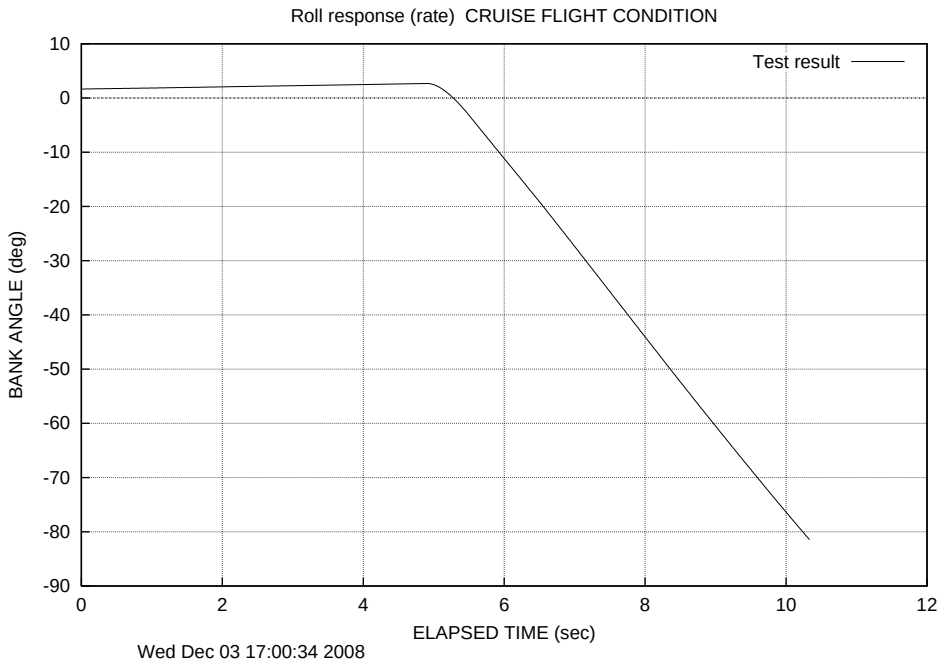

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
-0.5
-1
-1.5
-2
-2.5
-3
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008

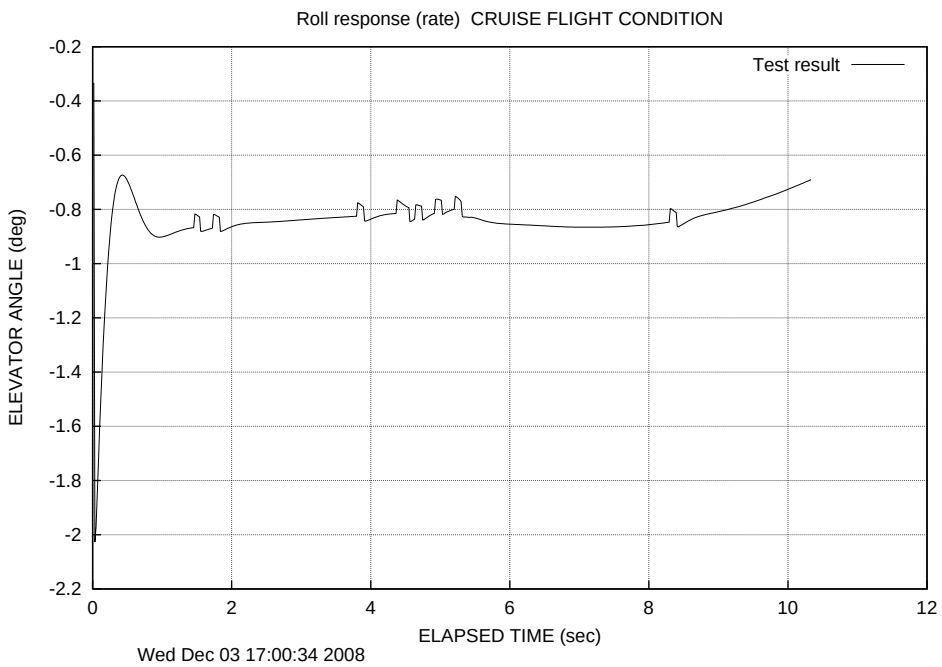

Roll response (rate) APPROACH FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.22
69.2
69.18
69.16
69.14
69.12
69.1
69.08
69.06
69.04
69.02
69
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 16:58:58 2008

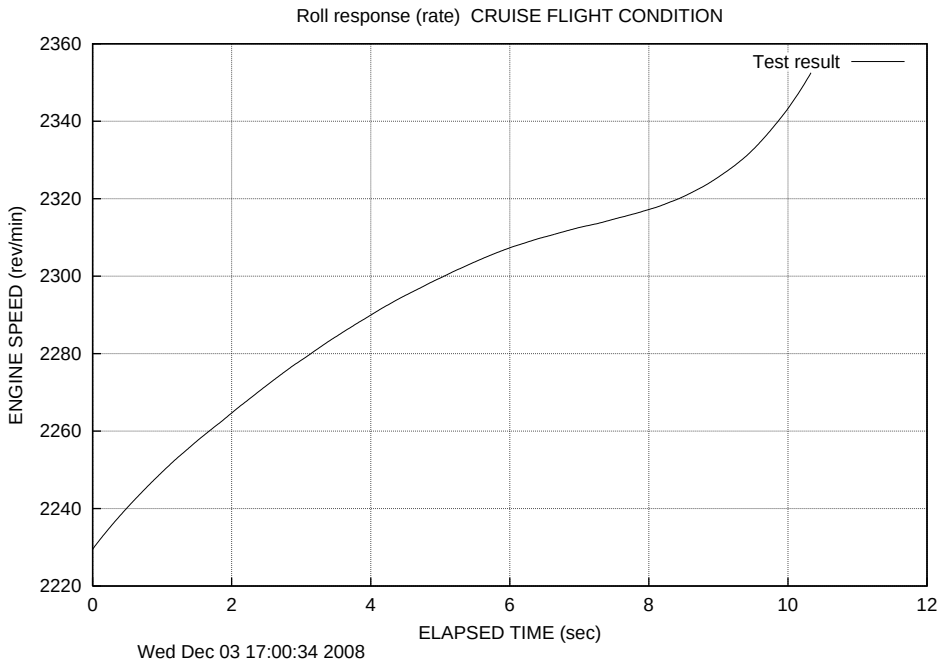
Cruise flight condition (Left):

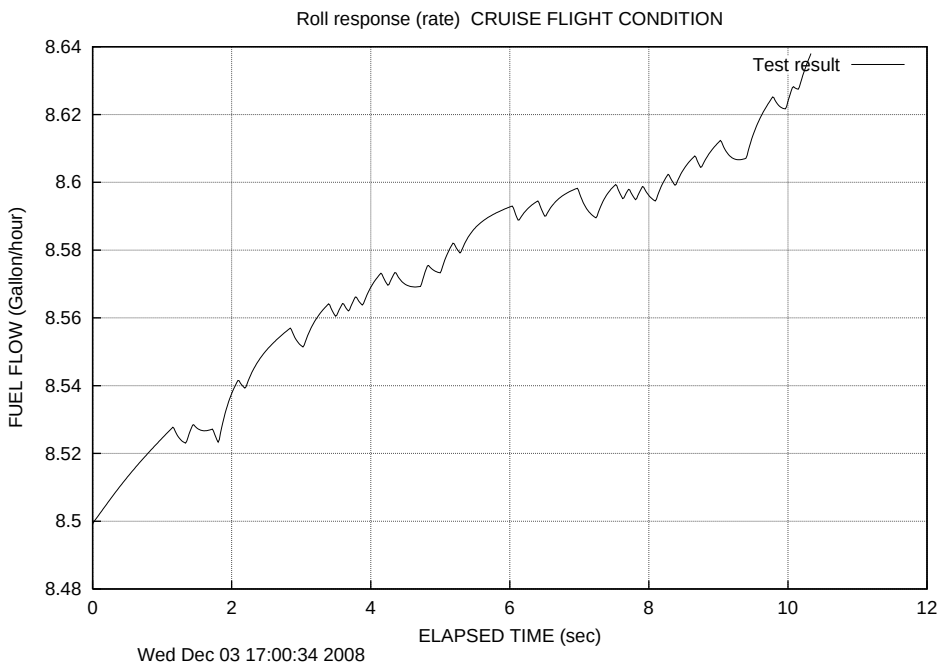


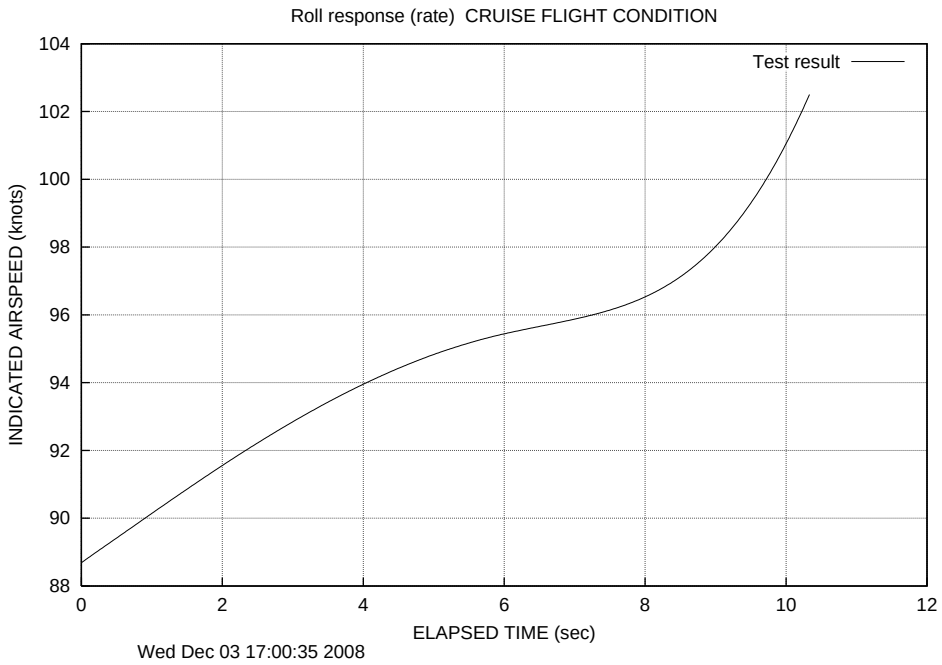


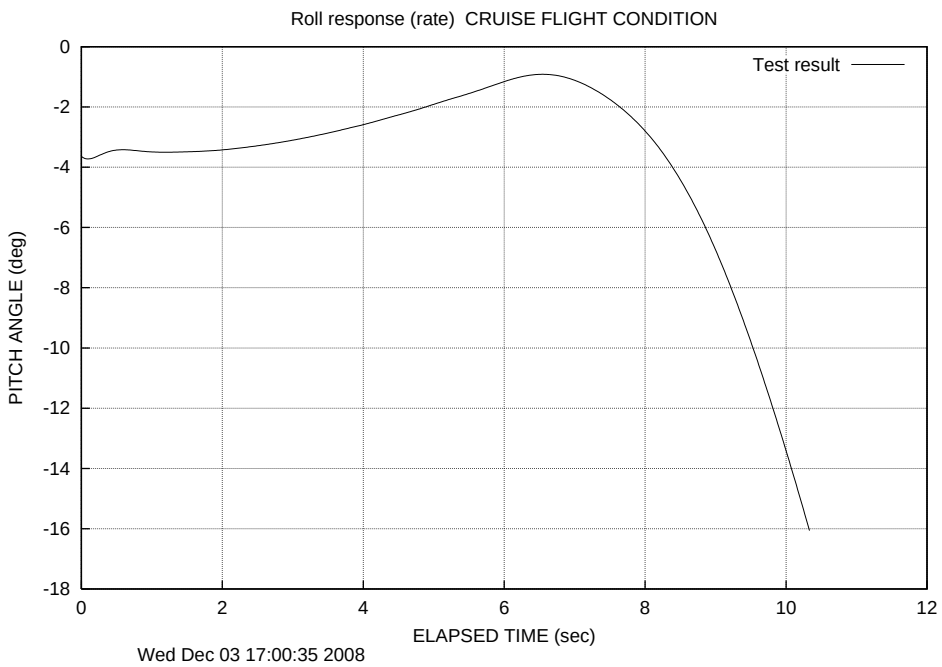

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:34 2008

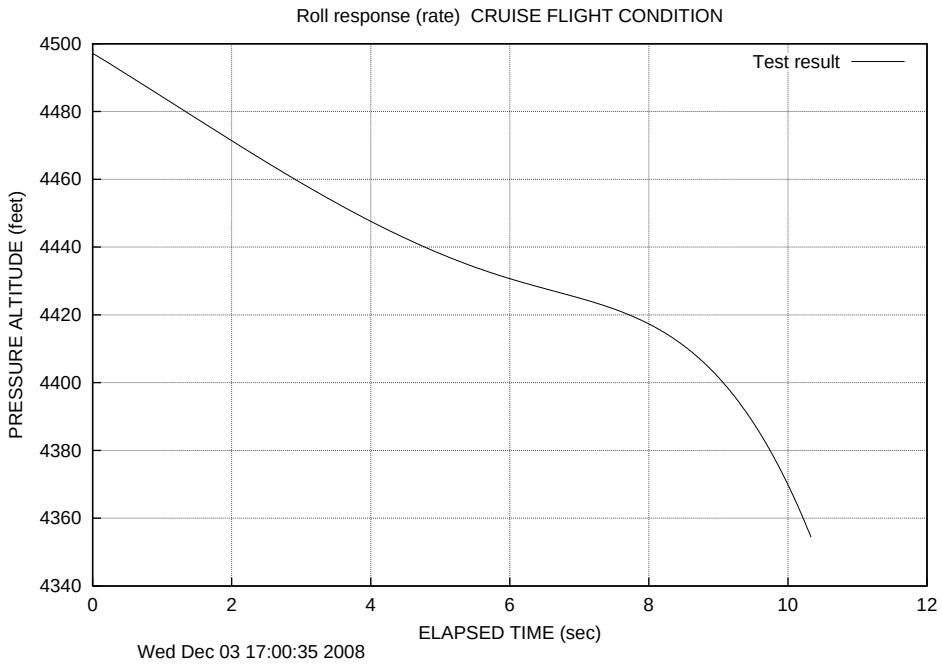

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:34 2008

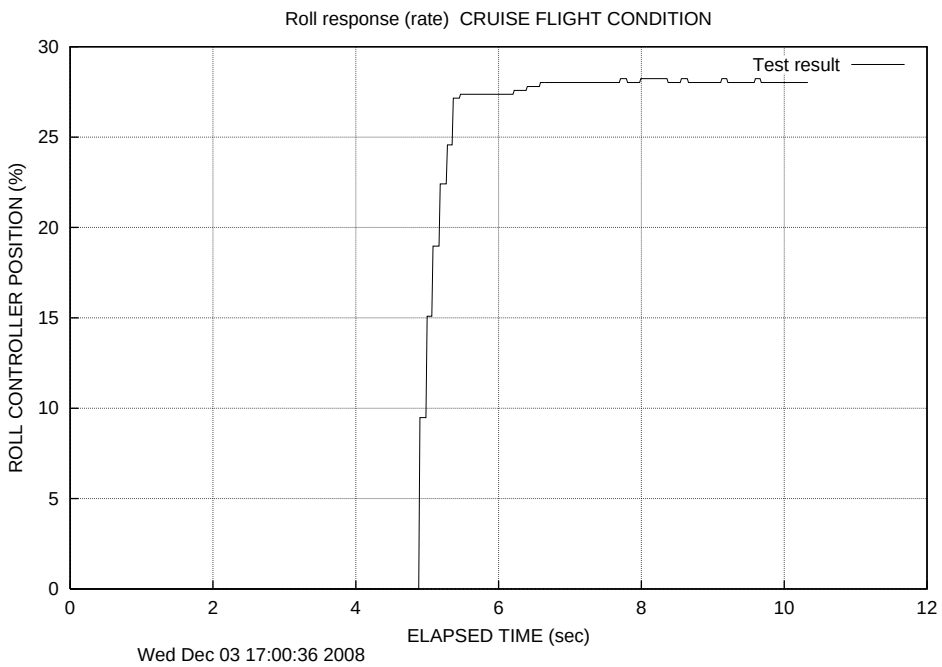

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2360
2340
2320
2300
2280
2260
2240
2220
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:34 2008

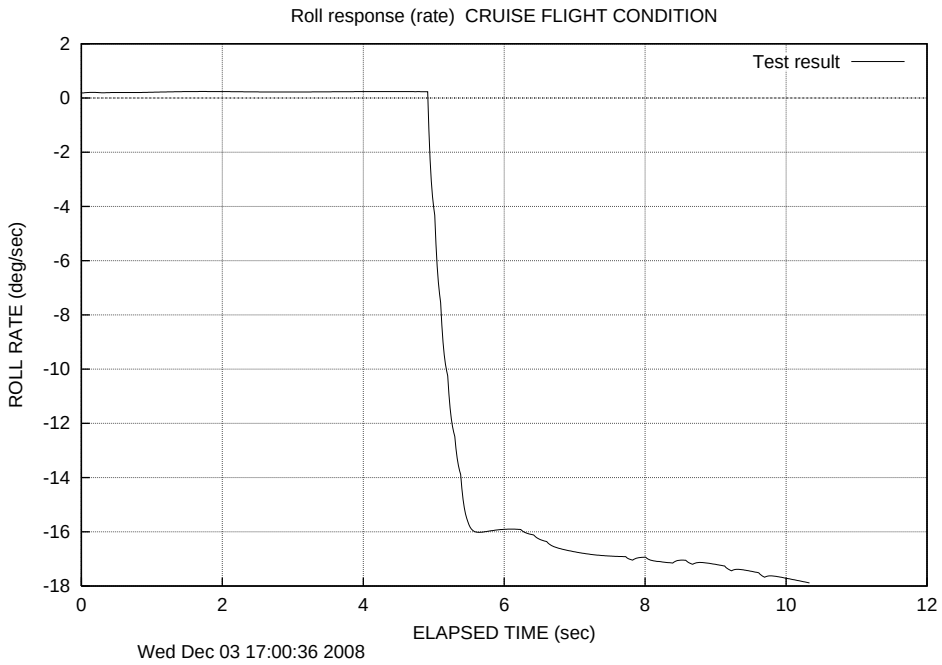

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.64
8.62
8.6
8.58
8.56
8.54
8.52
8.5
8.48
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:34 2008

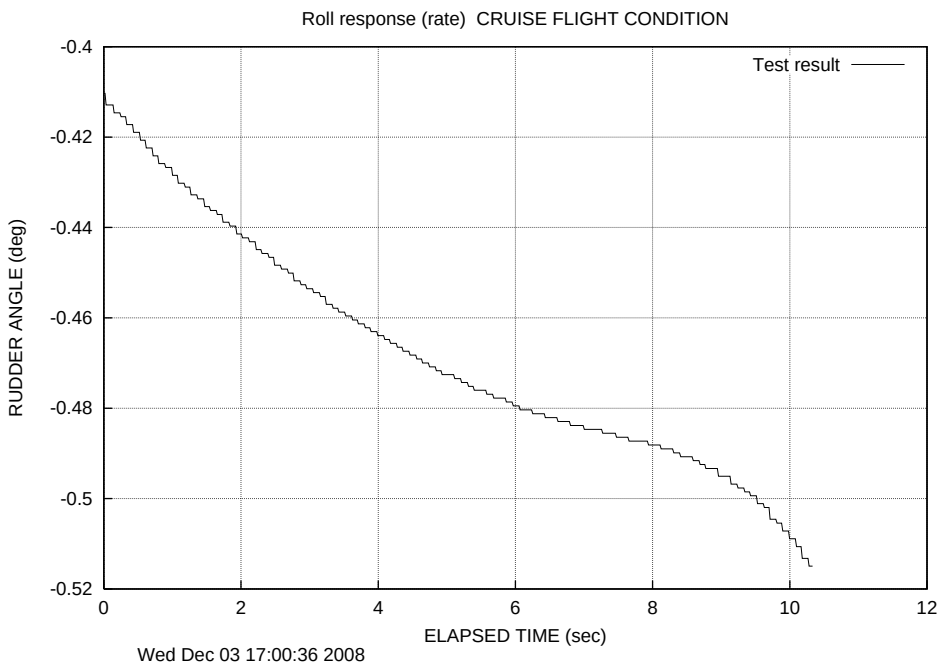

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
104
102
100
98
96
94
92
90
88
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:35 2008

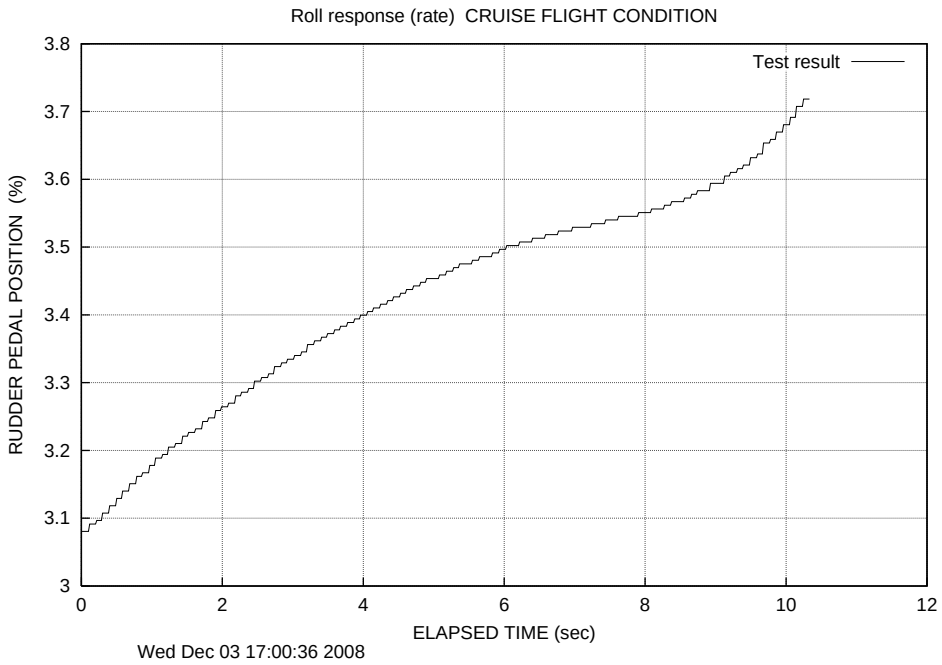

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:35 2008

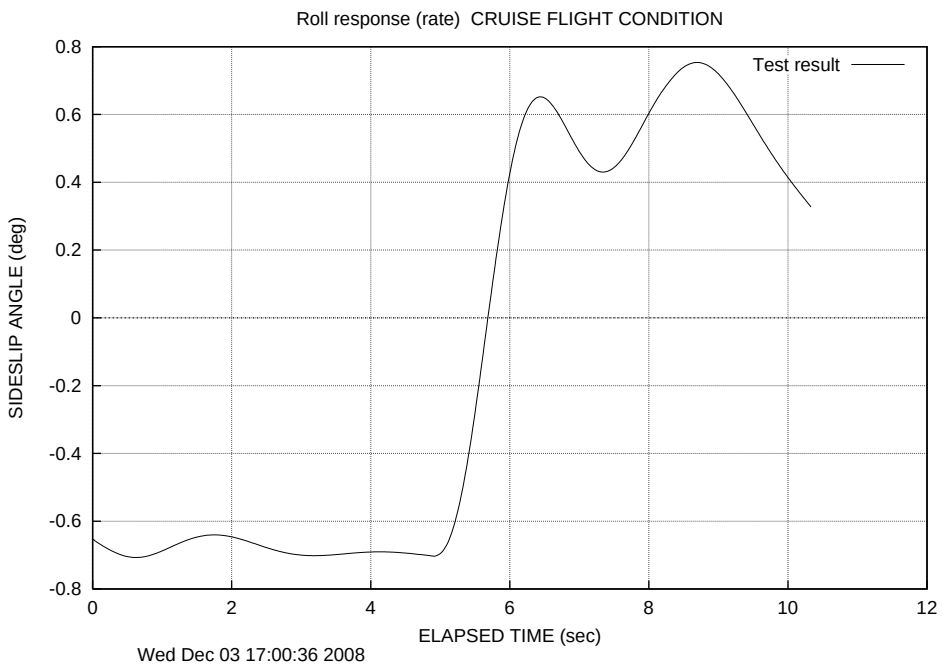

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4500
4480
4460
4440
4420
4400
4380
4360
4340
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:35 2008

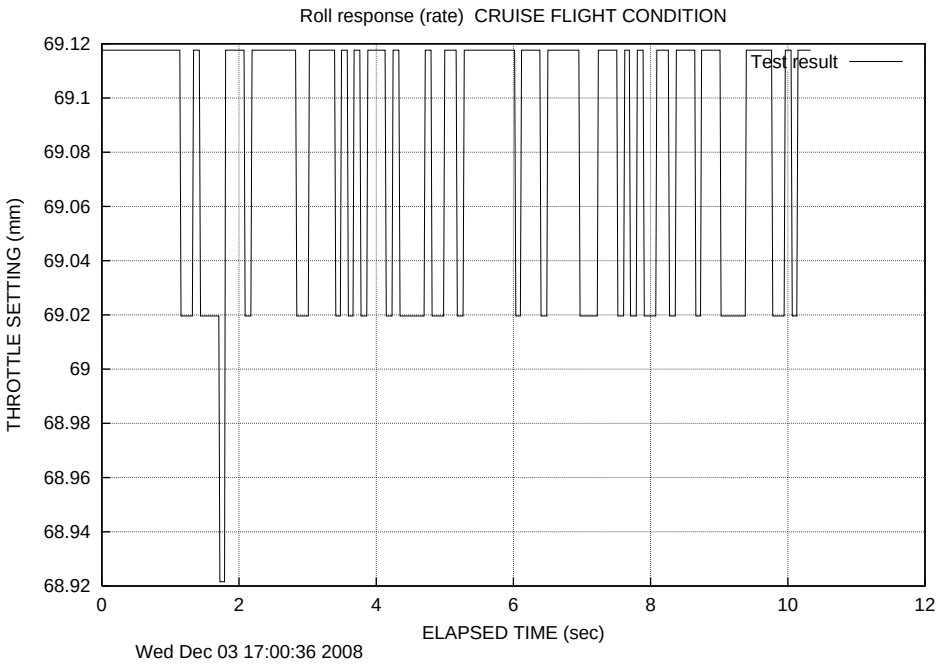

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008


Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008

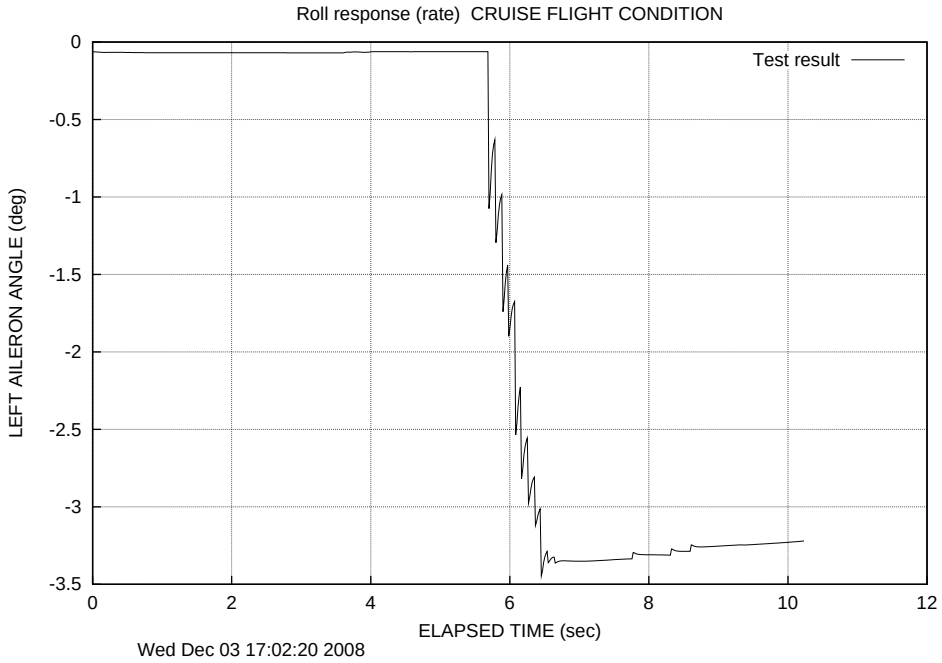

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
-0.4
-0.42
-0.44
-0.46
-0.48
-0.5
-0.52
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008

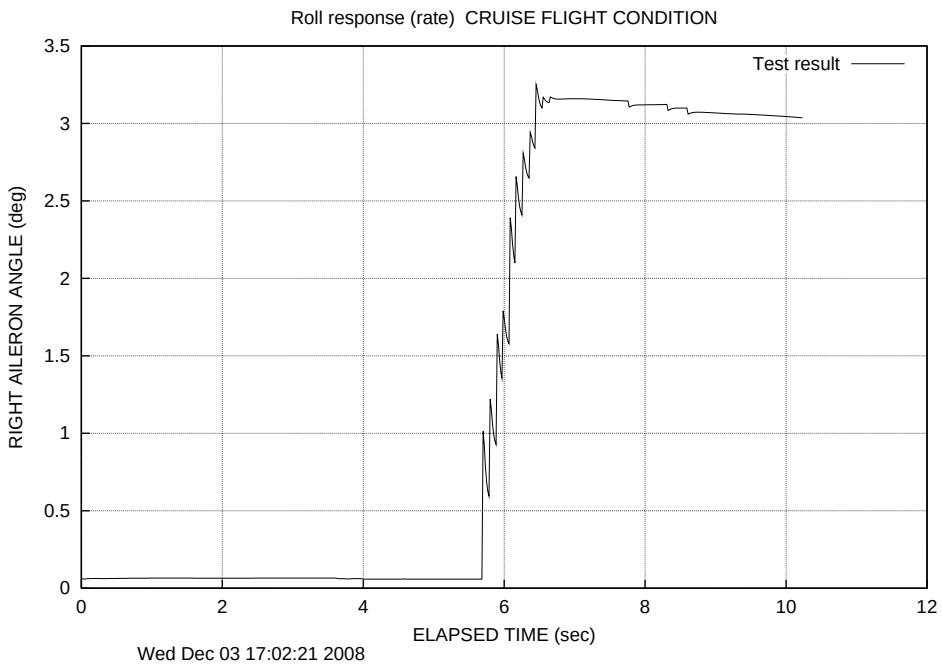

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008

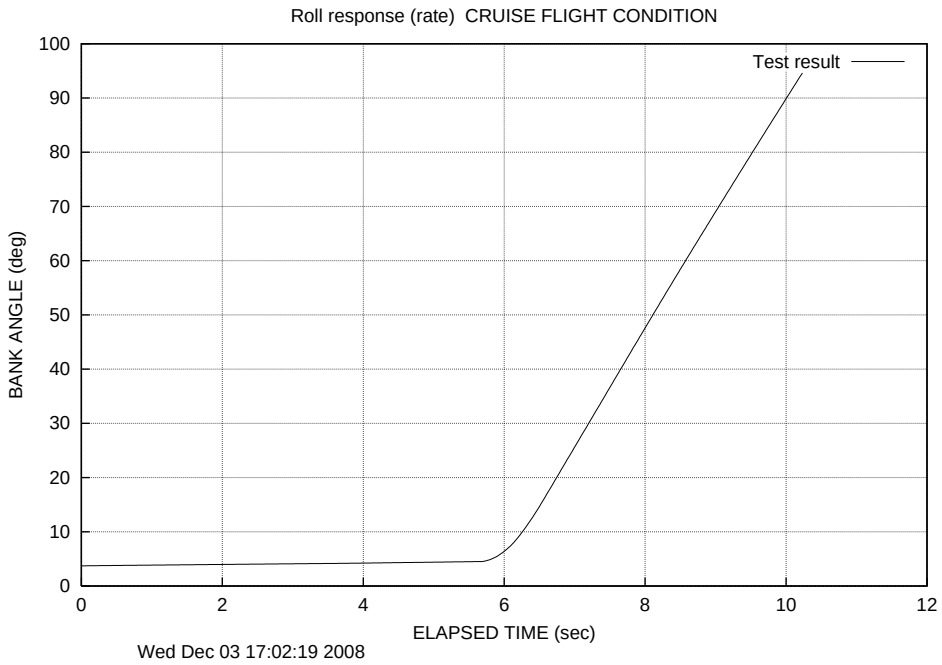

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008

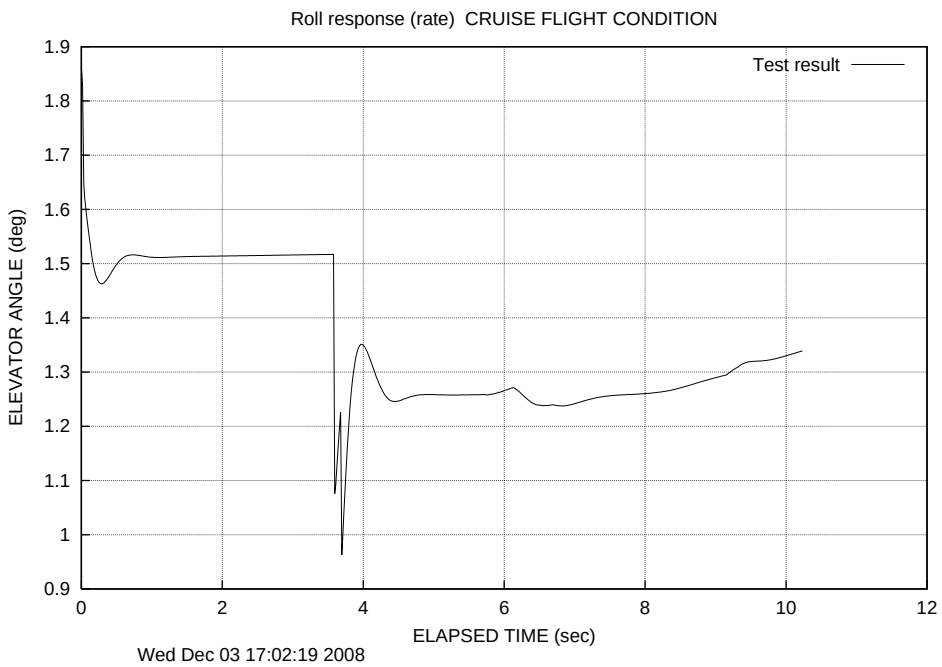

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.12
69.1
69.08
69.06
69.04
69.02
69
68.98
68.96
68.94
68.92
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:00:36 2008

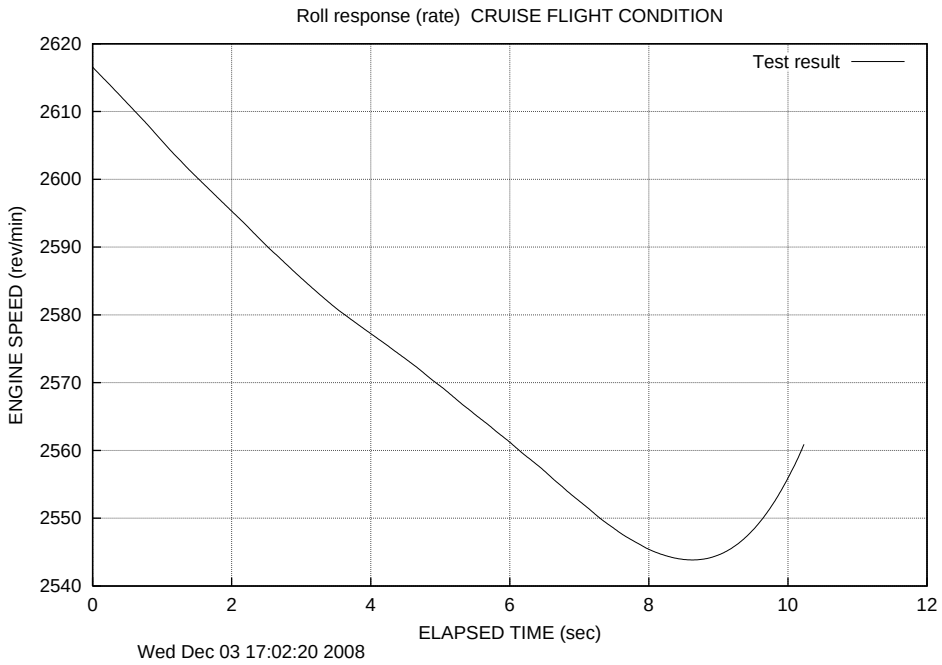
Cruise flight condition (Right):

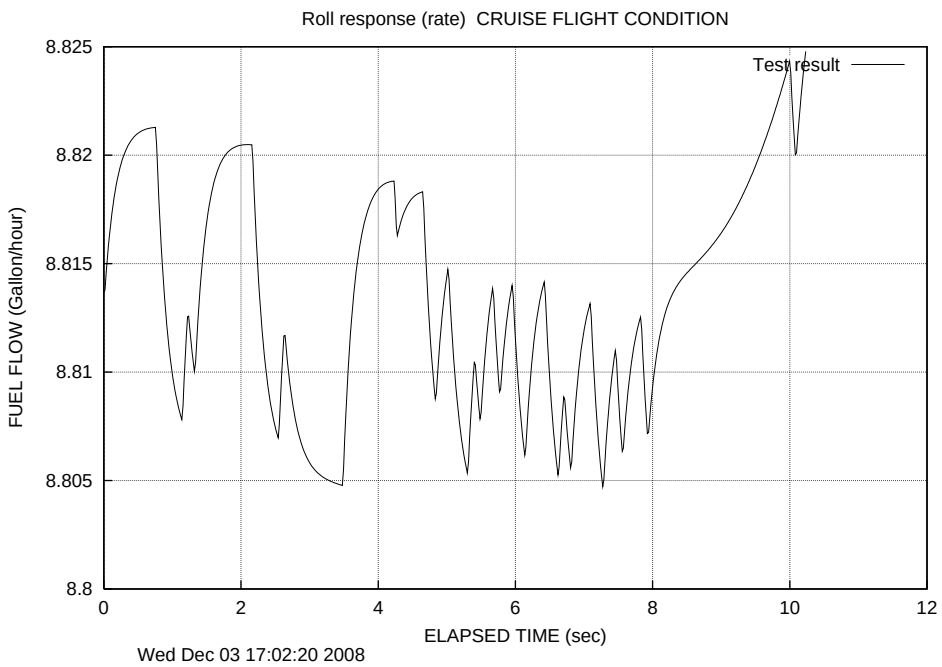


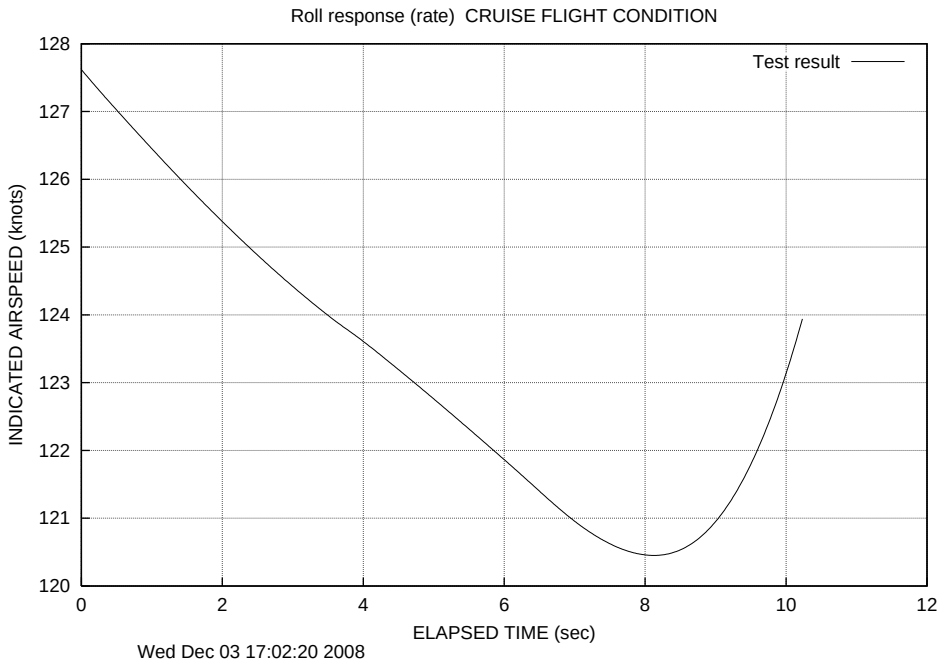


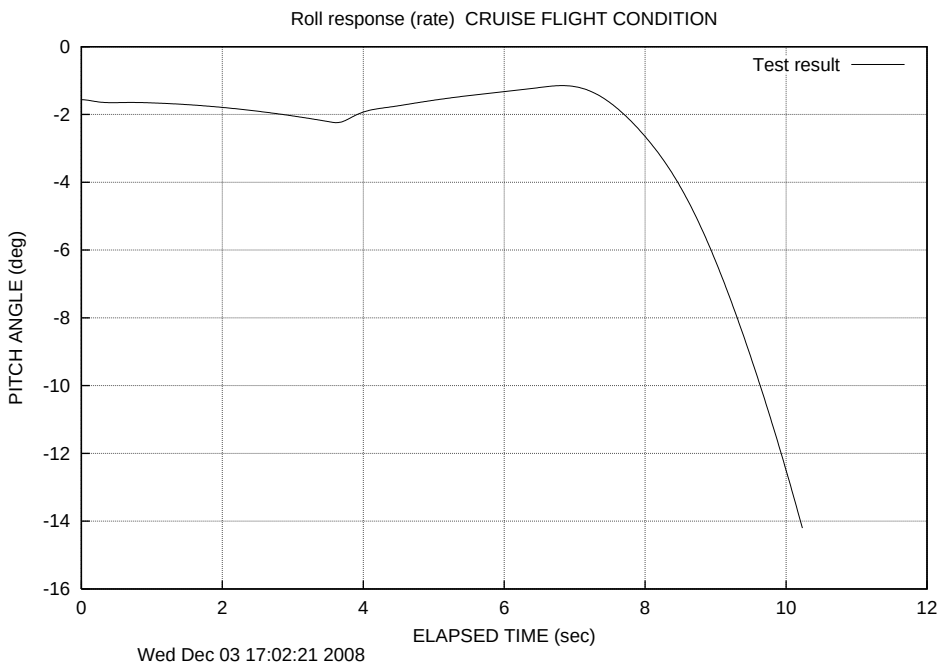

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:02:19 2008
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12

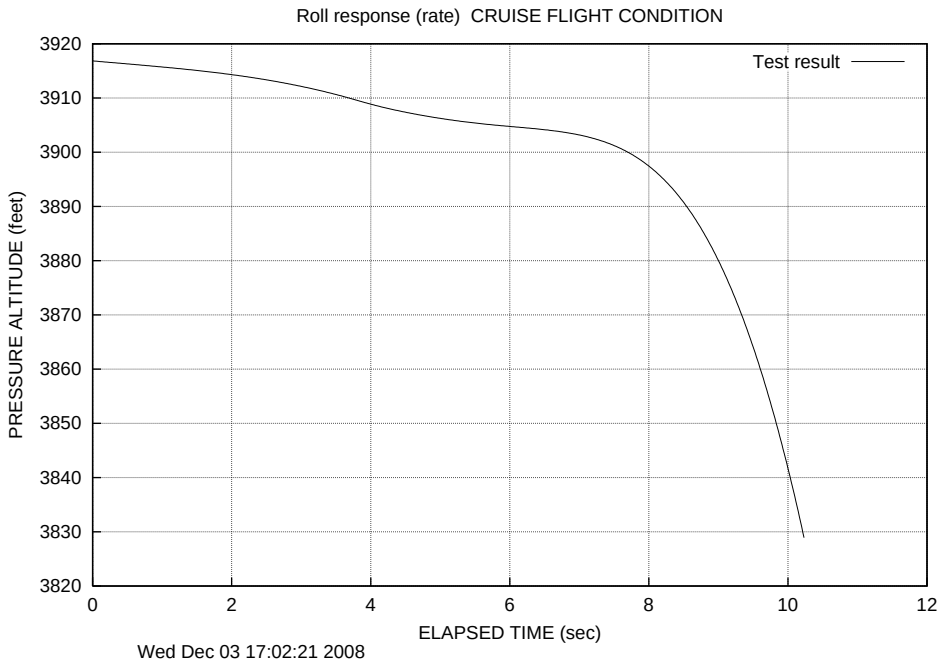

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:02:19 2008
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
0
2
4
6
8
10
12

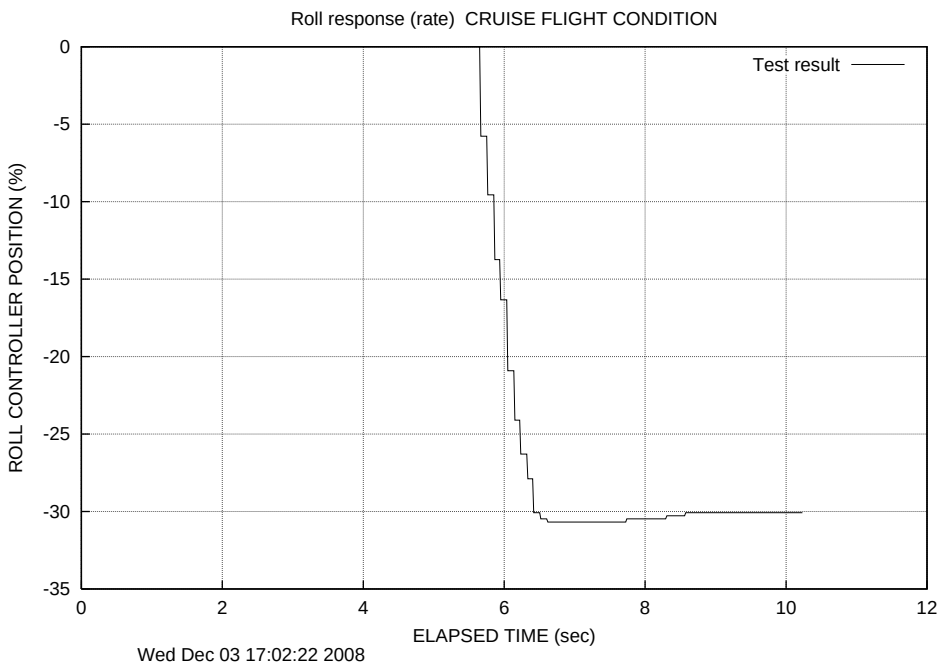

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2620
2610
2600
2590
2580
2570
2560
2550
2540
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:20 2008

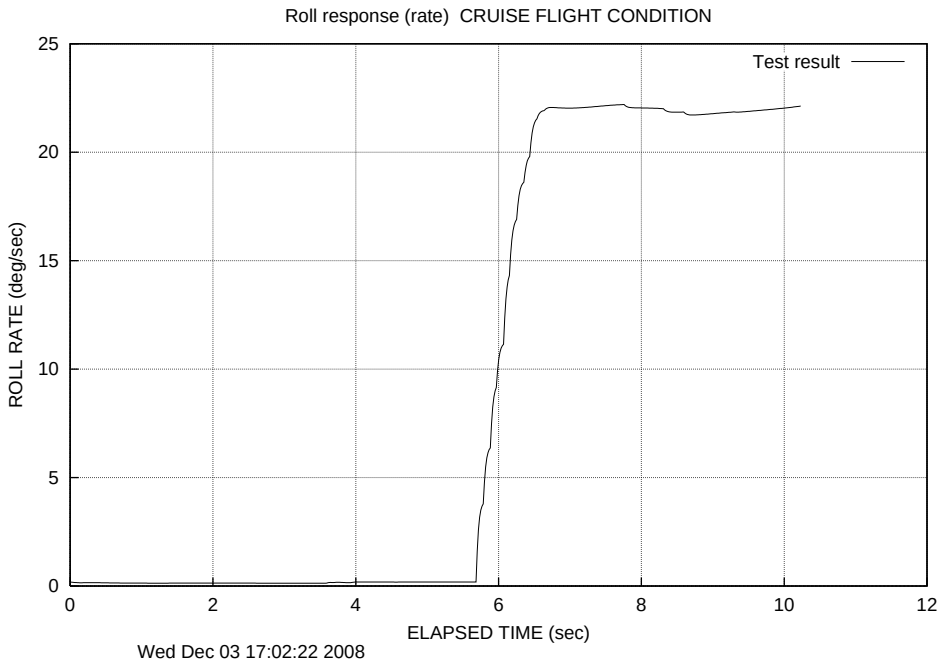

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.825
8.82
8.815
8.81
8.805
8.8
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:20 2008

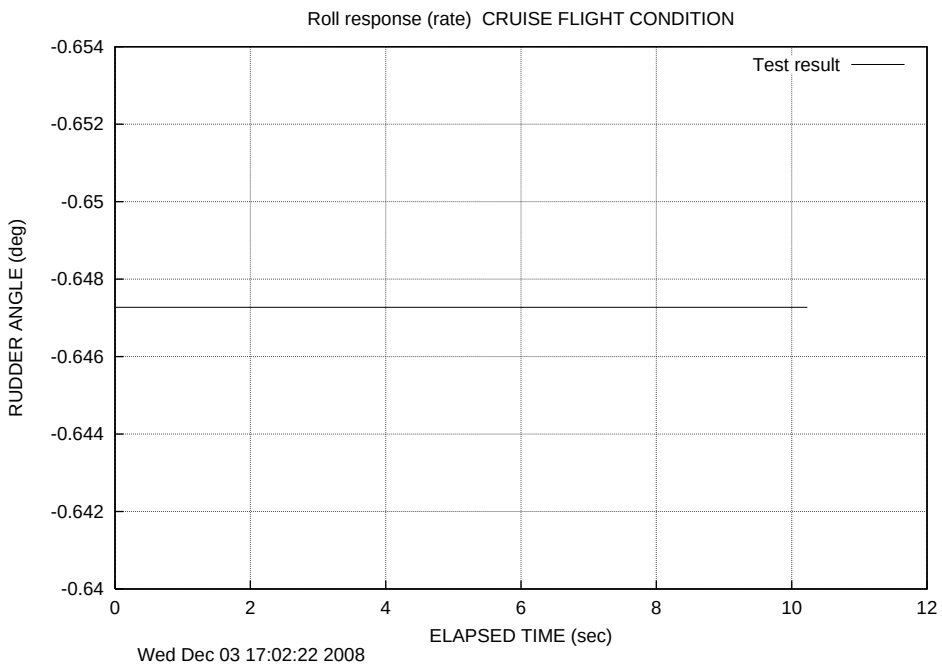

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
128
127
126
125
124
123
122
121
120
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:20 2008

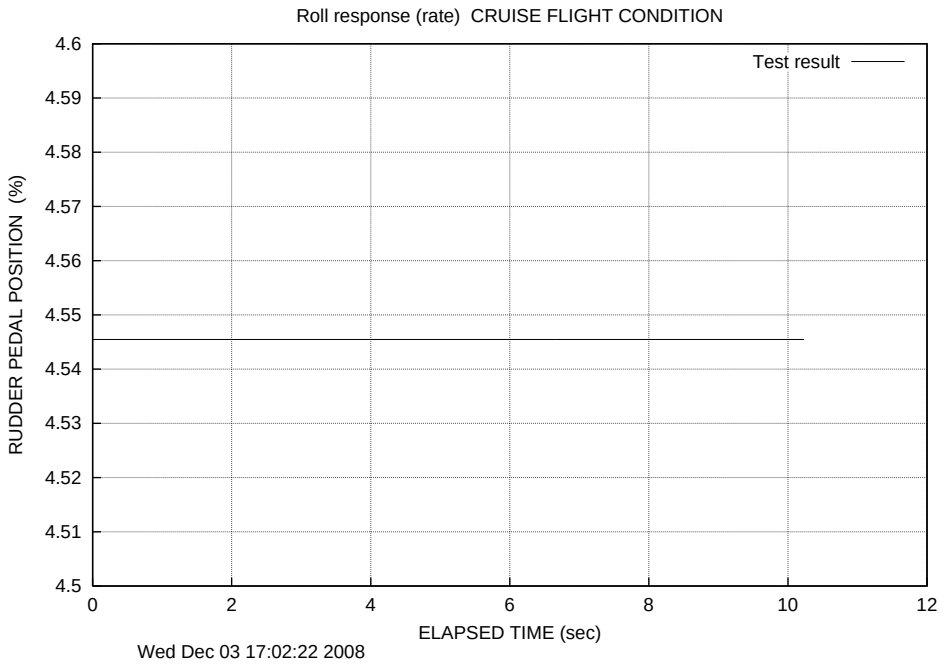

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
0
-2
-4
-6
-8
-10
-12
-14
-16
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:21 2008

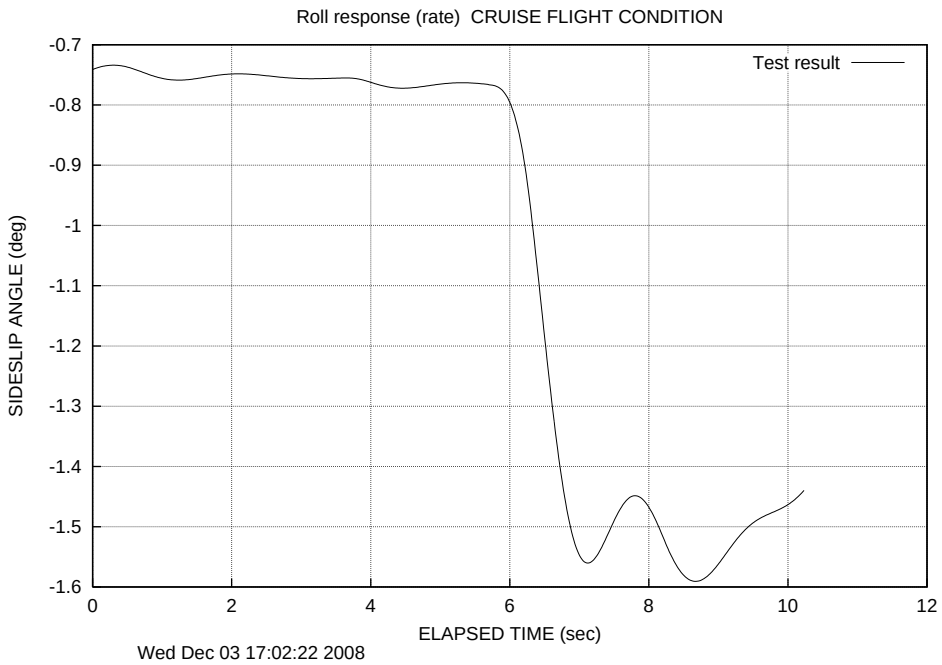

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
3920
3910
3900
3890
3880
3870
3860
3850
3840
3830
3820
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:21 2008

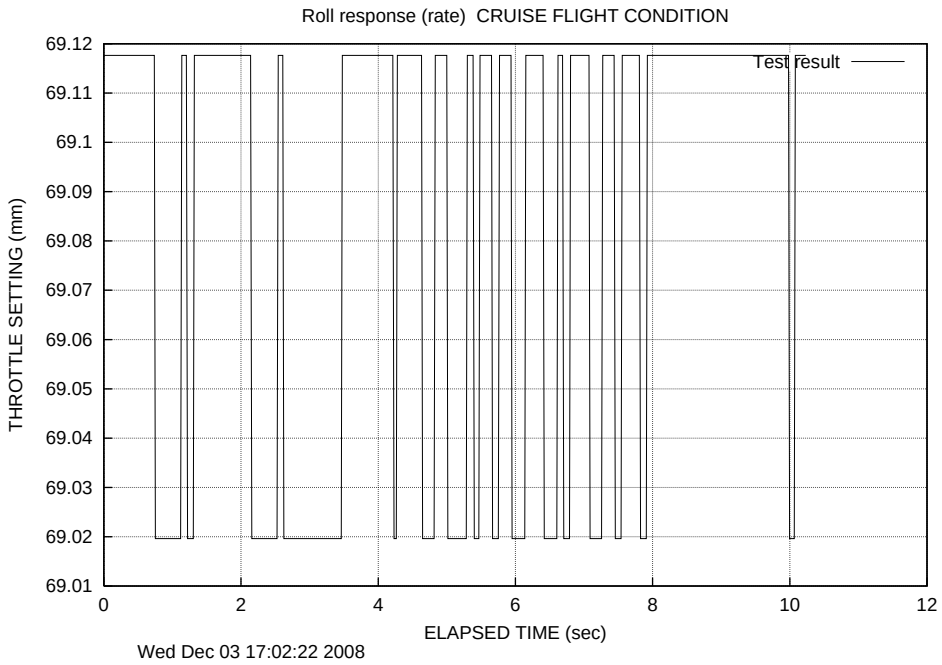

Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
0
-5
-10
-15
-20
-25
-30
-35
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:22 2008


Roll response (rate) CRUISE FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
25
20
15
10
5
0
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:22 2008


Roll response (rate) CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
-0.654
-0.652
-0.65
-0.648
-0.646
-0.644
-0.642
-0.64
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:22 2008


Roll response (rate) CRUISE FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
4.6
4.59
4.58
4.57
4.56
4.55
4.54
4.53
4.52
4.51
4.5
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:22 2008


Roll response (rate) CRUISE FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
0
2
4
6
8
10
12
ELAPSED TIME (sec)
Wed Dec 03 17:02:22 2008



Source data	Section 3.16 of [1]
Comparison of results	The roll response (rate) test shows compliance towards the Validation Reference Data result as described in Section 3.16 of [1].

6.21 Spiral stability (2c4)

Test objective	To demonstrate that the simulation of the dynamic lateral/directional characteristics in the spiral mode conform to the class of aeroplane.
Demonstration procedure	From an established bank angle of approximately 30 degrees, release the lateral controller and allow the aeroplane to respond freely until the bank angle reaches approximately 10 degrees if decreasing, or approximately 45 degrees if increasing. In either case the time interval for the free response need not exceed one minute. The test should be conducted in both directions. As an alternative, the test may be conducted by establishing a steady bank angle of approximately 30 degrees, then applying the lateral control required to maintain bank angle.
References	[2], [3], [4]
Initial conditions	**Approach flight condition (Left):**

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-10.67	(%)
ROLL CONTROLLER POSITION	=	1.804	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2155	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.0	(deg)
LEFT AILERON ANGLE	=	0.2	(deg)
RIGHT AILERON ANGLE	=	-0.2	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON

SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Approach flight condition (Right):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.088	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-10.00	(%)
ROLL CONTROLLER POSITION	=	1.804	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2311	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-0.8	(deg)
LEFT AILERON ANGLE	=	0.2	(deg)
RIGHT AILERON ANGLE	=	-0.2	(deg)
RUDDER ANGLE	=	0.0	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions **Cruise flight condition (Left):**

CONTROL INPUTS:

THROTTLE SETTING	=	38.01	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.080	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-12.67	(%)
ROLL CONTROLLER POSITION	=	2.320	(%)
RUDDER PEDAL POSITION	=	-1.818	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	86.5	(kts)
RATE OF CLIMB	=	200	(fpm)
PRESSURE ALTITUDE	=	4510	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	3.5	(deg)
BANK ANGLE	=	-1.5	(deg)
ANGLE OF ATTACK	=	2.1	(deg)
SIDESLIP ANGLE	=	0.1	(deg)
PITCH RATE	=	0.7	(deg/sec)
ROLL RATE	=	-1.4	(deg/sec)
YAW RATE	=	-0.6	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2249	(rpm)
EXHAUST GAS TEMPERATURE	=	1084	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.7	(deg)
LEFT AILERON ANGLE	=	0.3	(deg)
RIGHT AILERON ANGLE	=	-0.3	(deg)
RUDDER ANGLE	=	0.4	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions **Cruise flight condition (Right):**

CONTROL INPUTS:

THROTTLE SETTING	=	38.01	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.080	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-12.67	(%)
ROLL CONTROLLER POSITION	=	0.0	(%)
RUDDER PEDAL POSITION	=	1.091	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	86.5	(kts)
RATE OF CLIMB	=	200	(fpm)
PRESSURE ALTITUDE	=	4510	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	3.5	(deg)
BANK ANGLE	=	-1.5	(deg)
ANGLE OF ATTACK	=	2.1	(deg)
SIDESLIP ANGLE	=	0.1	(deg)
PITCH RATE	=	0.7	(deg/sec)
ROLL RATE	=	-1.4	(deg/sec)
YAW RATE	=	-0.6	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2272	(rpm)
EXHAUST GAS TEMPERATURE	=	1084	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.7	(deg)
LEFT AILERON ANGLE	=	-0.1	(deg)
RIGHT AILERON ANGLE	=	0.1	(deg)
RUDDER ANGLE	=	-0.1	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `617_FSTD_2d4_Approach.sit` or `617_FSTD_2d4_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the Yoke in roll position at the prescribed trimmed initial condition:
1. From the initial roll controller position, rotate the the Yoke such that the aeroplane rolls to the left. Release the Yoke, allowing the aeroplane to respond freely, from an establishes bank angle of 30 degrees.
2. Stop recording when the bank angle reaches 10 degrees if decreasing, or approximately 45 degrees if increasing, or when a total of 65 seconds have elapsed.

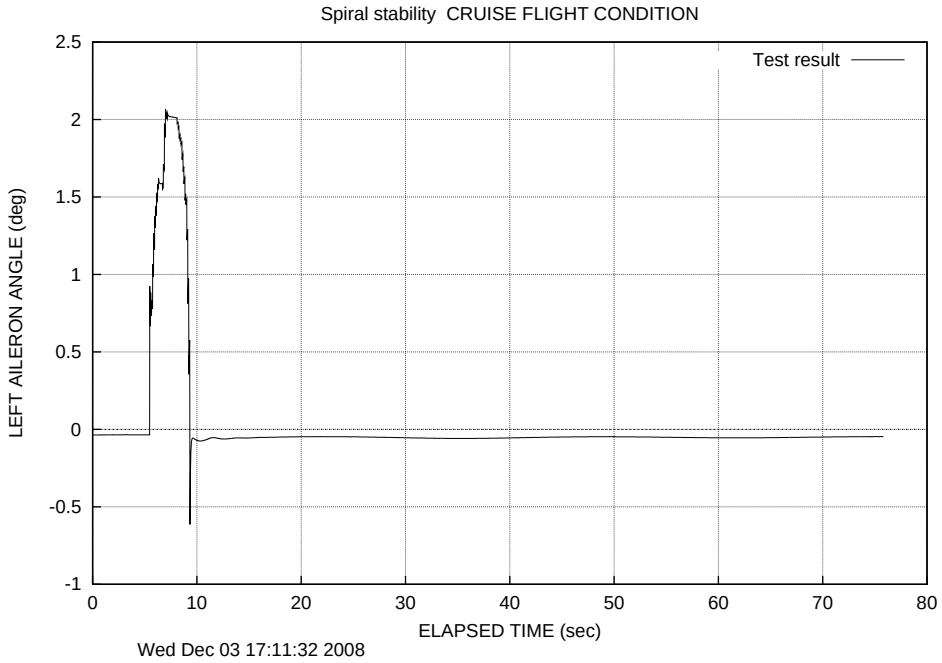
Repeat this manual test procedure for a roll to the right.

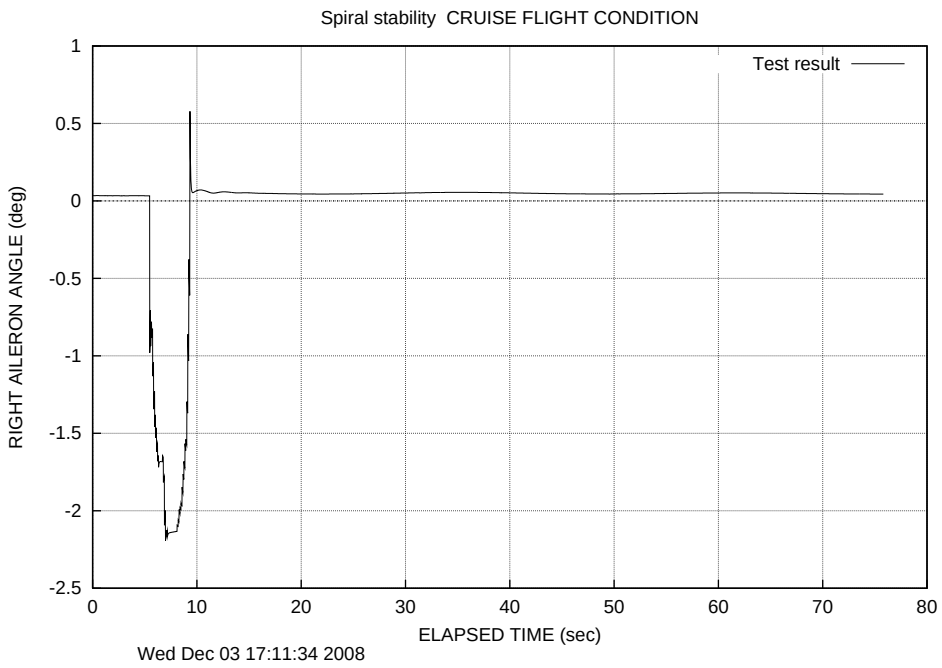
Evaluated parameters

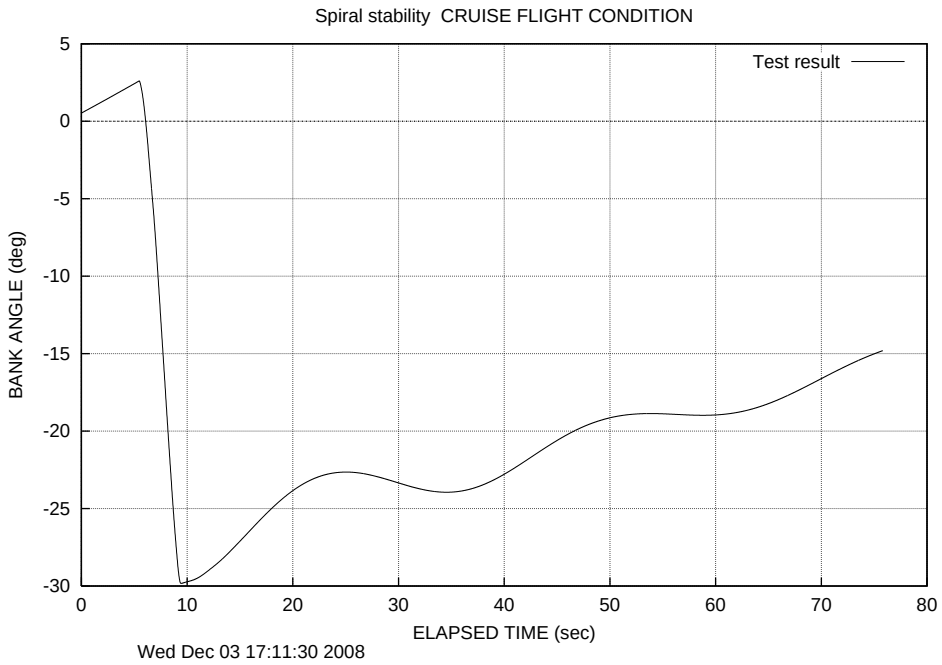
AILERON ANGLE
BANK ANGLE
ELEVATOR ANGLE
ENGINE SPEED
FUEL FLOW
INDICATED AIRSPEED

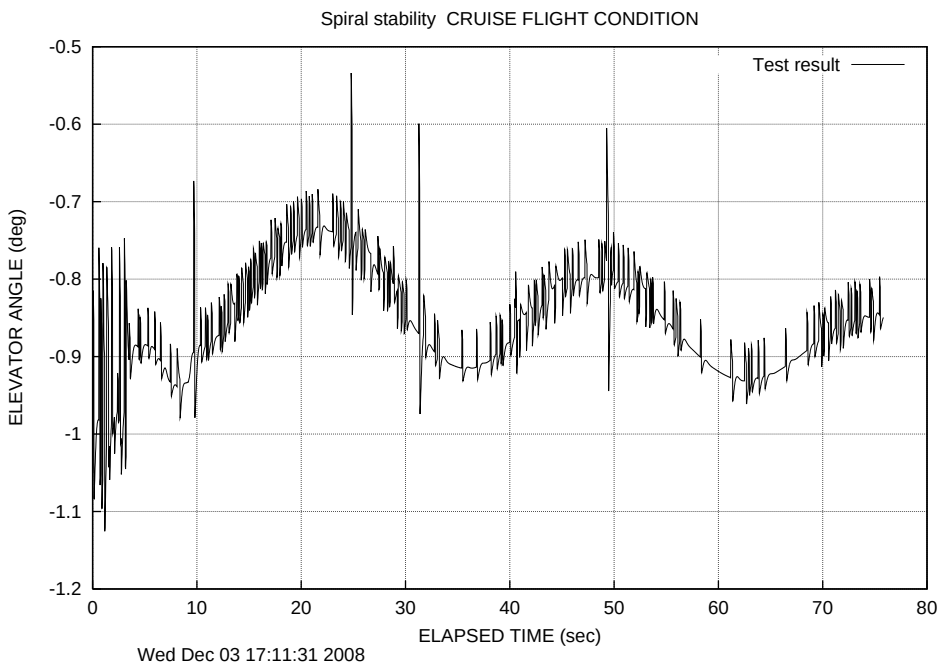
	PITCH ANGLE PRESSURE ALTITUDE ROLL CONTROLLER POSITION ROLL RATE RUDDER ANGLE RUDDER PEDAL POSITION SIDESLIP ANGLE THROTTLE SETTING	
Expected results	The bank angle is expected to slightly increase or decrease as the aeroplane is allowed to respond freely. See section 3.17 of [1].	
Tolerances	BANK ANGLE	Correct trend and $\pm 2°$ or $\pm 10\%$ in 20 sec
Test result	Under approach and under cruise flight condition, for both rolling to the left and rolling to the right, the bank angle slightly increases as the aeroplane is allowed to respond freely.	

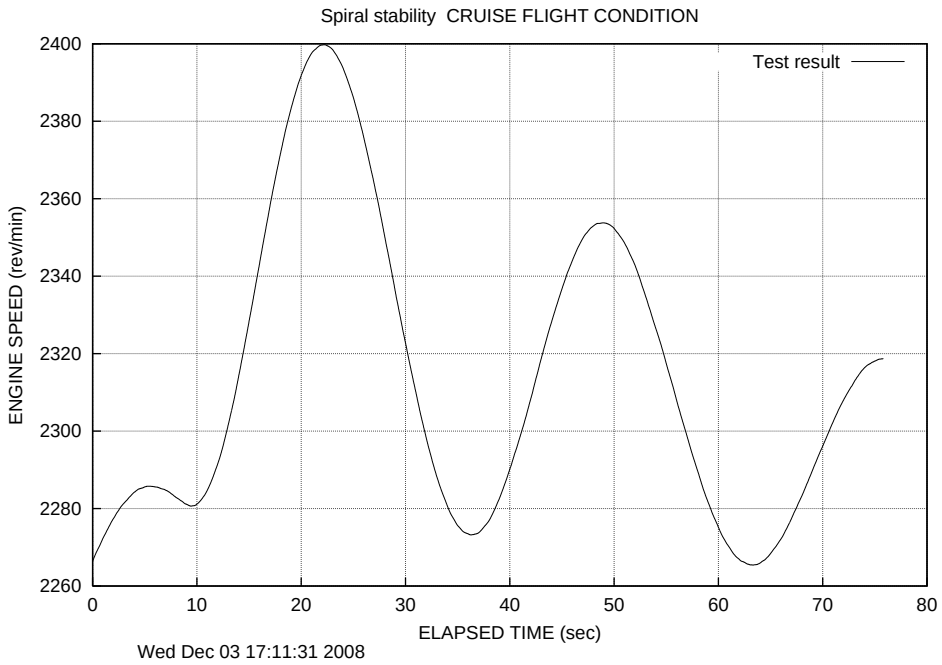
Rolling left (Cruise):

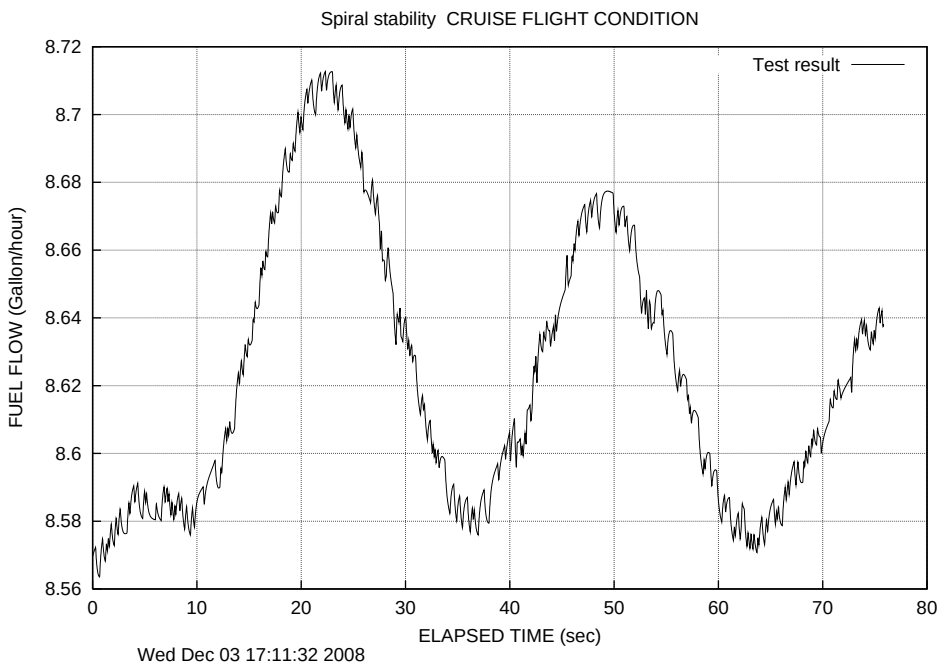


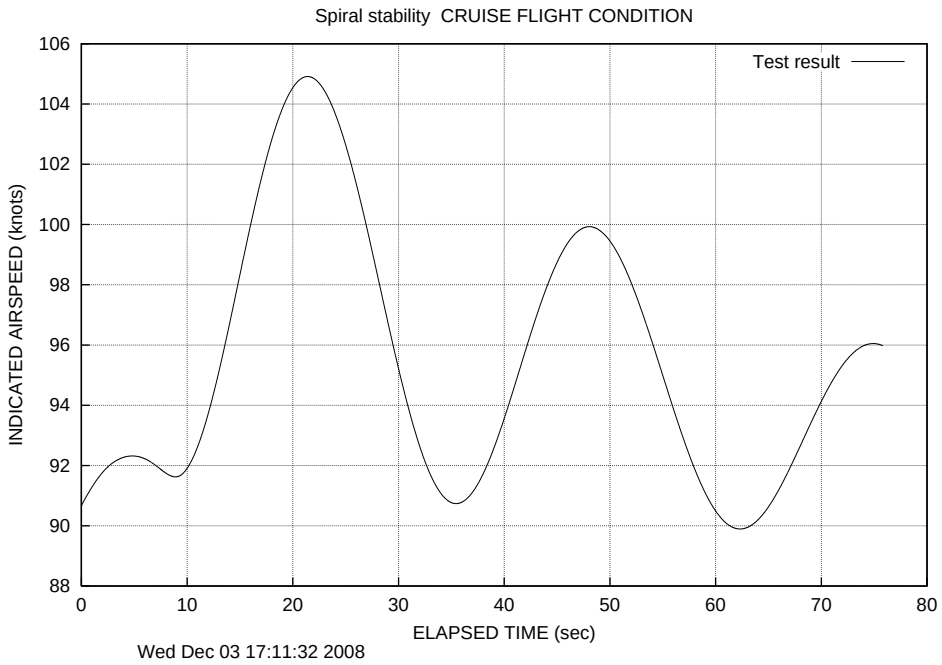


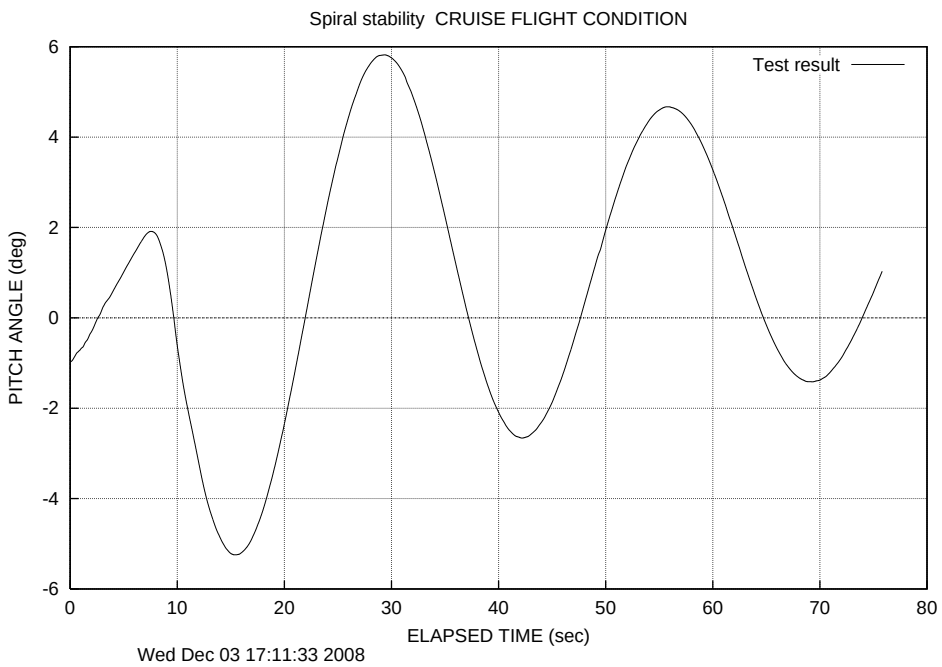

Spiral stability CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:30 2008

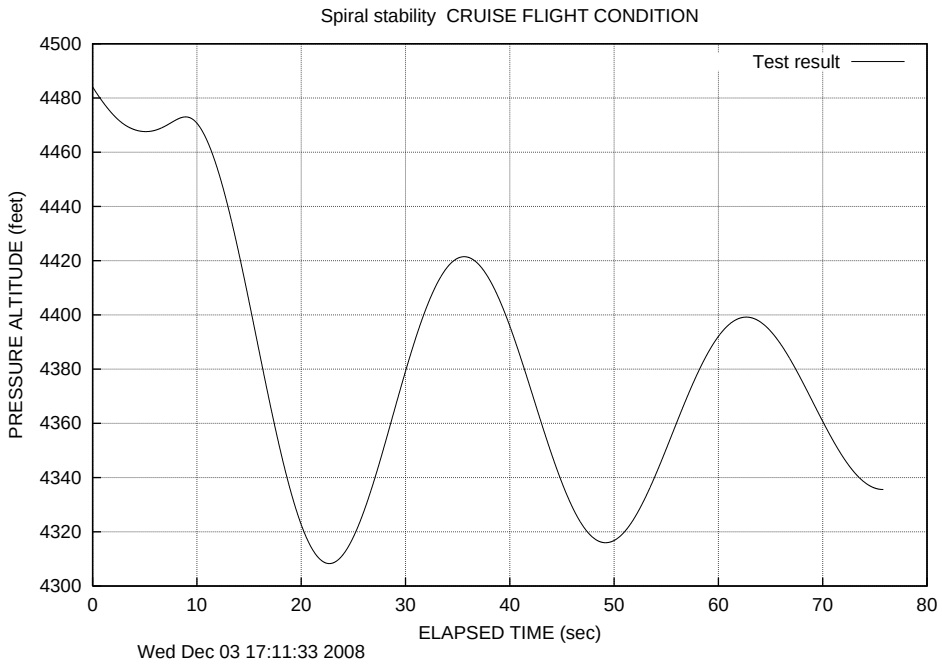

Spiral stability CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:31 2008

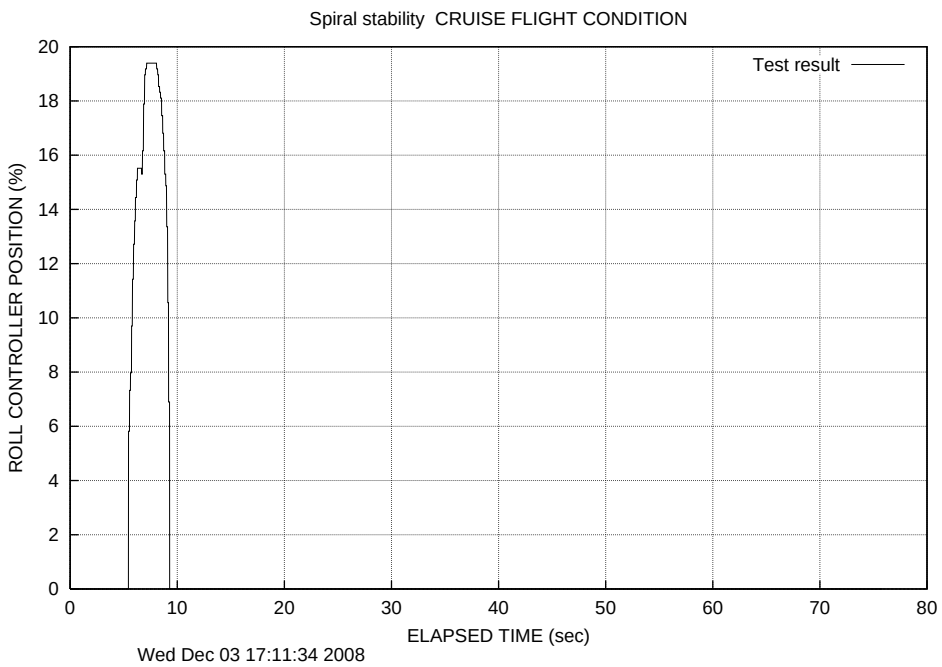

Spiral stability CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2400
2380
2360
2340
2320
2300
2280
2260
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:31 2008

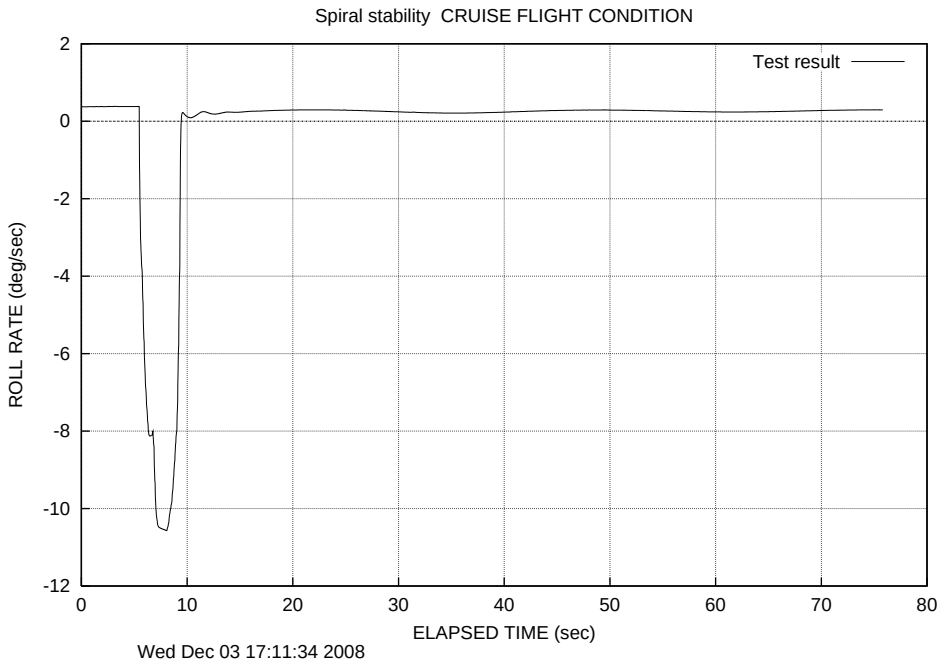

Spiral stability CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.72
8.7
8.68
8.66
8.64
8.62
8.6
8.58
8.56
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:32 2008

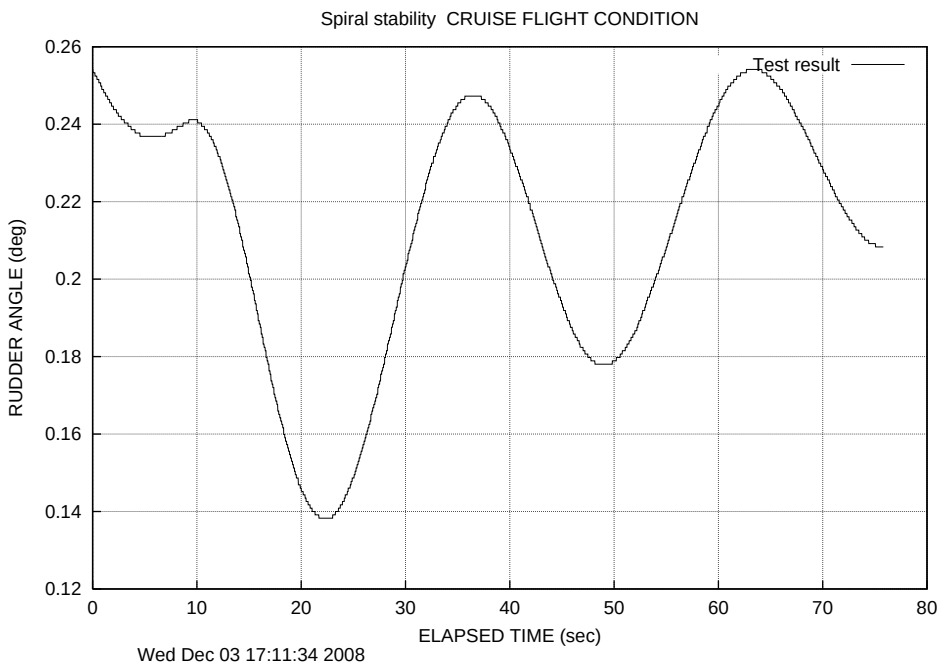

Spiral stability CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
106
104
102
100
98
96
94
92
90
88
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:32 2008

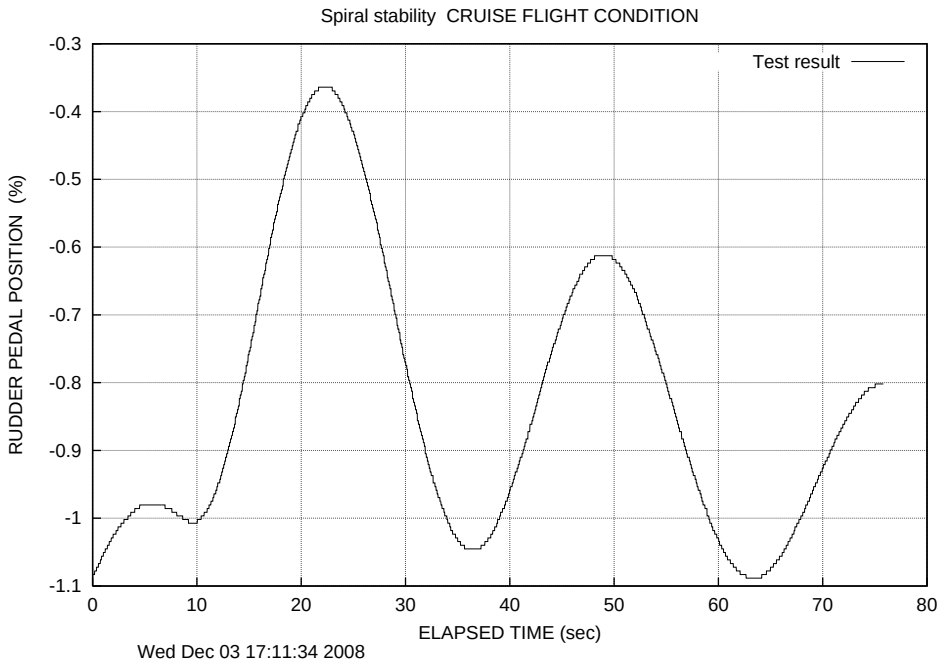

Spiral stability CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
6
4
2
0
-2
-4
-6
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:33 2008

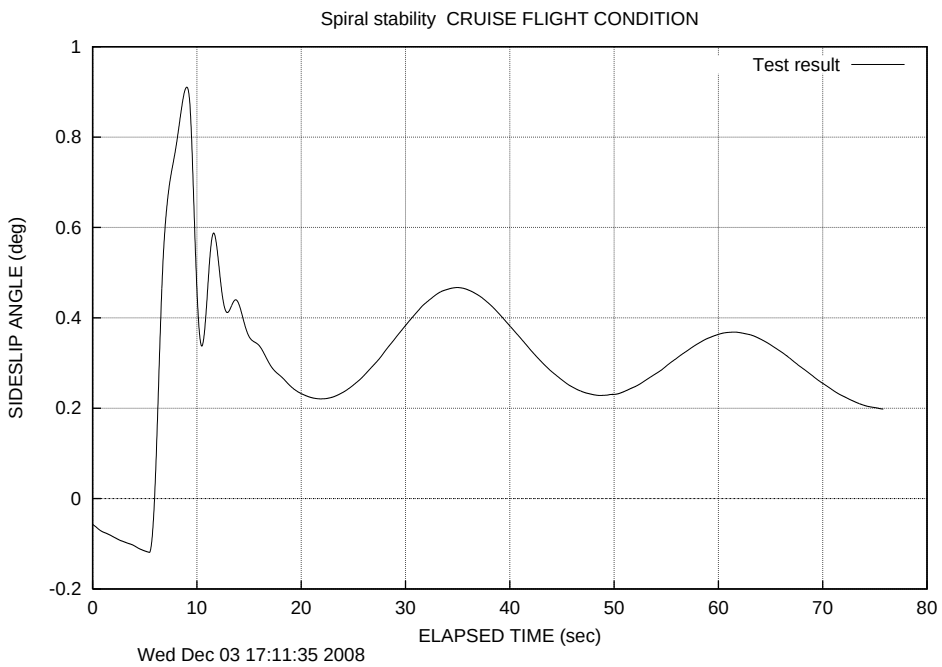

Spiral stability CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4500
4480
4460
4440
4420
4400
4380
4360
4340
4320
4300
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:33 2008

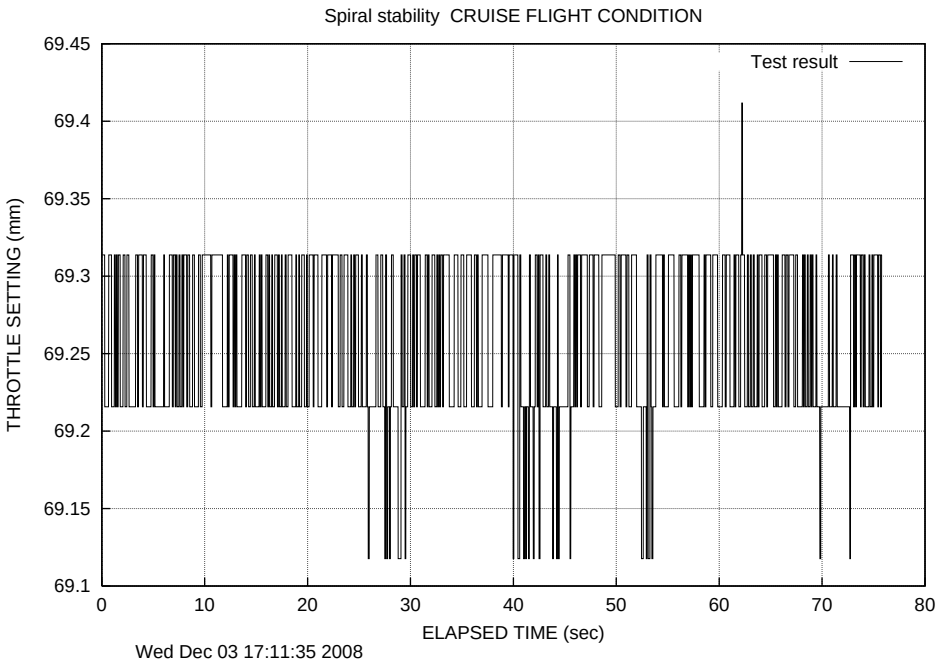

Spiral stability CRUISE FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:34 2008


Spiral stability CRUISE FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
2
0
-2
-4
-6
-8
-10
-12
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:34 2008

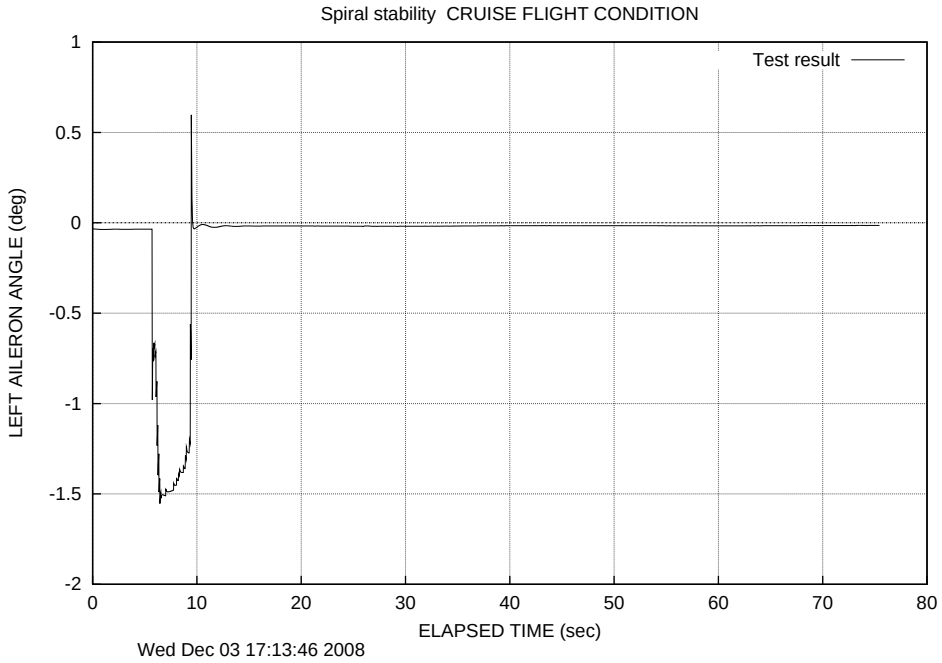

Spiral stability CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:34 2008

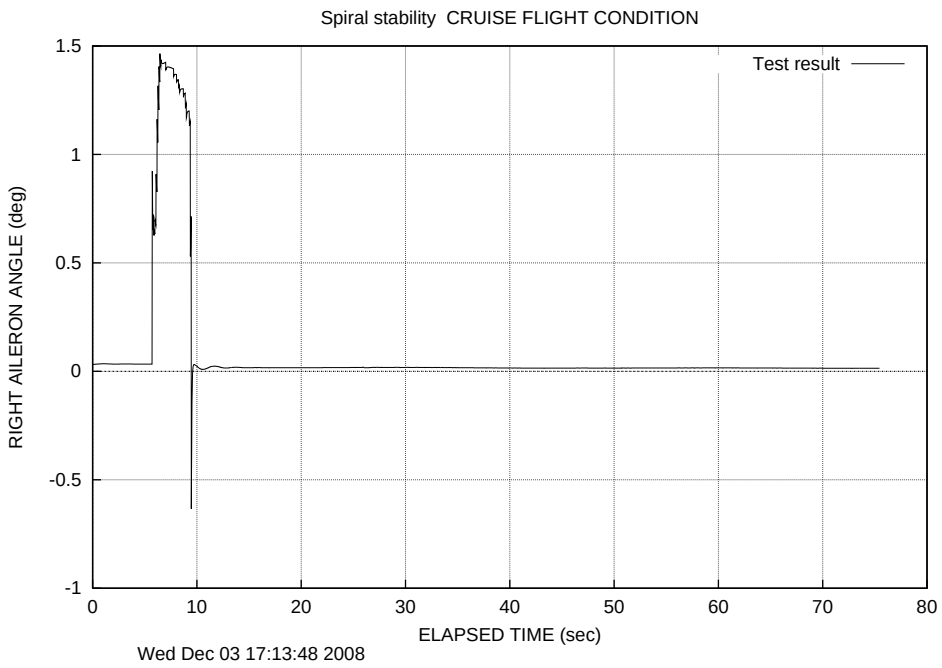

Spiral stability CRUISE FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:34 2008

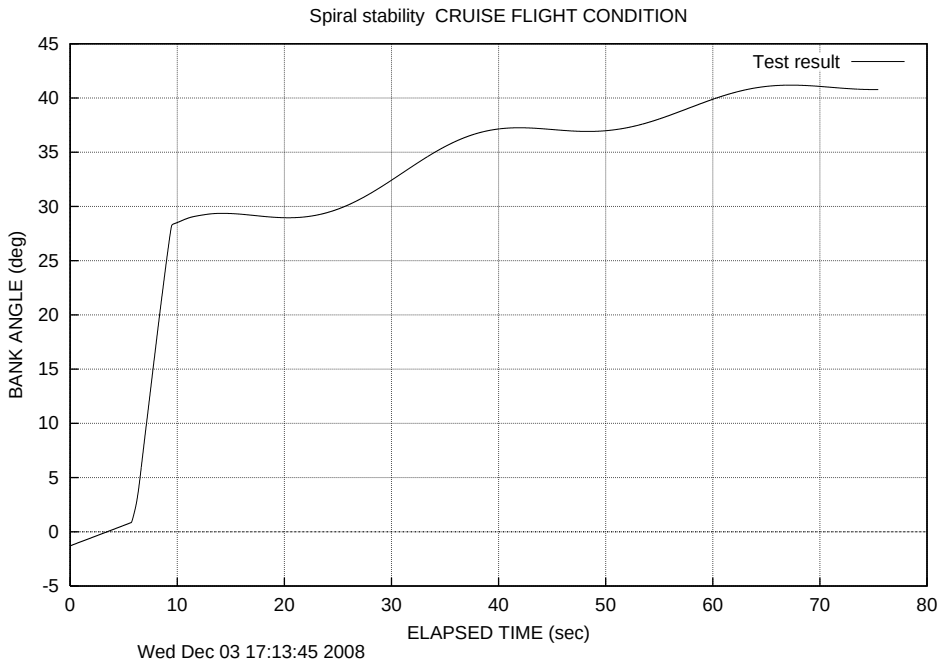

Spiral stability CRUISE FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
1
0.8
0.6
0.4
0.2
0
-0.2
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:35 2008

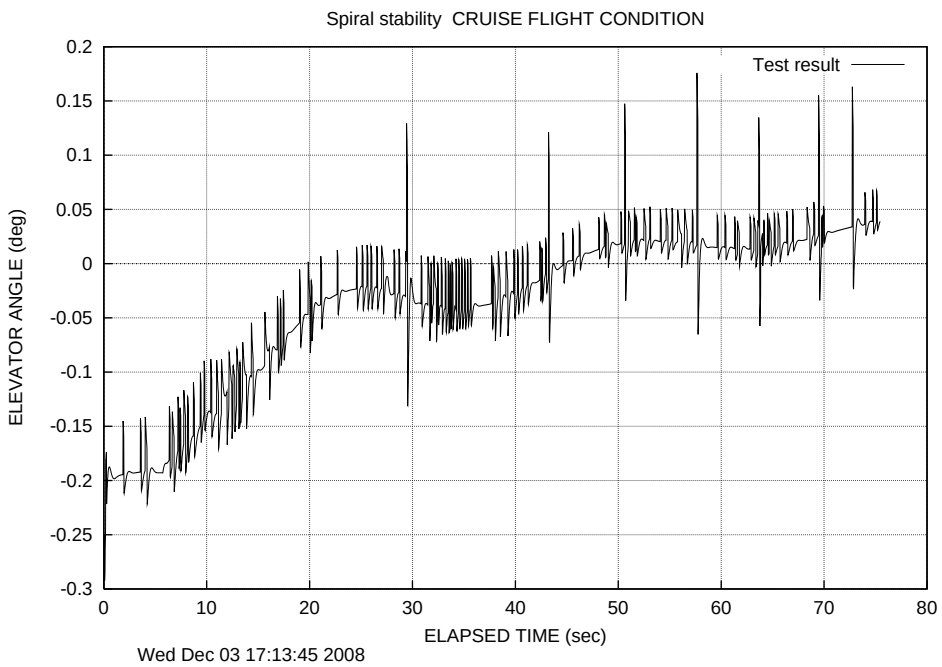

Spiral stability CRUISE FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.45
69.4
69.35
69.3
69.25
69.2
69.15
69.1
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:11:35 2008

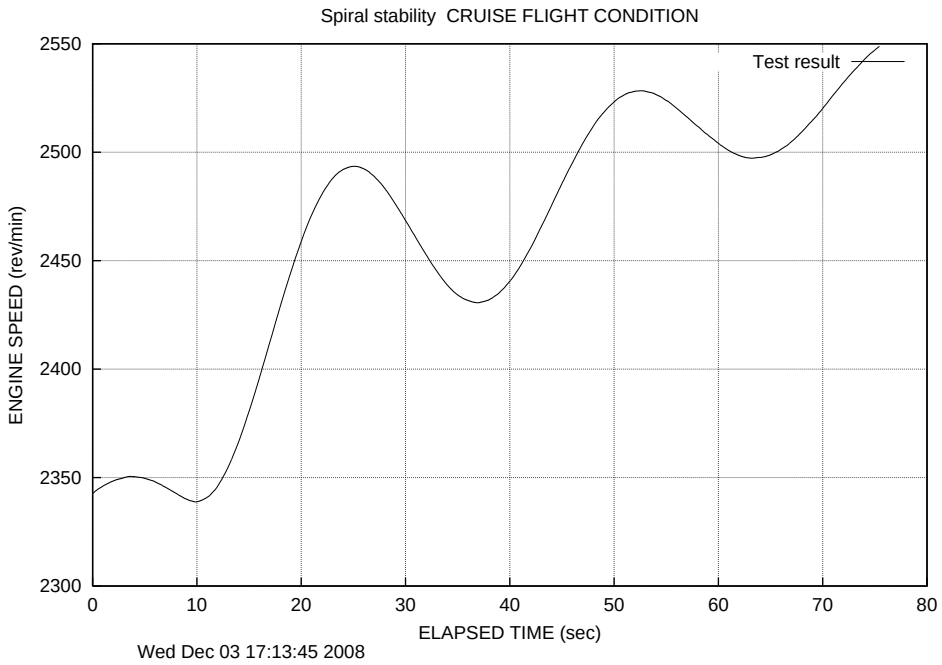
Rolling right (Cruise):

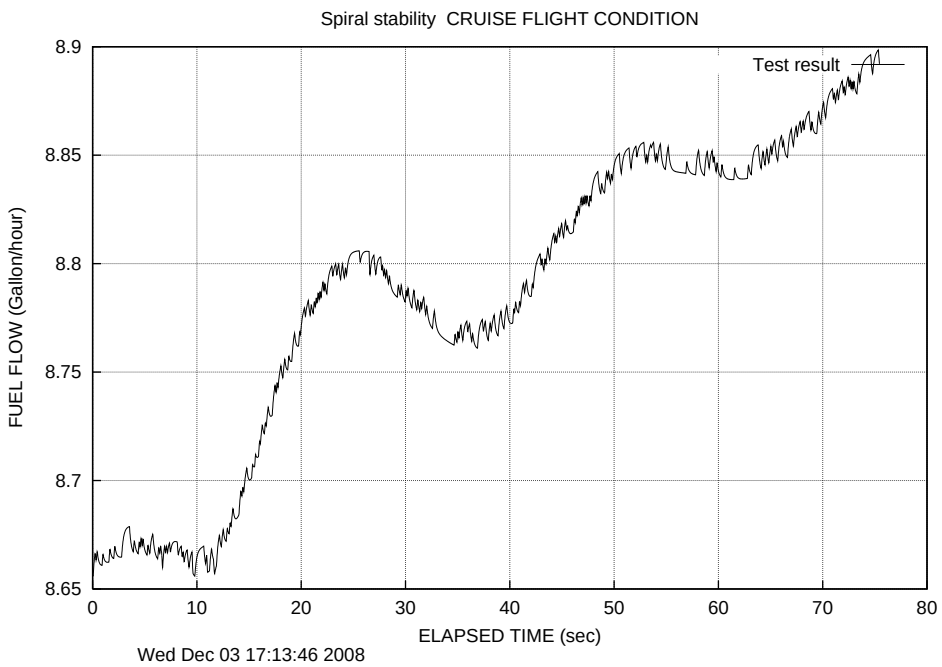


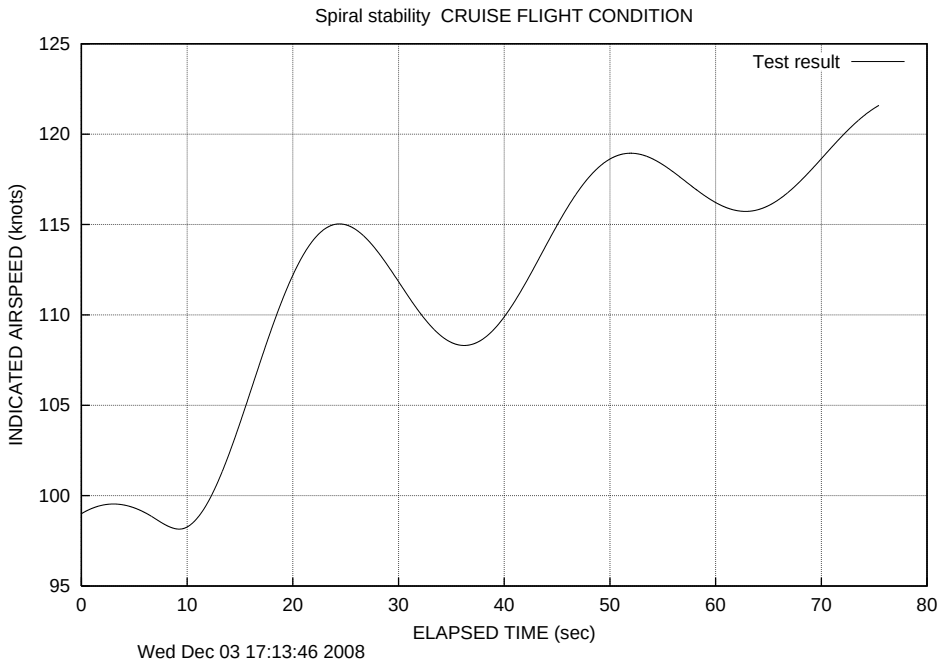


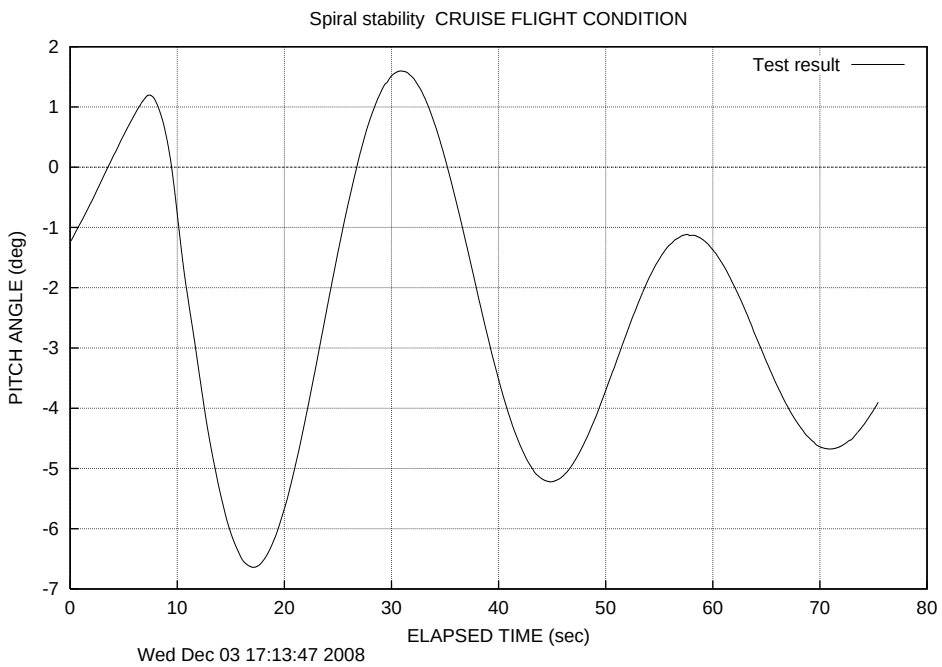

Spiral stability CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:13:45 2008

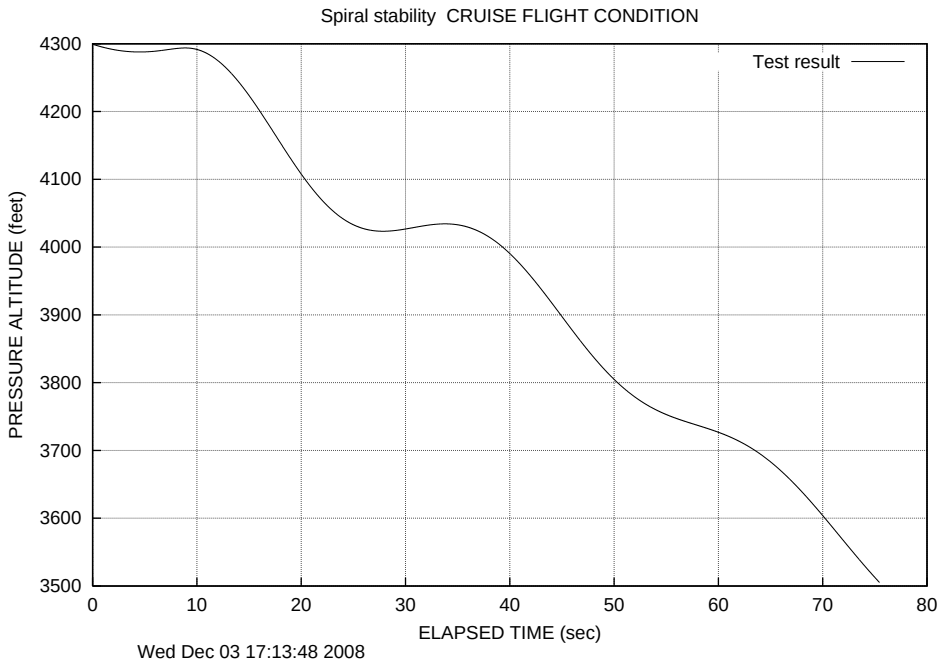

Spiral stability CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:13:45 2008

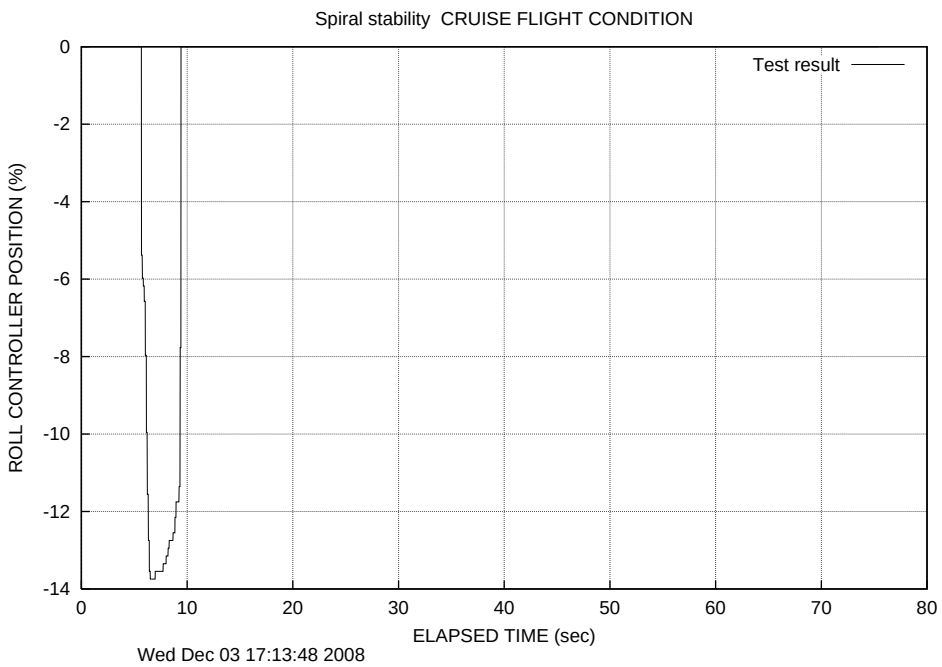

Spiral stability CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2550
2500
2450
2400
2350
2300
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:45 2008

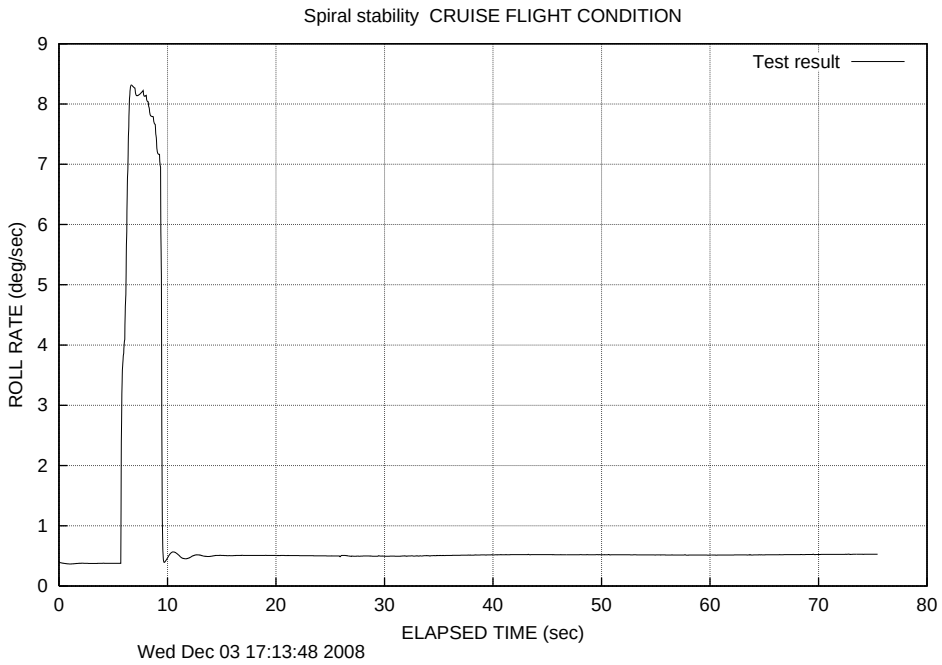

Spiral stability CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.9
8.85
8.8
8.75
8.7
8.65
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:46 2008

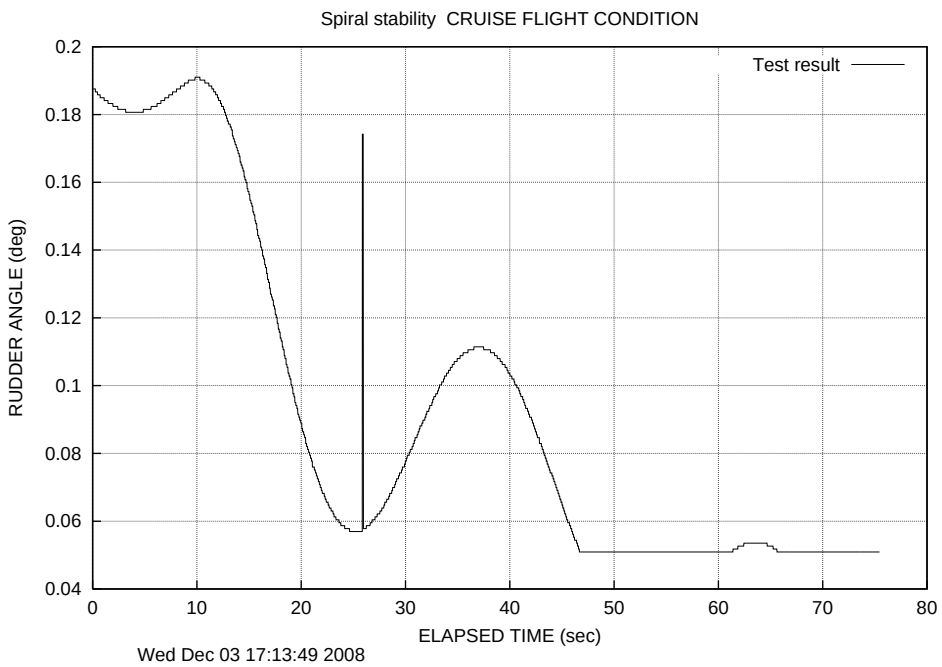

Spiral stability CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
125
120
115
110
105
100
95
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:46 2008

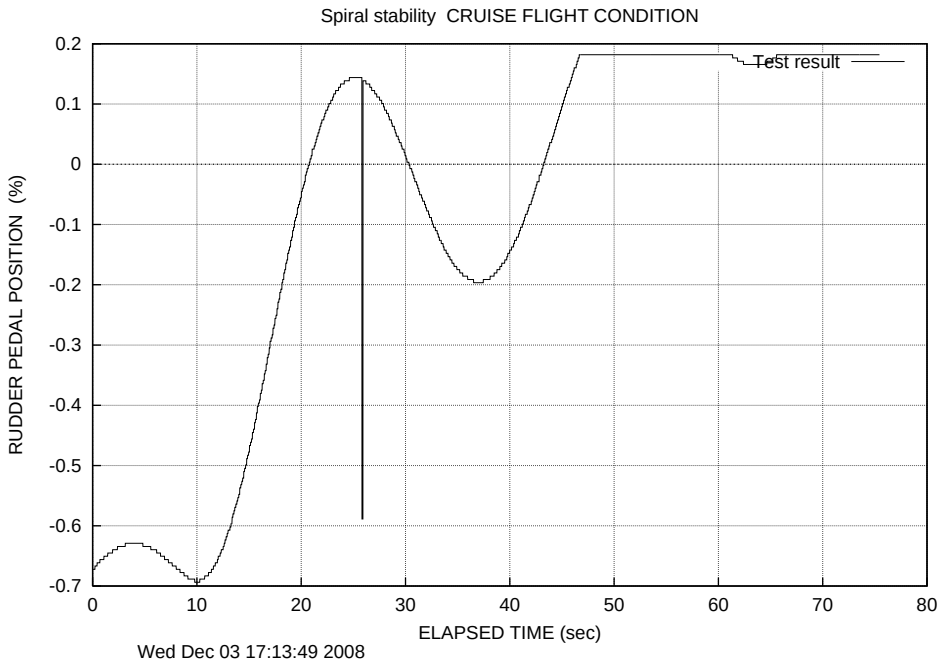

Spiral stability CRUISE FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
2
1
0
-1
-2
-3
-4
-5
-6
-7
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:47 2008

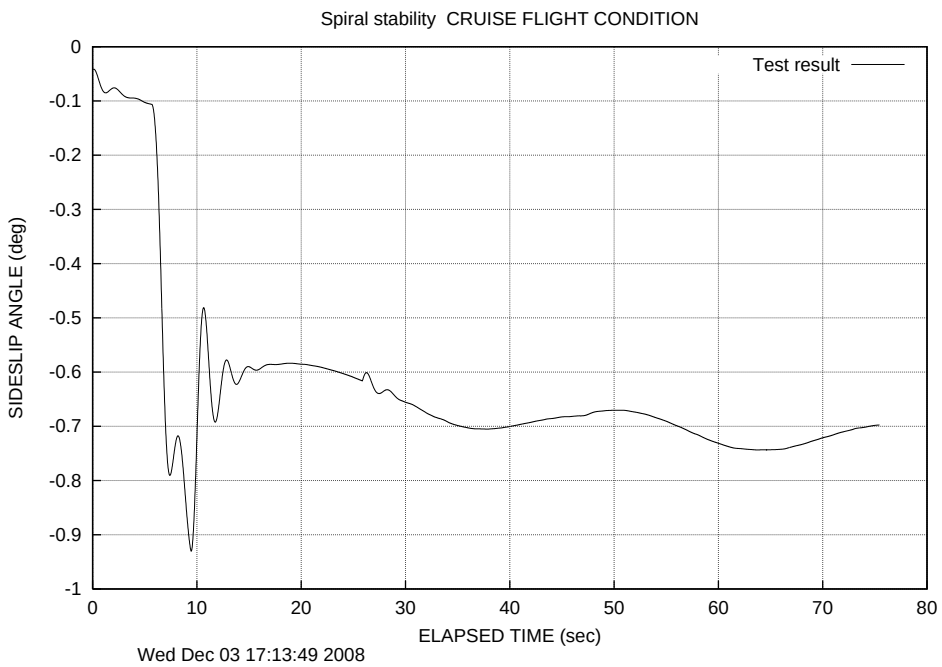

Spiral stability CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4300
4200
4100
4000
3900
3800
3700
3600
3500
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:48 2008

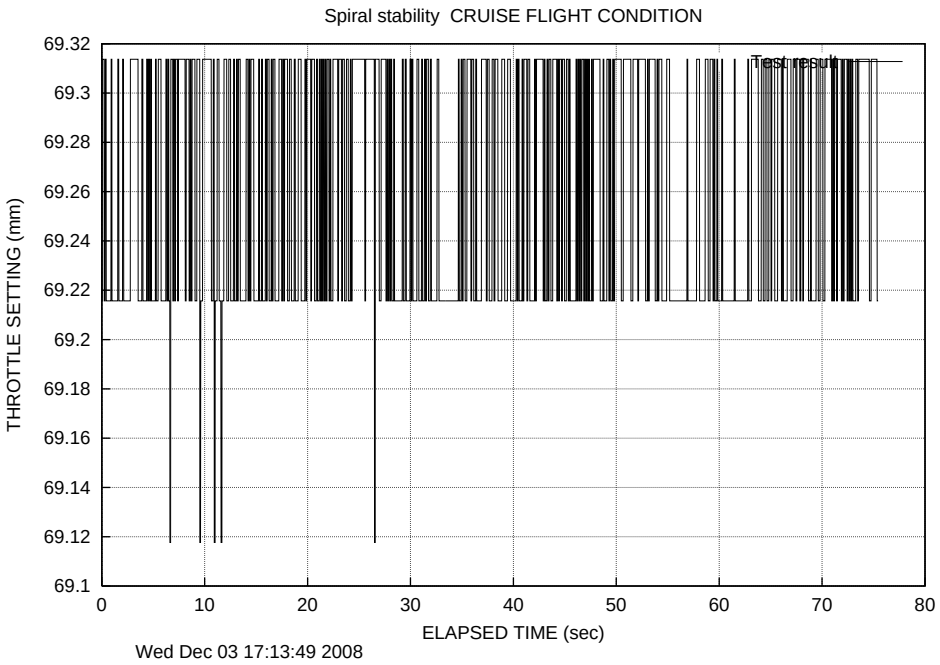

Spiral stability CRUISE FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
0
-2
-4
-6
-8
-10
-12
-14
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:48 2008


Spiral stability CRUISE FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 17:13:48 2008

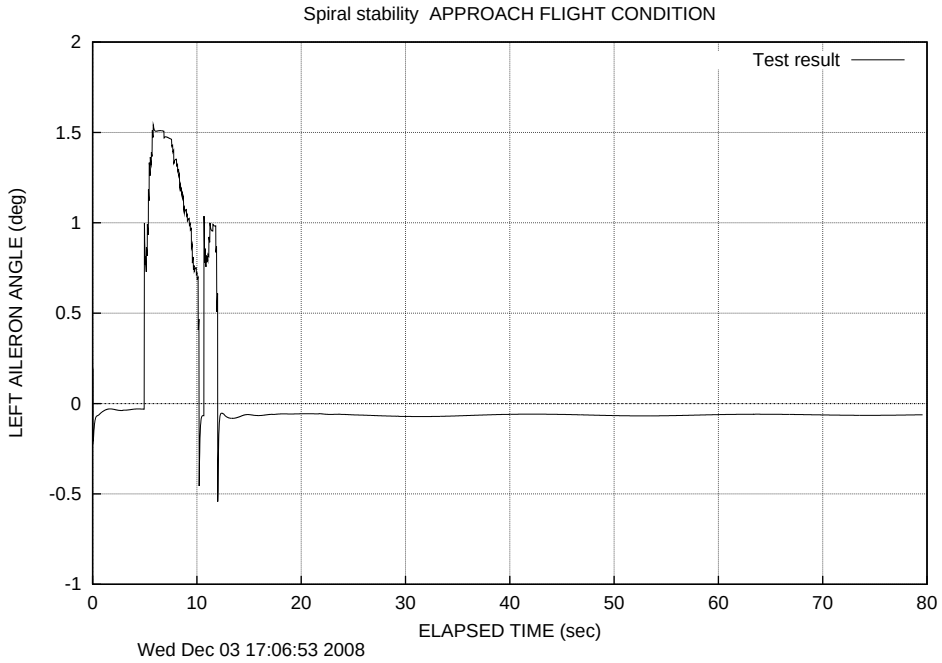

Spiral stability CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:13:49 2008

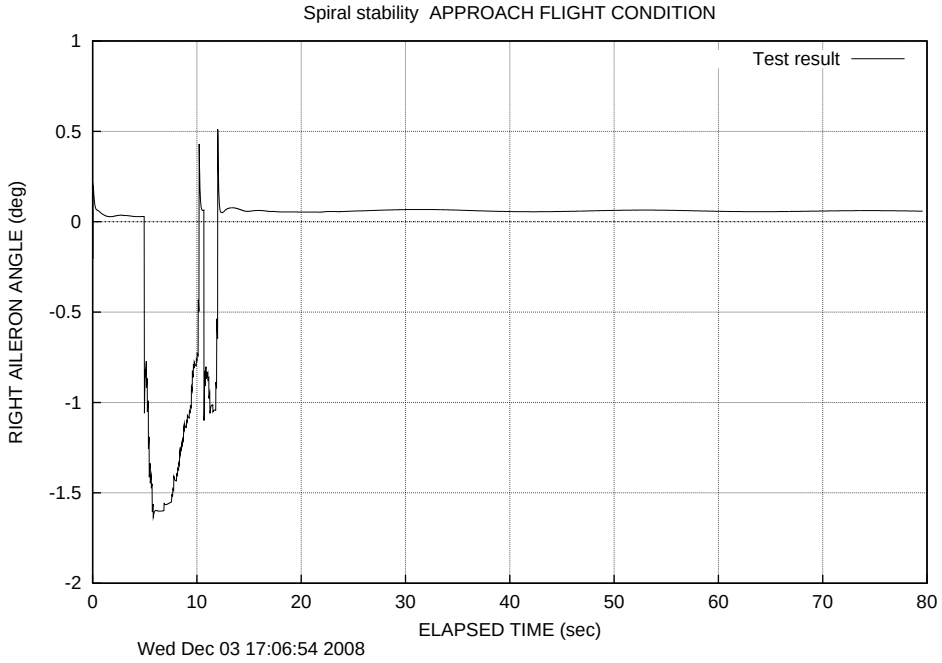

Spiral stability CRUISE FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:49 2008

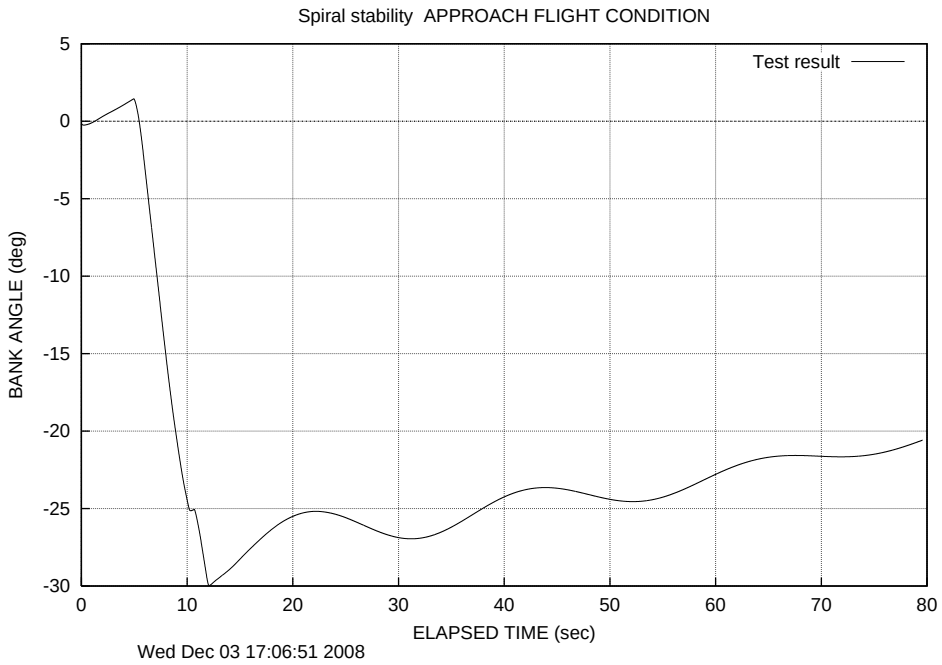

Spiral stability CRUISE FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:49 2008

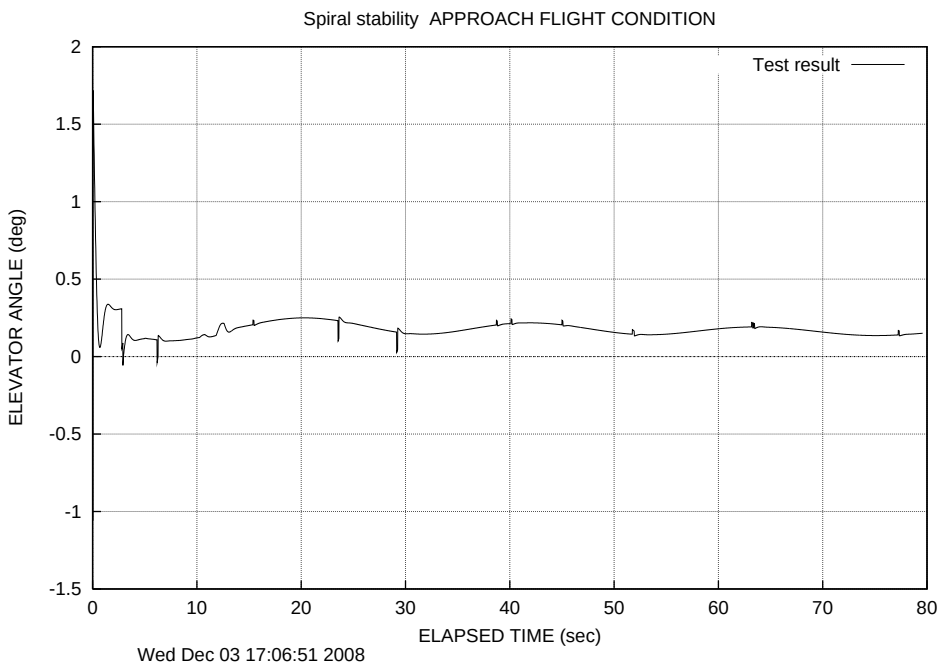

Spiral stability CRUISE FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.32
69.3
69.28
69.26
69.24
69.22
69.2
69.18
69.16
69.14
69.12
69.1
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:13:49 2008

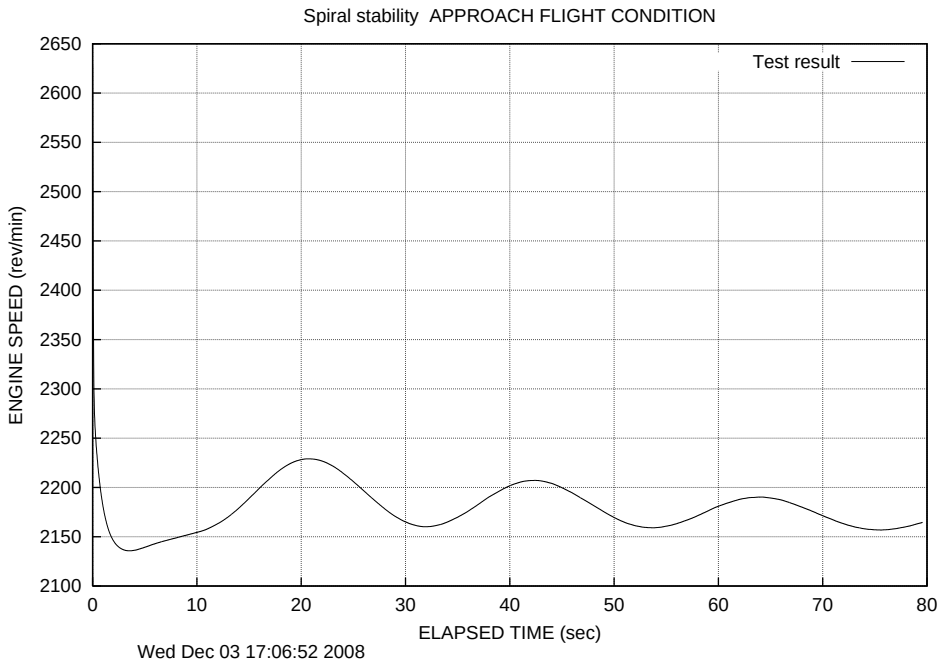
Rolling left (Approach):

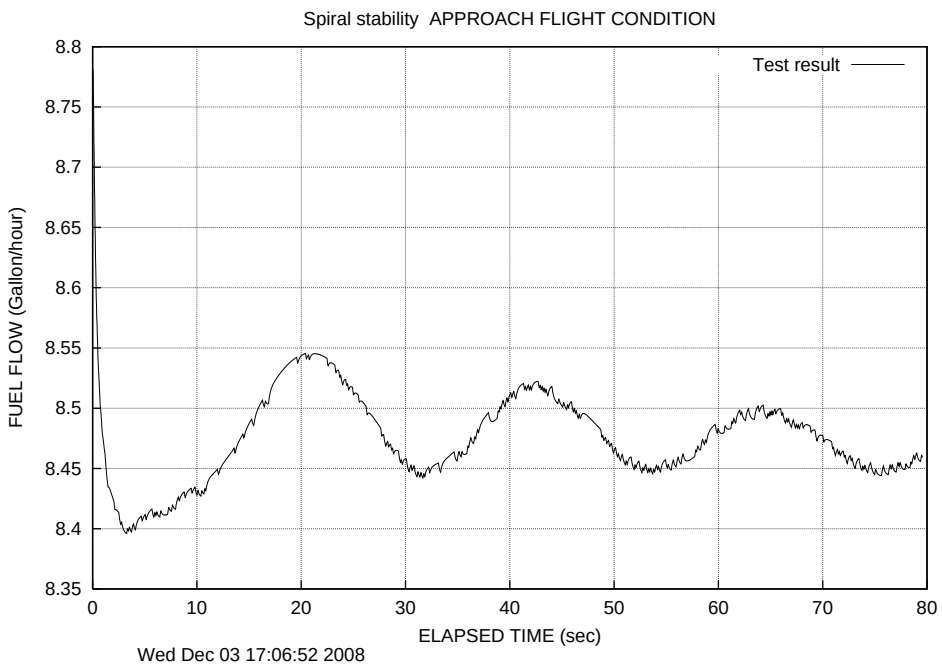


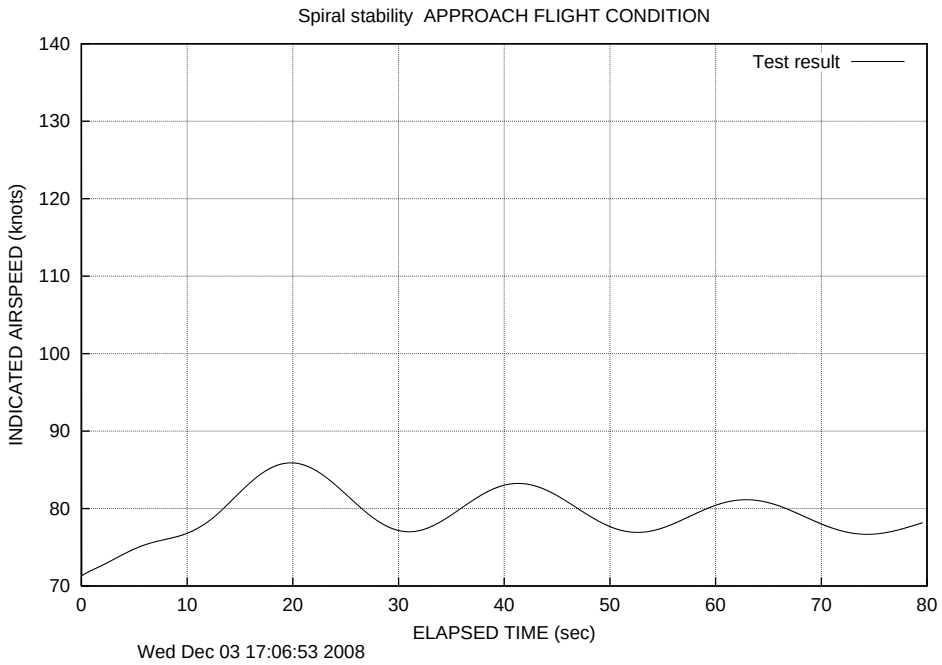


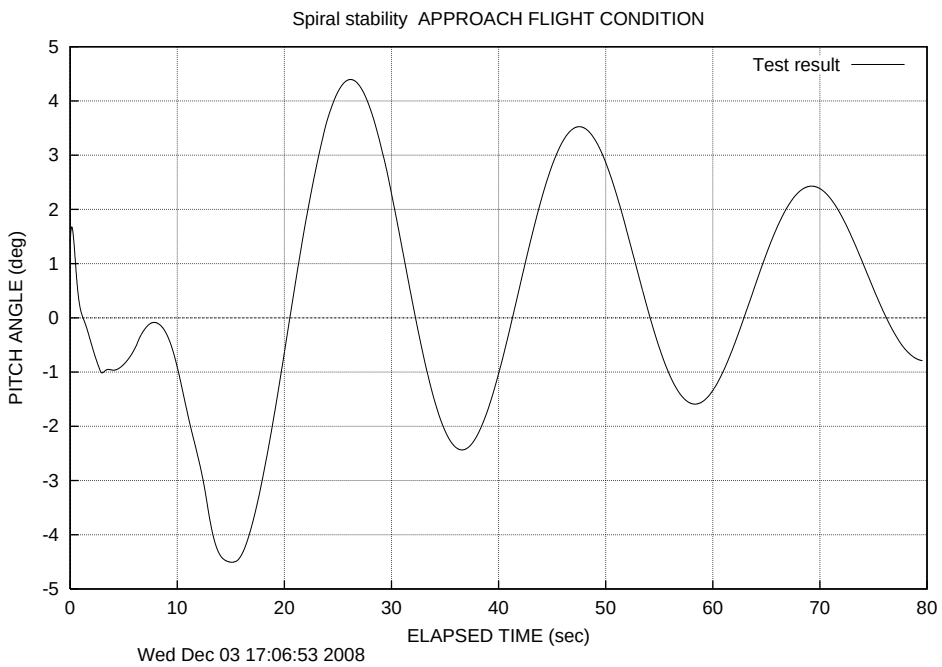

Spiral stability APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:51 2008

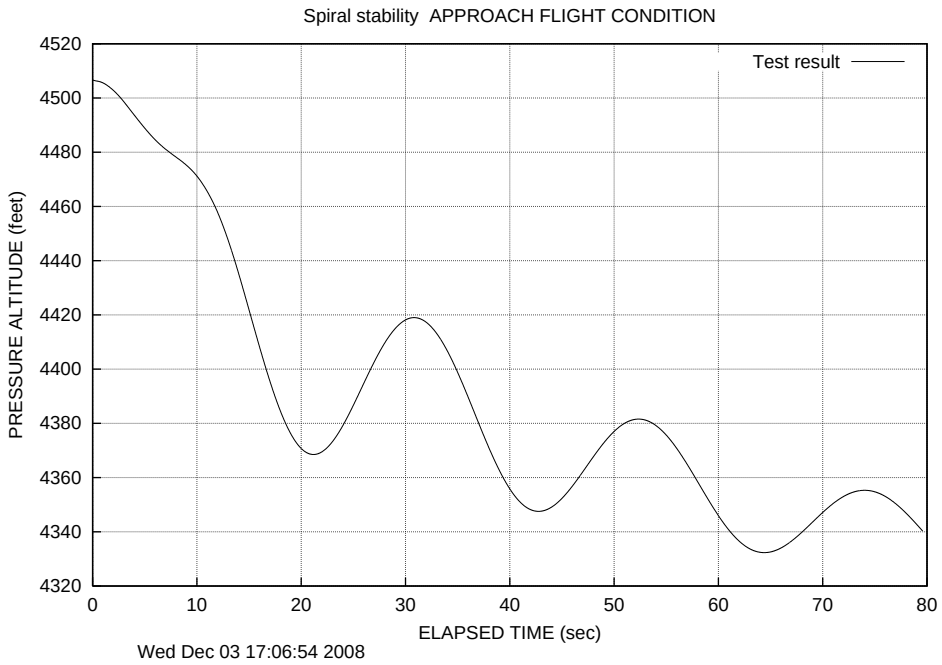

Spiral stability APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:51 2008

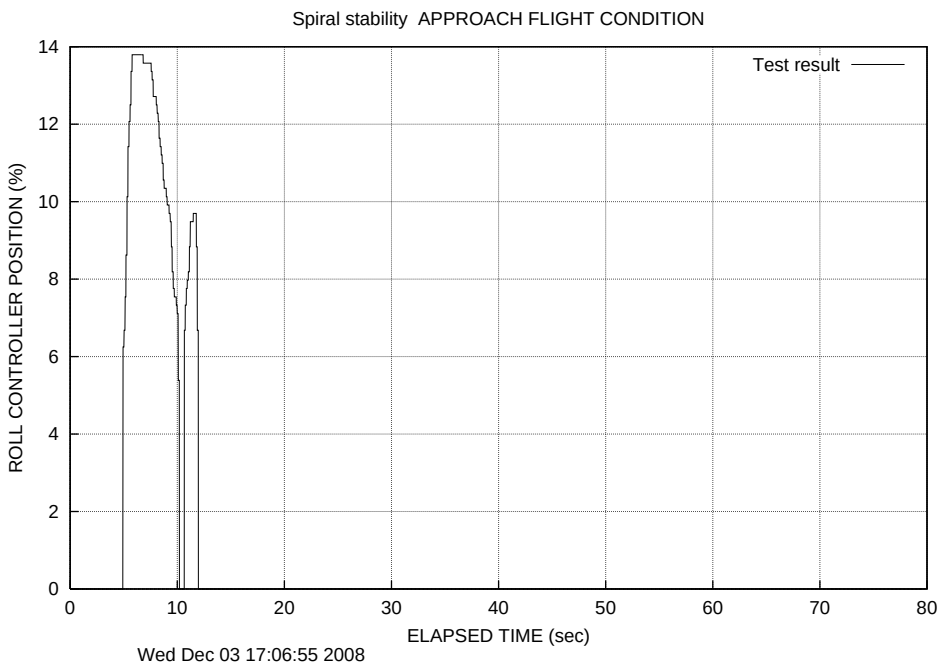

Spiral stability APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2650
2600
2550
2500
2450
2400
2350
2300
2250
2200
2150
2100
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:52 2008

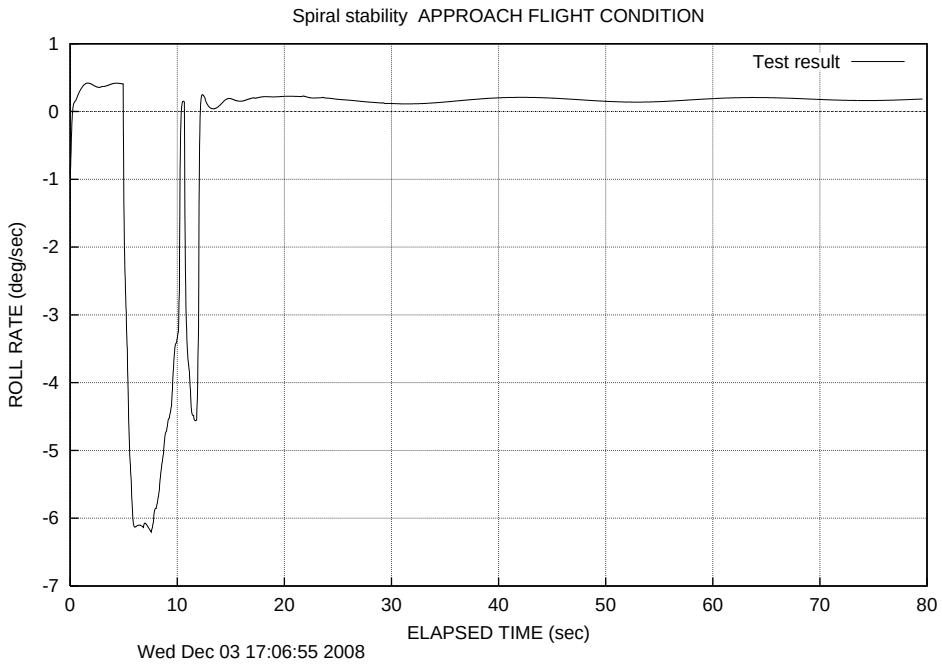

Spiral stability APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.8
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:52 2008

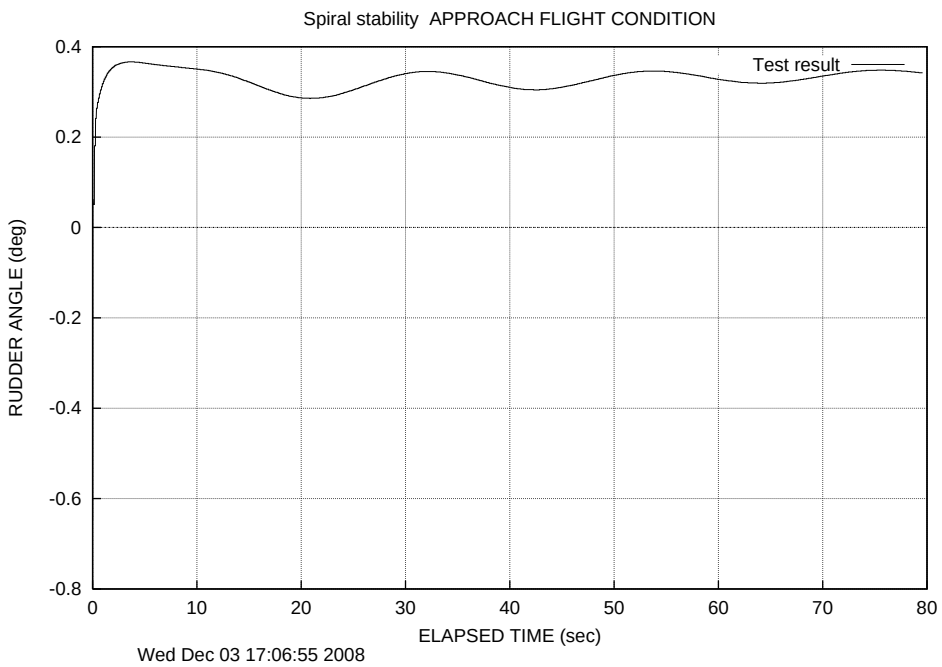

Spiral stability APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
140
130
120
110
100
90
80
70
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:53 2008

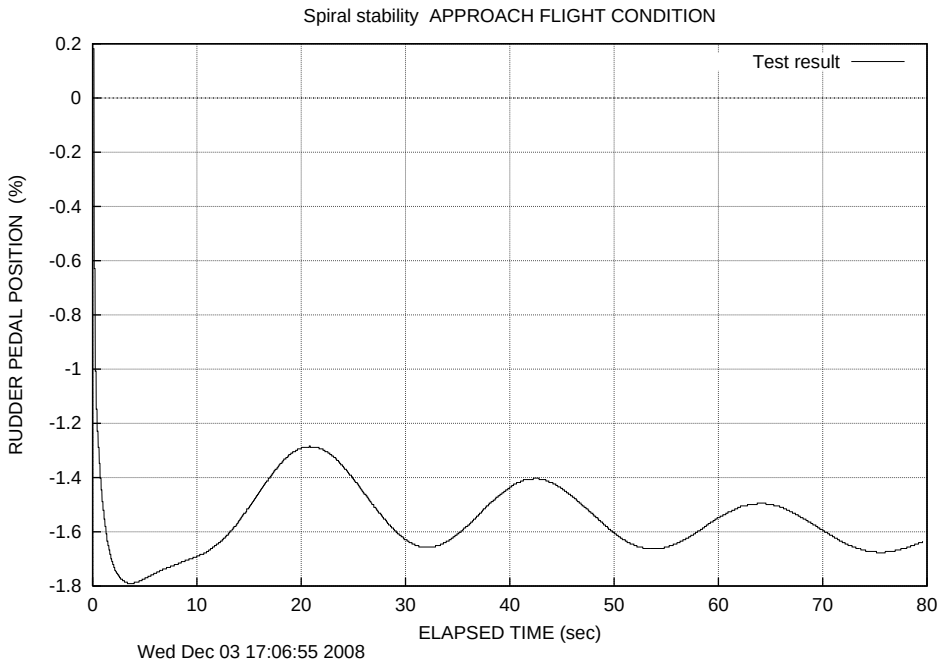

Spiral stability APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
5
4
3
2
1
0
-1
-2
-3
-4
-5
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:53 2008

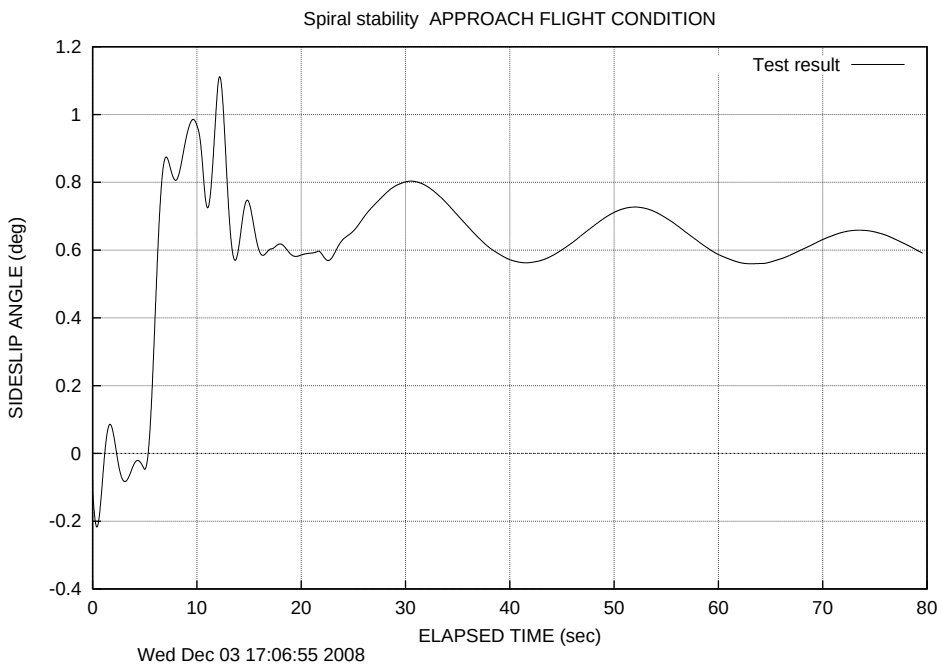

Spiral stability APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4520
4500
4480
4460
4440
4420
4400
4380
4360
4340
4320
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:54 2008

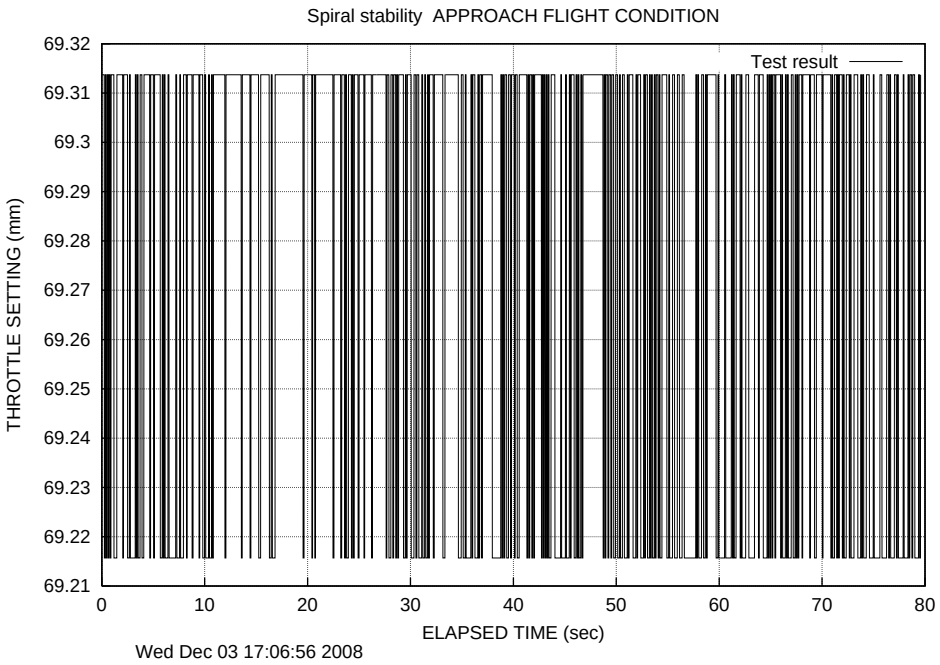

Spiral stability APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:55 2008


Spiral stability APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
1
0
-1
-2
-3
-4
-5
-6
-7
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:55 2008

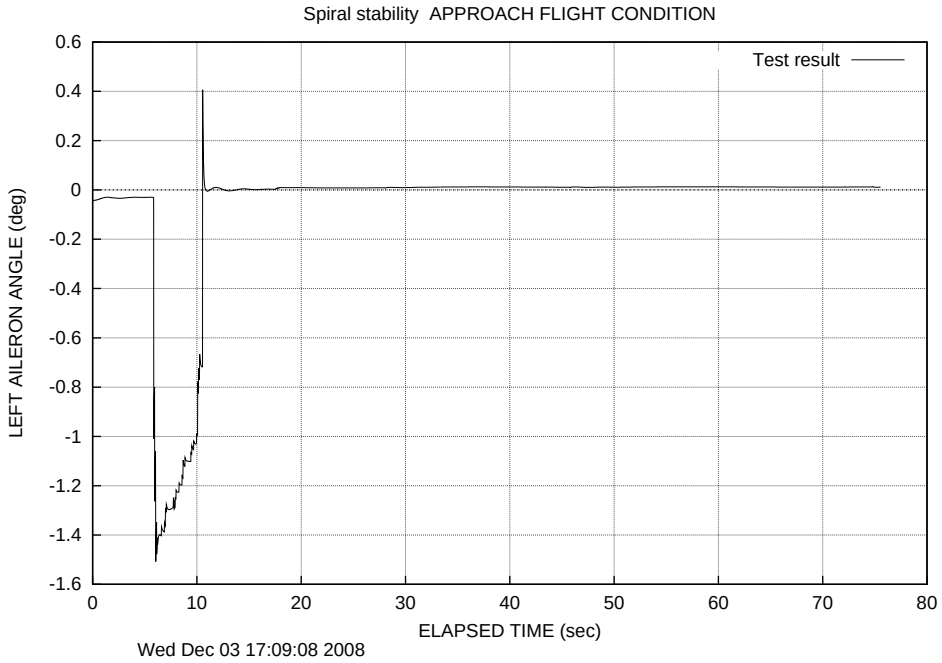

Spiral stability APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:55 2008

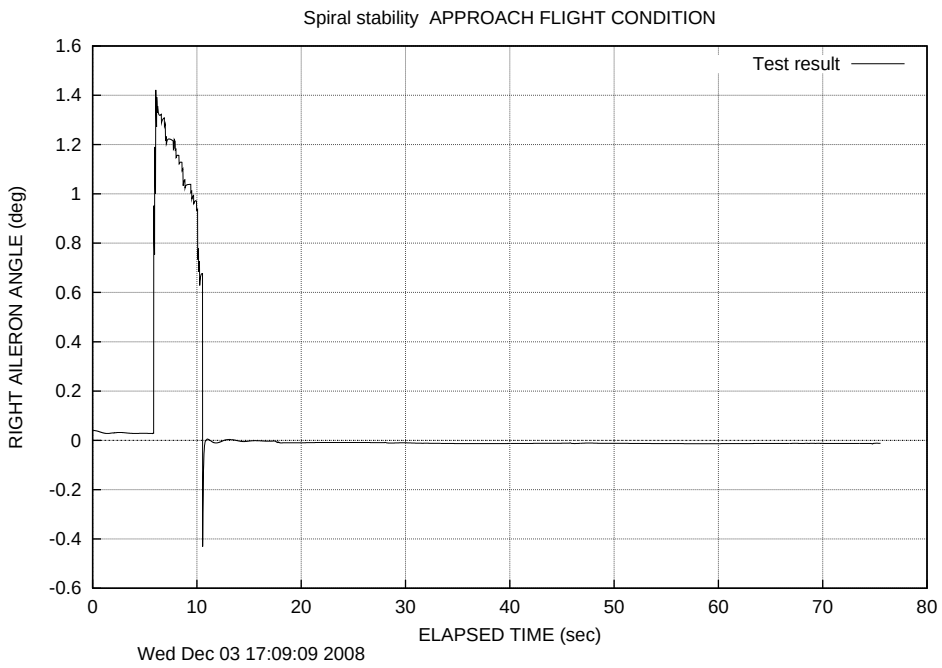

Spiral stability APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:55 2008

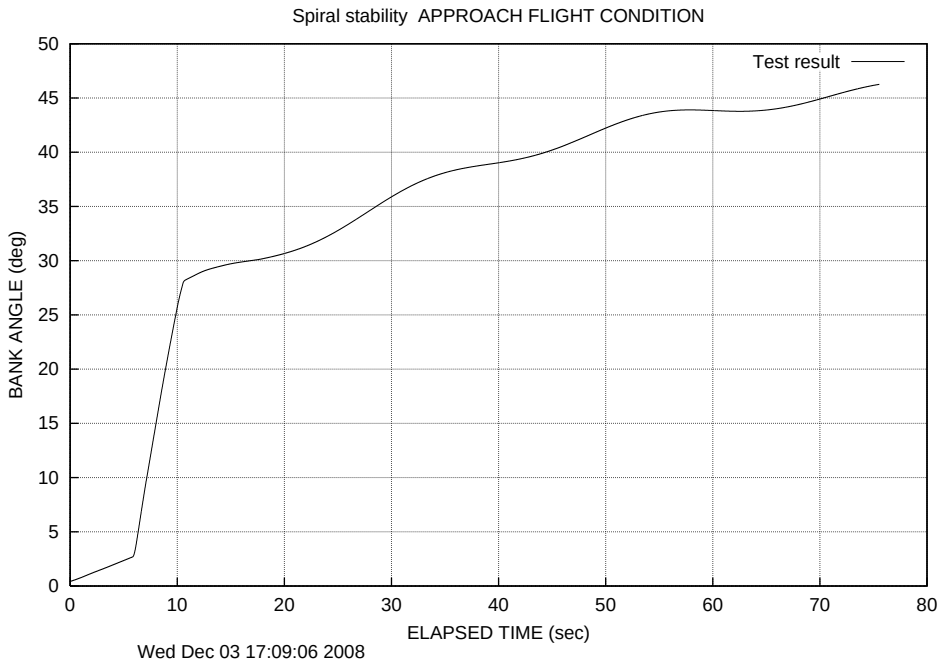

Spiral stability APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:55 2008

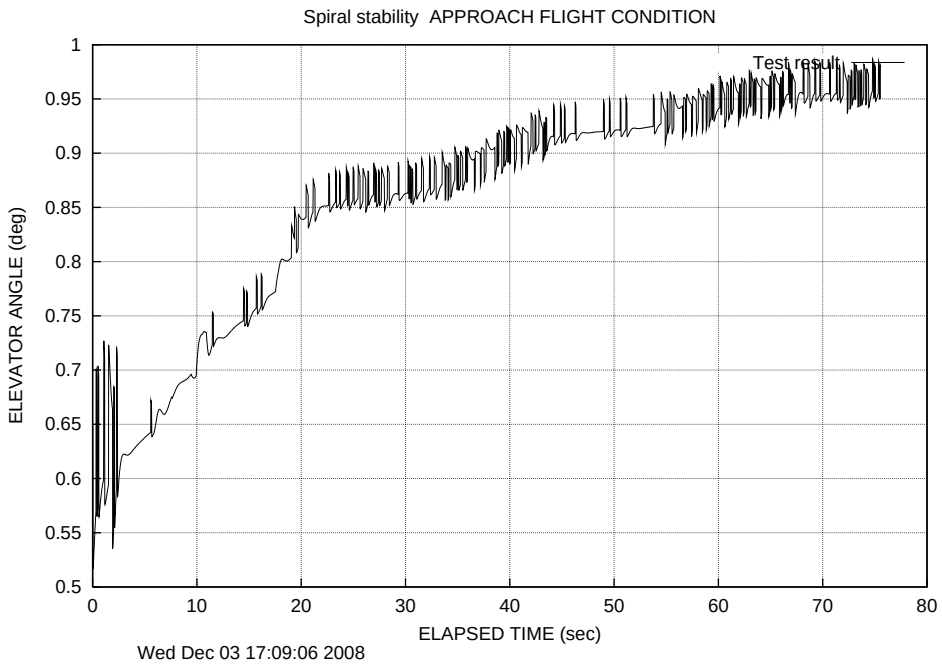

Spiral stability APPROACH FLIGHT CONDITION
Test result
THROTTLE SETTING (mm)
69.32
69.31
69.3
69.29
69.28
69.27
69.26
69.25
69.24
69.23
69.22
69.21
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:06:56 2008

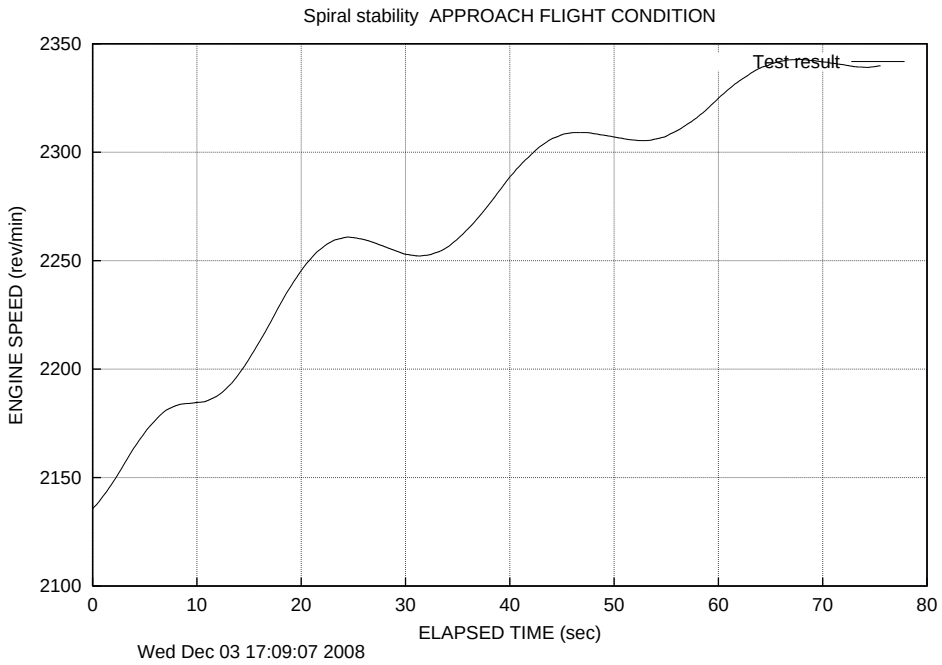
Rolling right (Approach):

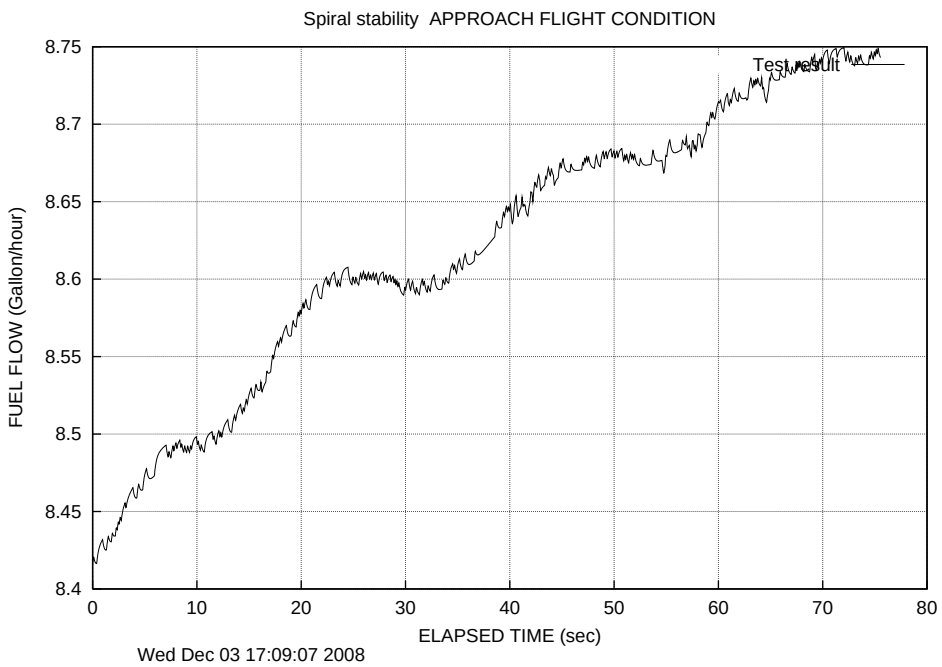


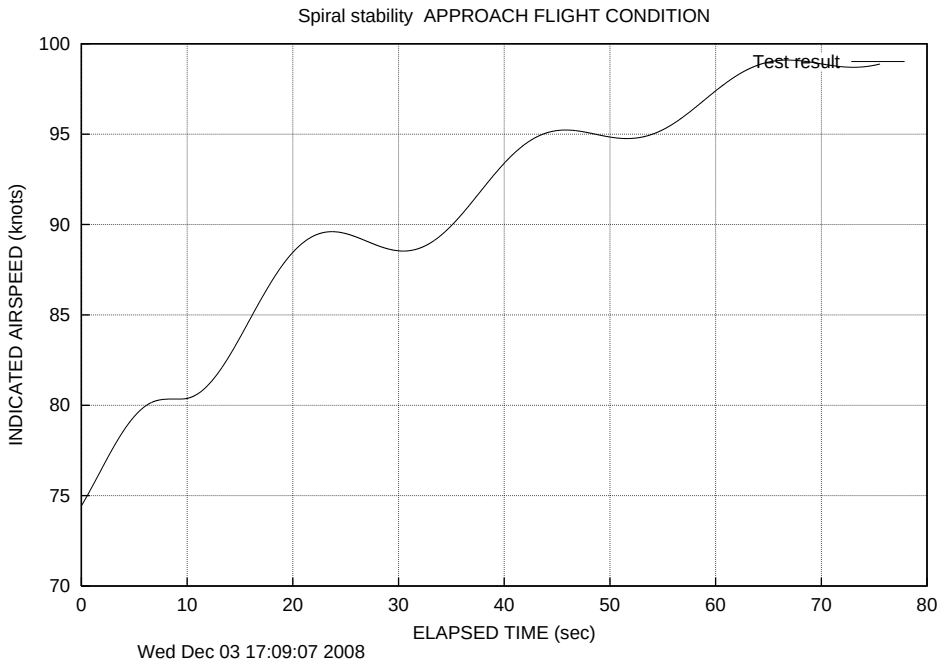


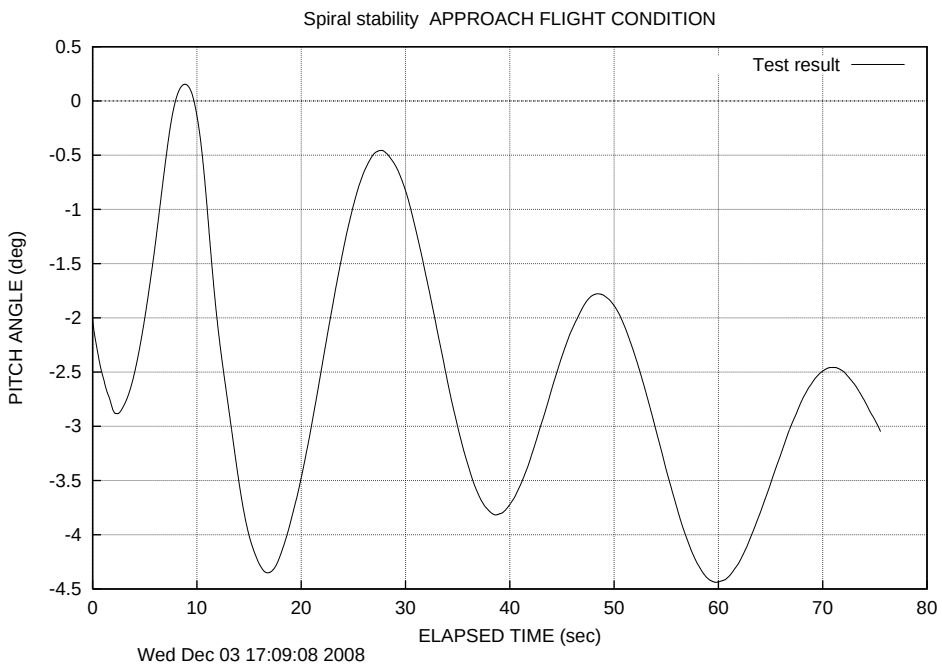

Spiral stability APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:09:06 2008
0
5
10
15
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70
80

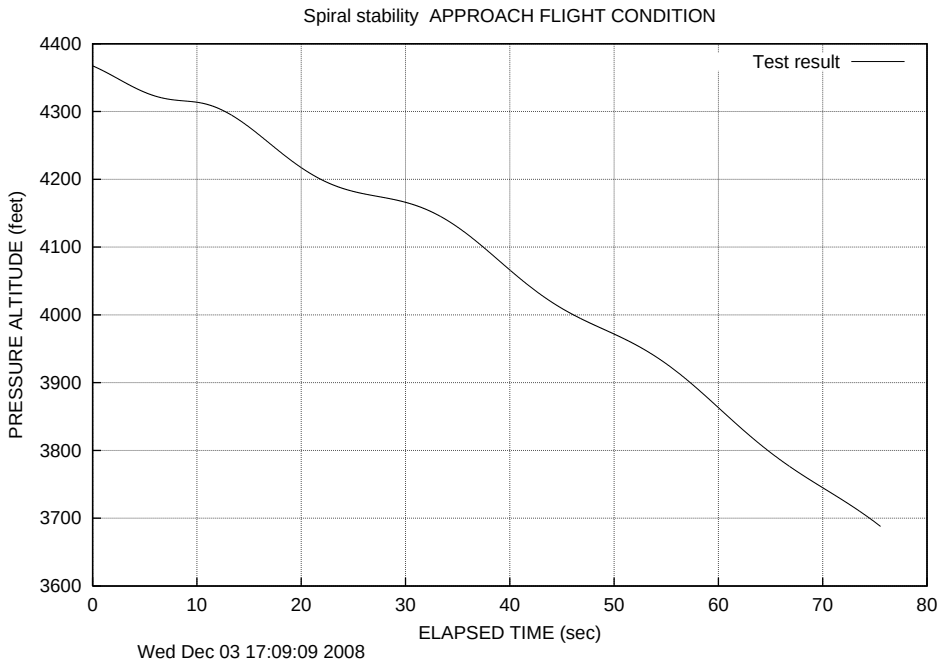

Spiral stability APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:09:06 2008
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
0
10
20
30
40
50
60
70
80

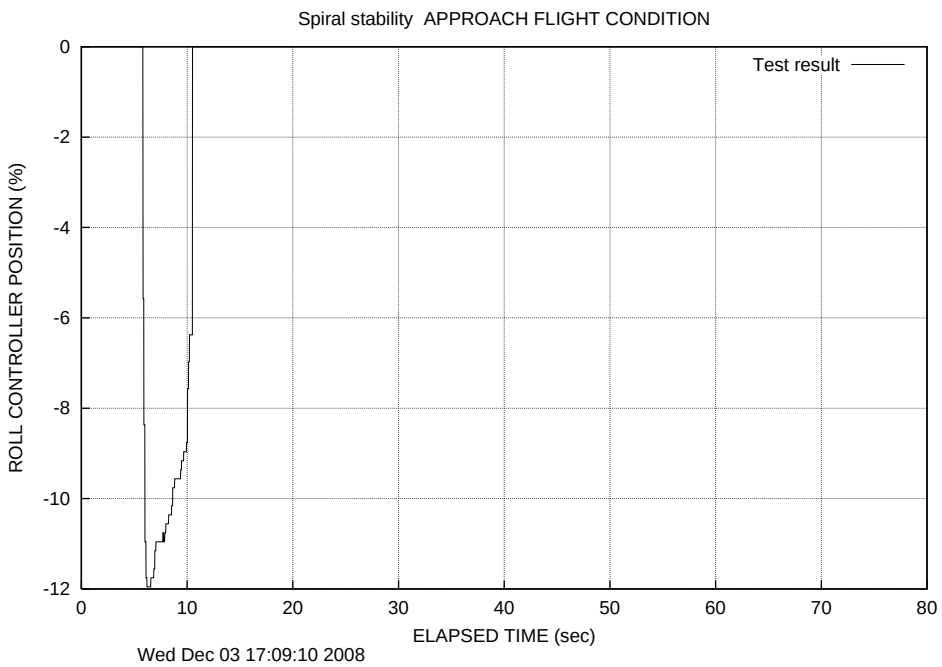

Spiral stability APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2350
2300
2250
2200
2150
2100
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:07 2008

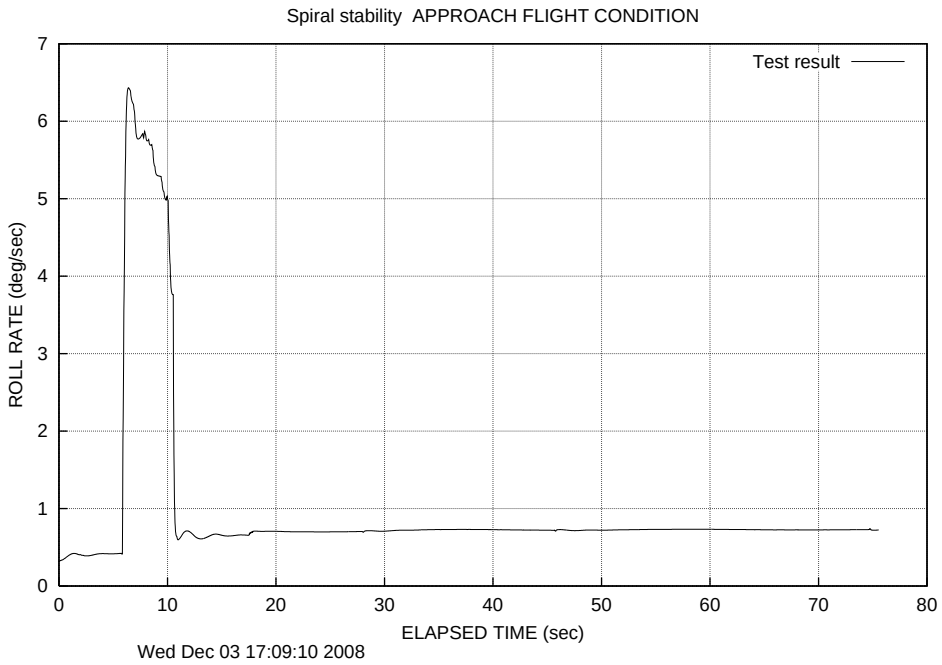

Spiral stability APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:07 2008

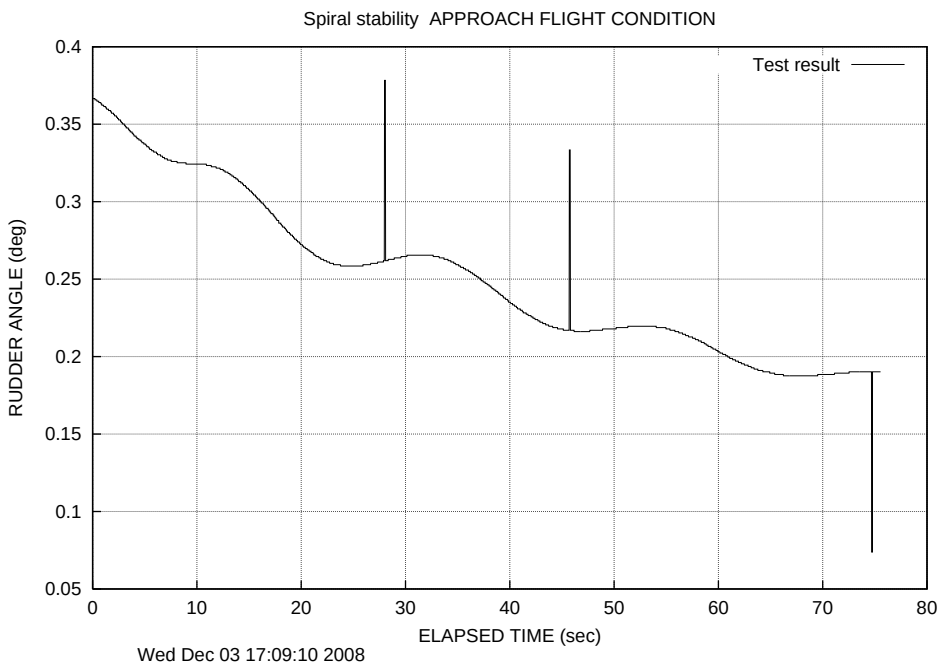

Spiral stability APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
100
95
90
85
80
75
70
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:07 2008

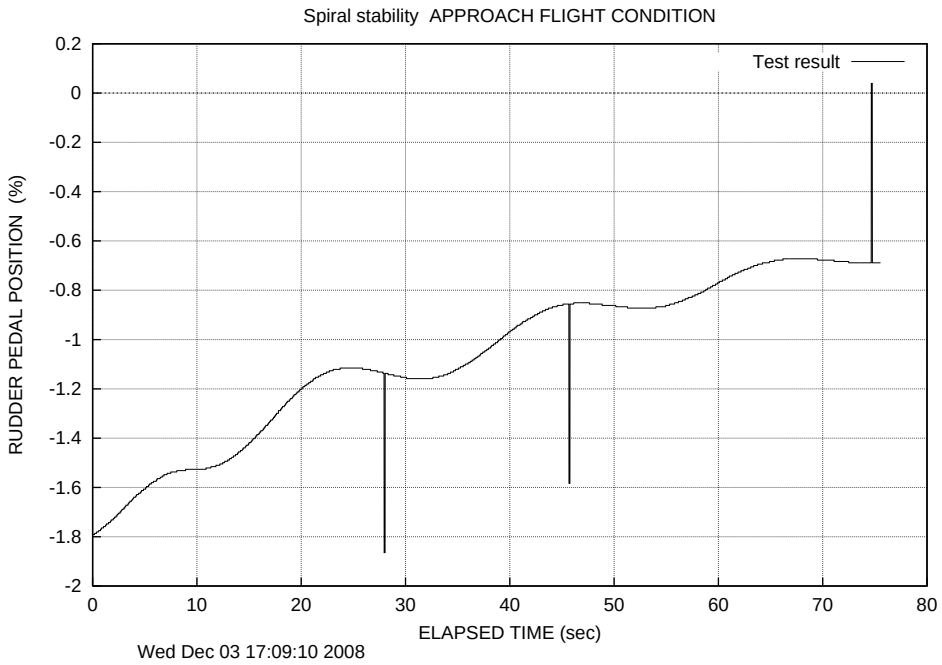

Spiral stability APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:08 2008

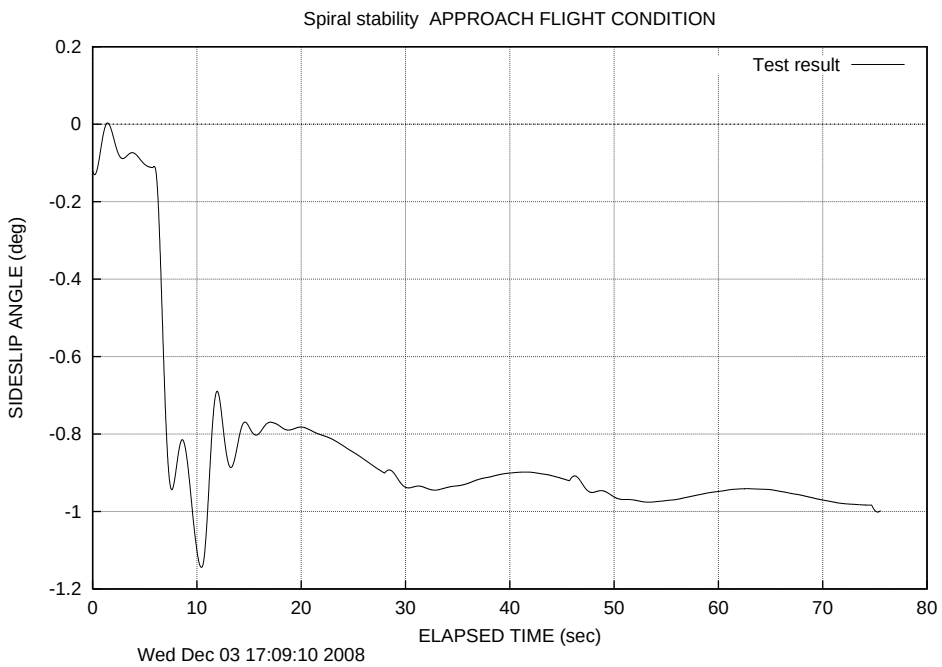

Spiral stability APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4400
4300
4200
4100
4000
3900
3800
3700
3600
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:09 2008

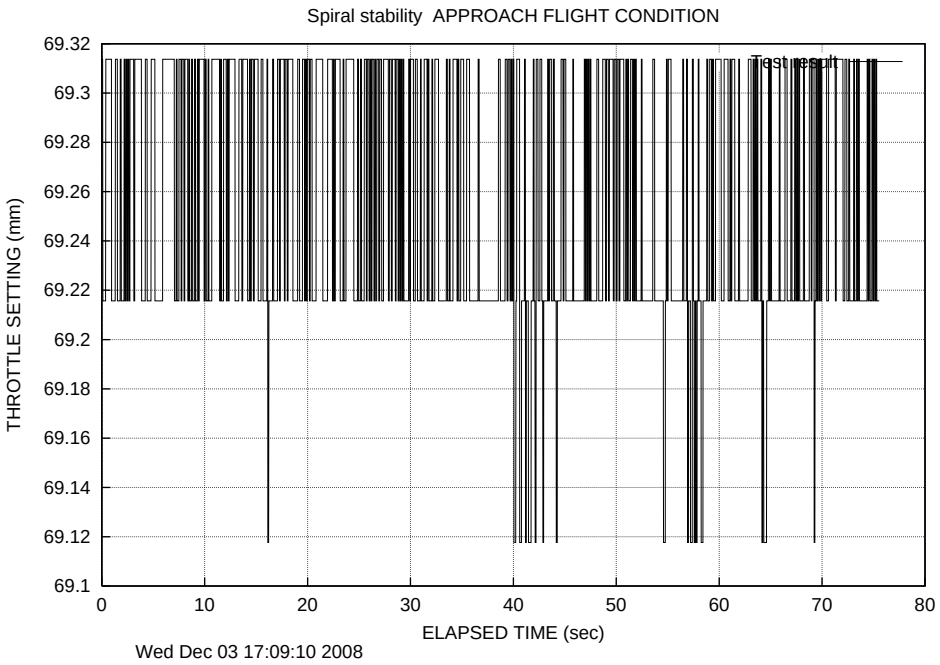

Spiral stability APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
0
-2
-4
-6
-8
-10
-12
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:10 2008


Spiral stability APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 17:09:10 2008
0
1
2
3
4
5
6
7
0
10
20
30
40
50
60
70
80


Spiral stability APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:09:10 2008
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0
10
20
30
40
50
60
70
80


Spiral stability APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:10 2008


Spiral stability APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
0
10
20
30
40
50
60
70
80
ELAPSED TIME (sec)
Wed Dec 03 17:09:10 2008



Source data	Section 3.17 of [1]
Comparison of results	The spiral stability test shows compliance towards the Validation Reference Data result as described in Section 3.17 of [1].

6.22 Rudder response (2c6)

Test objective	To demonstrate that the simulator directional responses from rudder control movements conform to the class of aeroplane.
Demonstration procedure	Starting from a wings-level trimmed condition, initiate a rapid rudder input to approximately 25 percent of full rudder travel. Then abruptly release the pedal and allow the aeroplane to respond freely. The response should not exceed 30 degrees of bank.
References	[2], [3], [4]

Initial conditions

Approach flight condition (Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-10.667	(%)
ROLL CONTROLLER POSITION	=	0.0	(%)
RUDDER PEDAL POSITION	=	1.091	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2311	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.6	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	0.1	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH

SWITCH FUEL CUTOFF	=	OFF	

Initial conditions

Approach flight condition (Full Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-4.667	(%)
ROLL CONTROLLER POSITION	=	0.258	(%)
RUDDER PEDAL POSITION	=	-0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)

ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2163	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.6	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	0.1	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

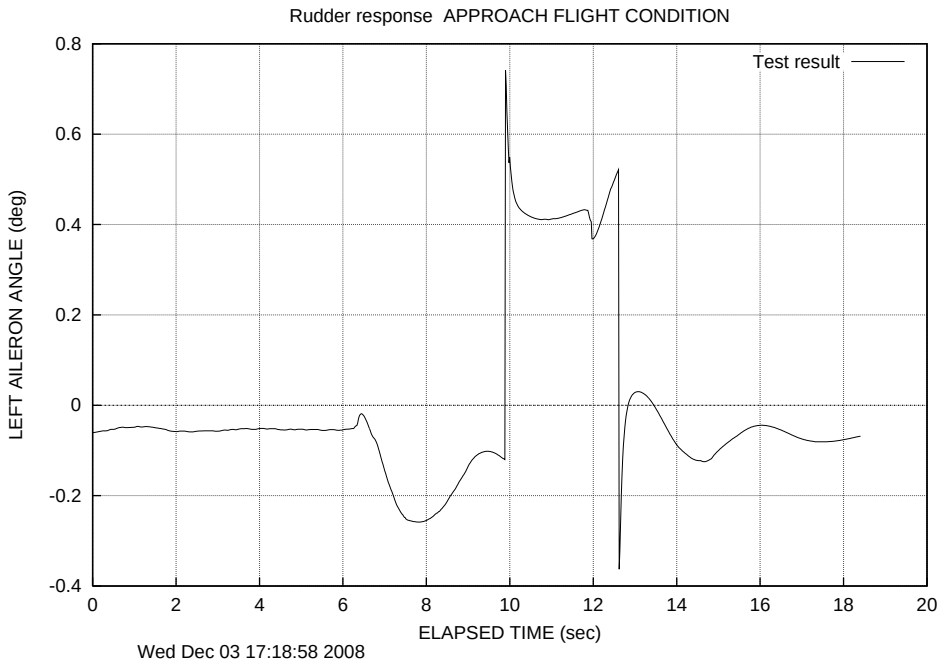
ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

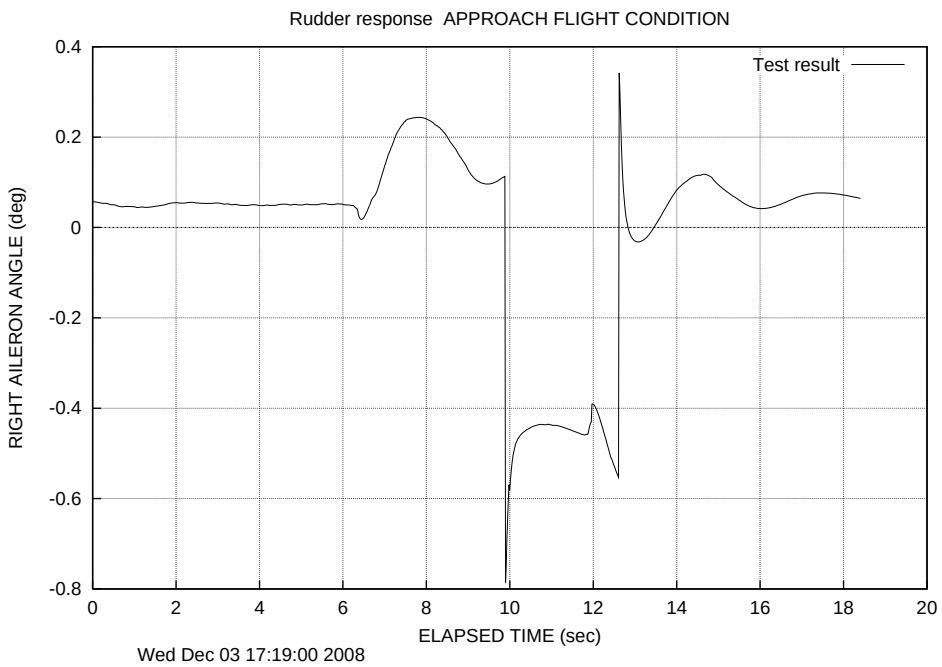
Manual test procedures

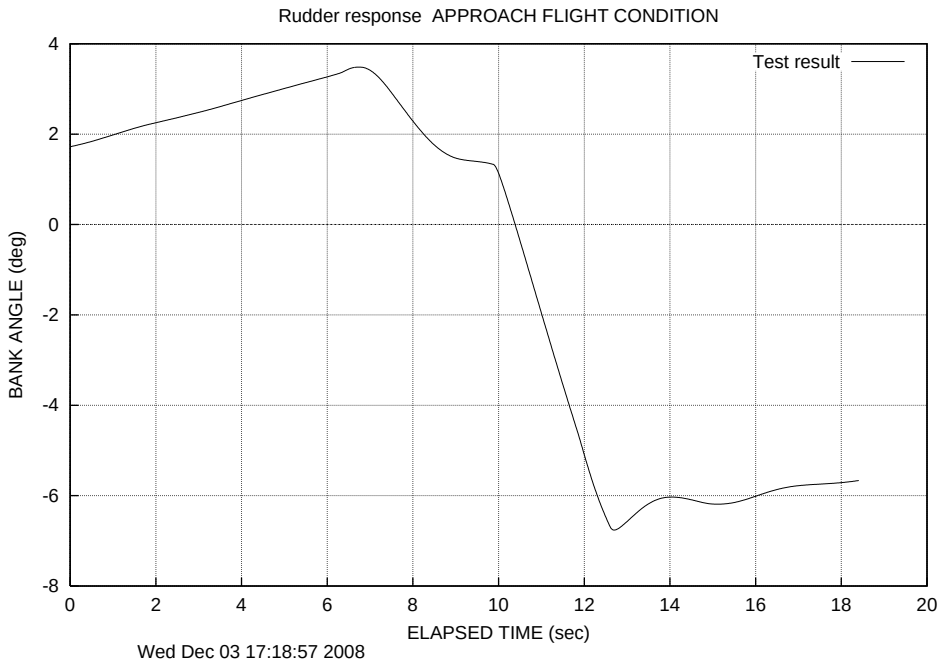
Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `618_FSTD_2d6_Approach.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

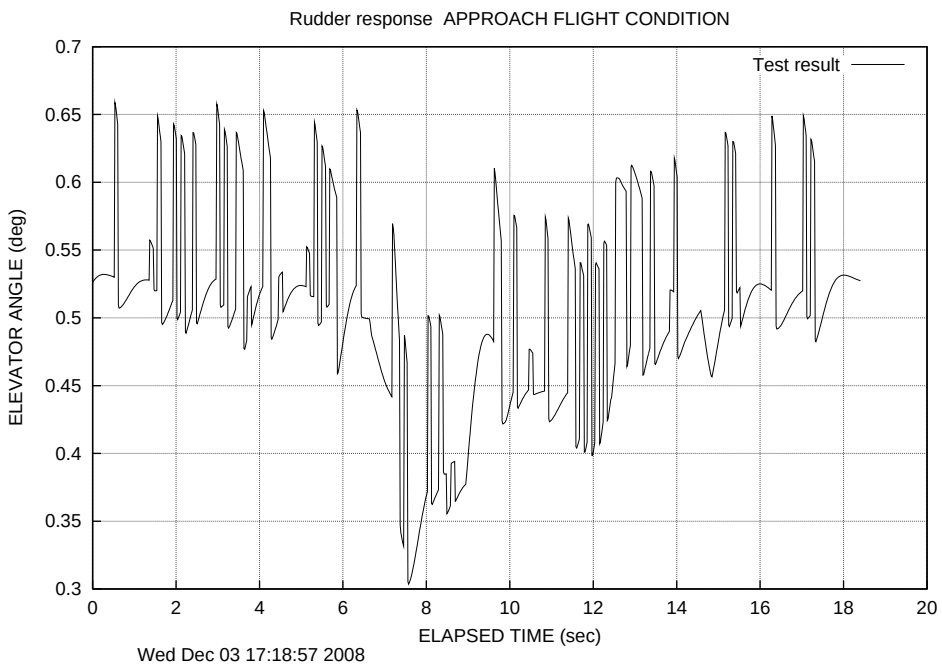
Starting after 5 seconds with the rudder pedal position at the prescribed trimmed initial condition:

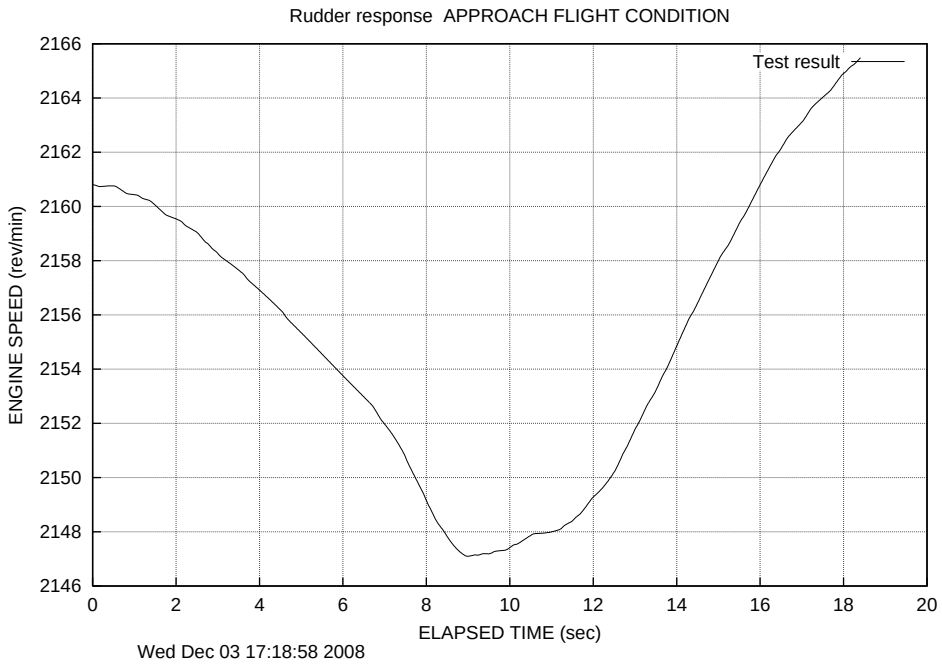
	1. From the initial rudder pedal position, push the left pedal such that it reaches 25% of its full travel. Abruptly release the pedal and allow the aeroplane to respond freely. 2. Stop recording after a total of 30 seconds have elapsed.
Evaluated parameters	AILERON ANGLE BANK ANGLE ELEVATOR ANGLE ENGINE SPEED FUEL FLOW HEADING ANGLE INDICATED AIRSPEED PITCH ANGLE PRESSURE ALTITUDE ROLL CONTROLLER POSITION ROLL RATE RUDDER ANGLE RUDDER PEDAL POSITION SIDESLIP ANGLE YAW RATE
Expected results	The produced yawing moment is expected to restore the initial symmetric flight state very quickly. See section 3.18 of [1].
Tolerances	YAW RATE $\pm 2°$/sec or $\pm 10\%$ (HEADING CHANGE $\pm 2°$/sec or $\pm 10\%$)
Test result	The produced yawing moment is to restores the initial symmetric flight state very quickly for both a rudder pedal input of about 30 % and a full rudder pedal input.

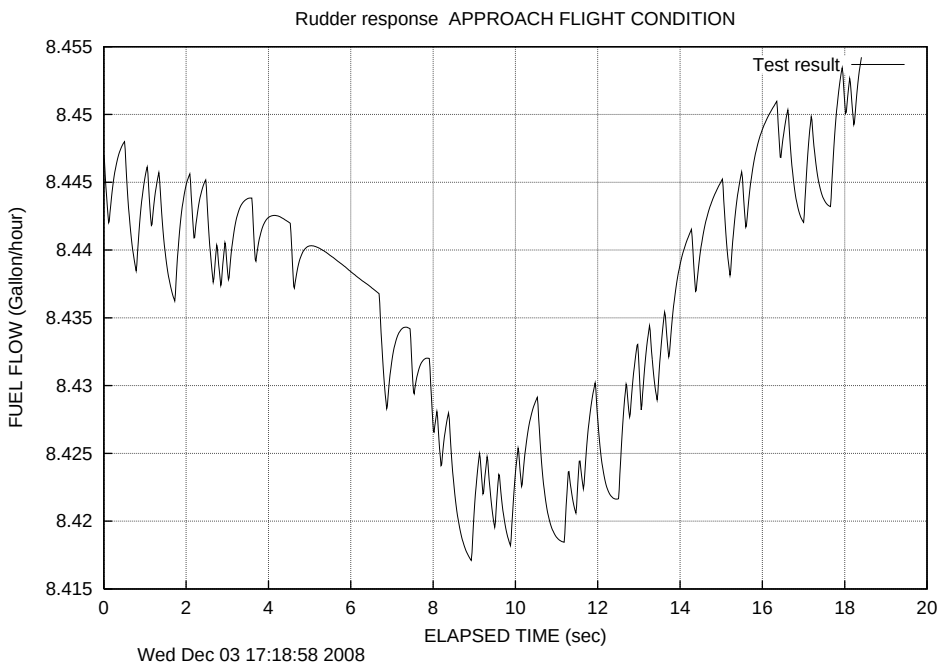

Rudder response APPROACH FLIGHT CONDITION
Test result
LEFT AILERON ANGLE (deg)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:58 2008

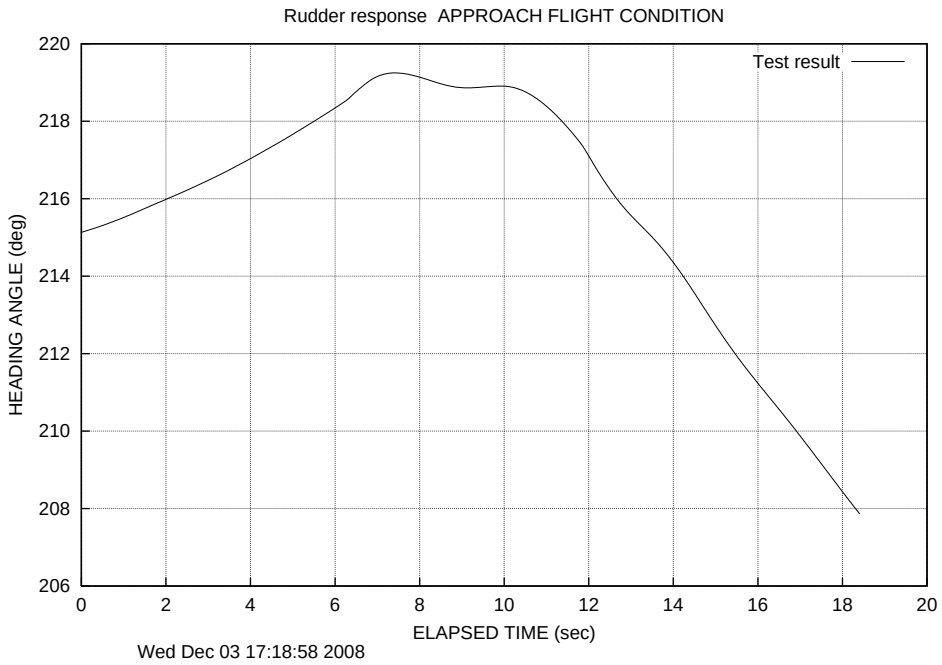

Rudder response APPROACH FLIGHT CONDITION
Test result
RIGHT AILERON ANGLE (deg)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008

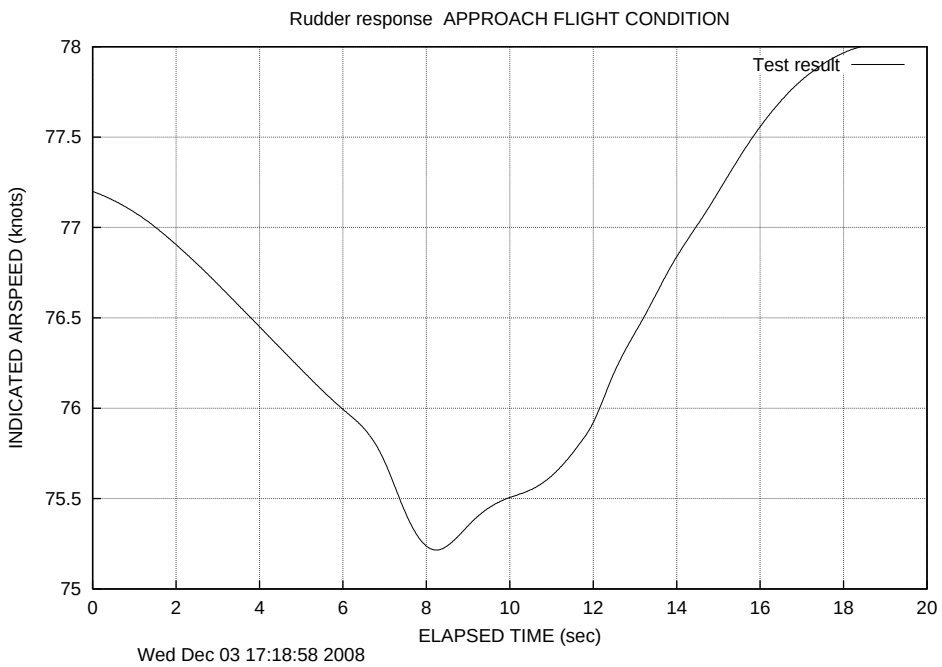

Rudder response APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:18:57 2008
4
2
0
-2
-4
-6
-8
0
2
4
6
8
10
12
14
16
18
20

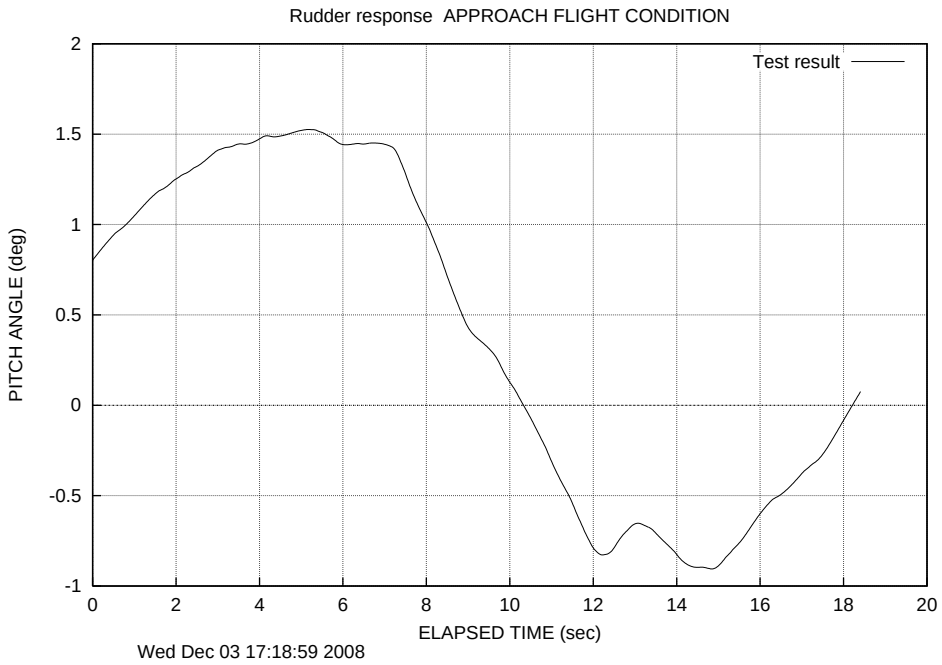

Rudder response APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:18:57 2008
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0
2
4
6
8
10
12
14
16
18
20

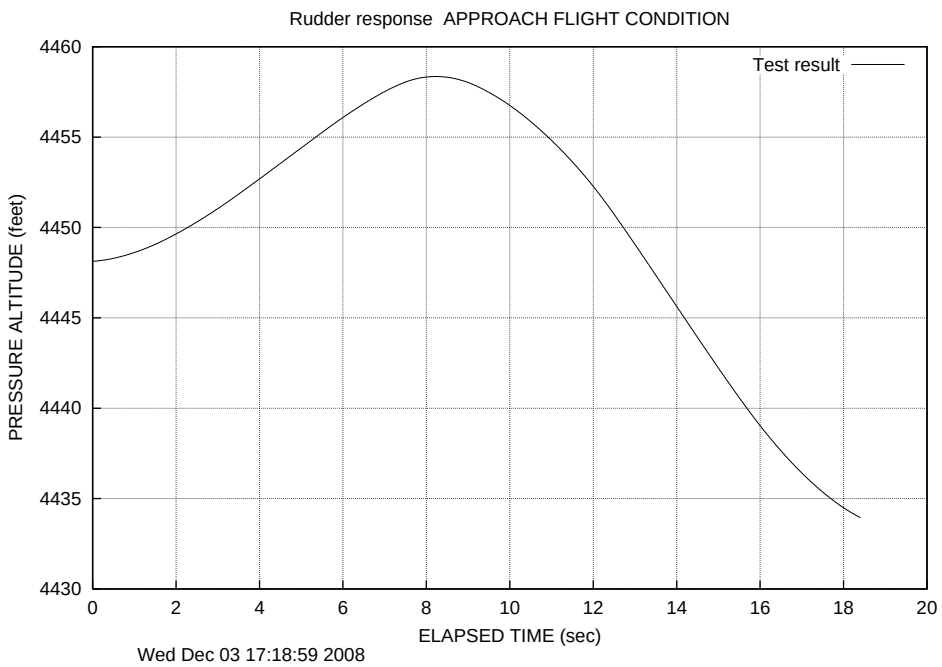

Rudder response APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2166
2164
2162
2160
2158
2156
2154
2152
2150
2148
2146
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:58 2008

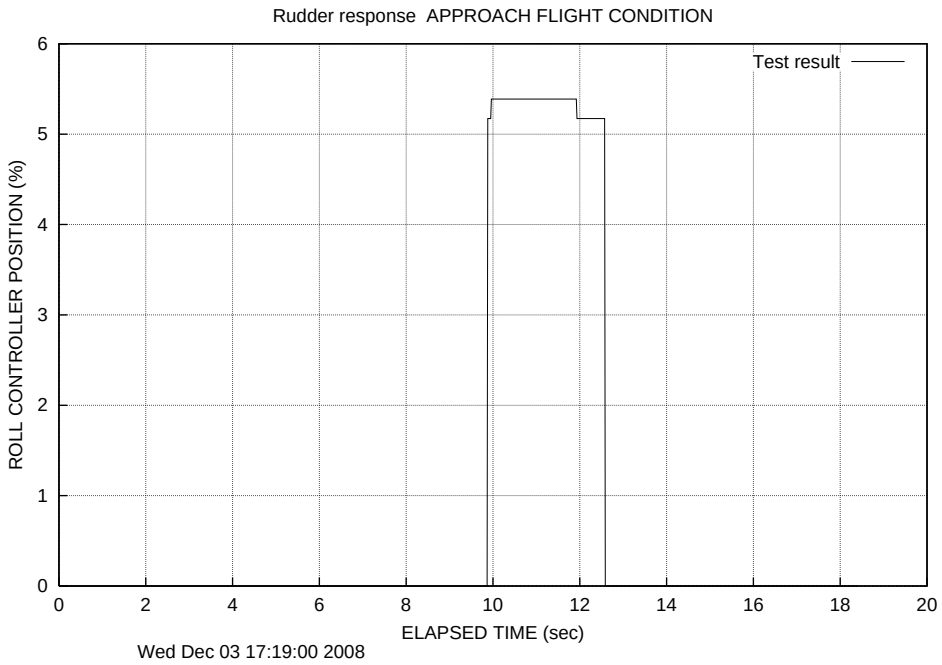

Rudder response APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.455
8.45
8.445
8.44
8.435
8.43
8.425
8.42
8.415
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:58 2008

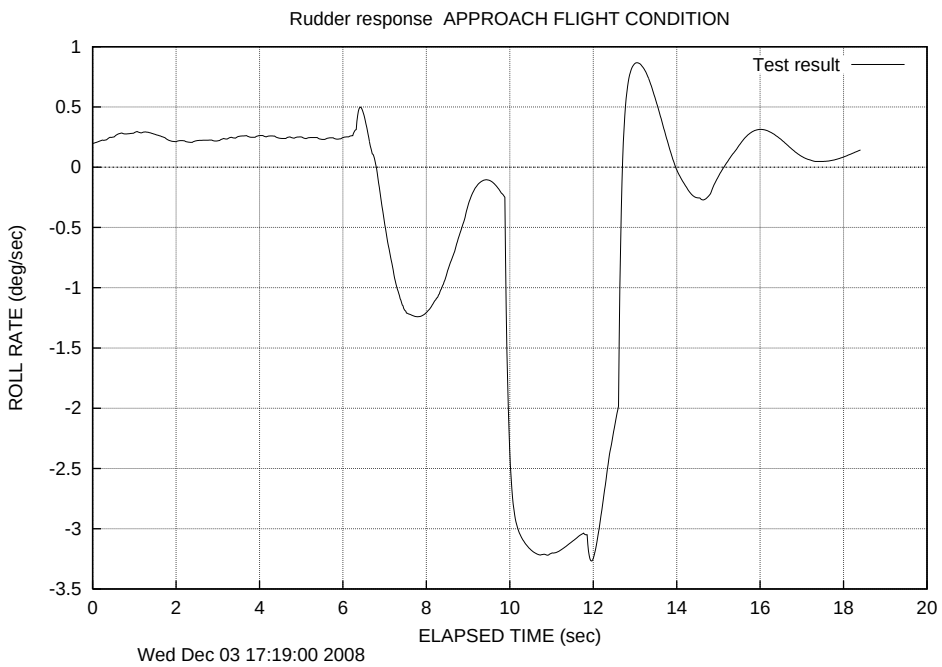

Rudder response APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
220
218
216
214
212
210
208
206
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:58 2008

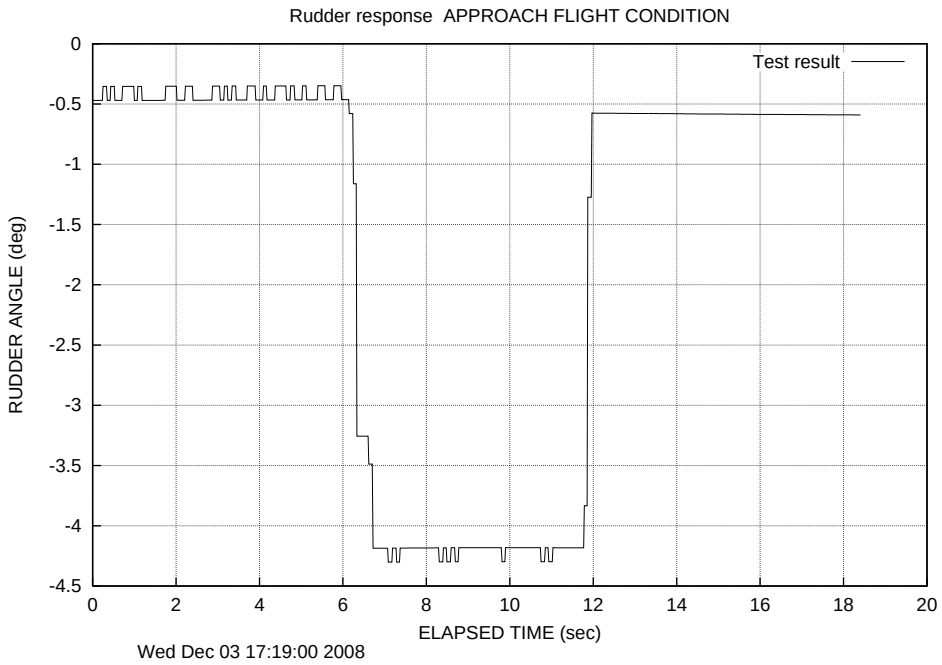

Rudder response APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
78
77.5
77
76.5
76
75.5
75
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:58 2008

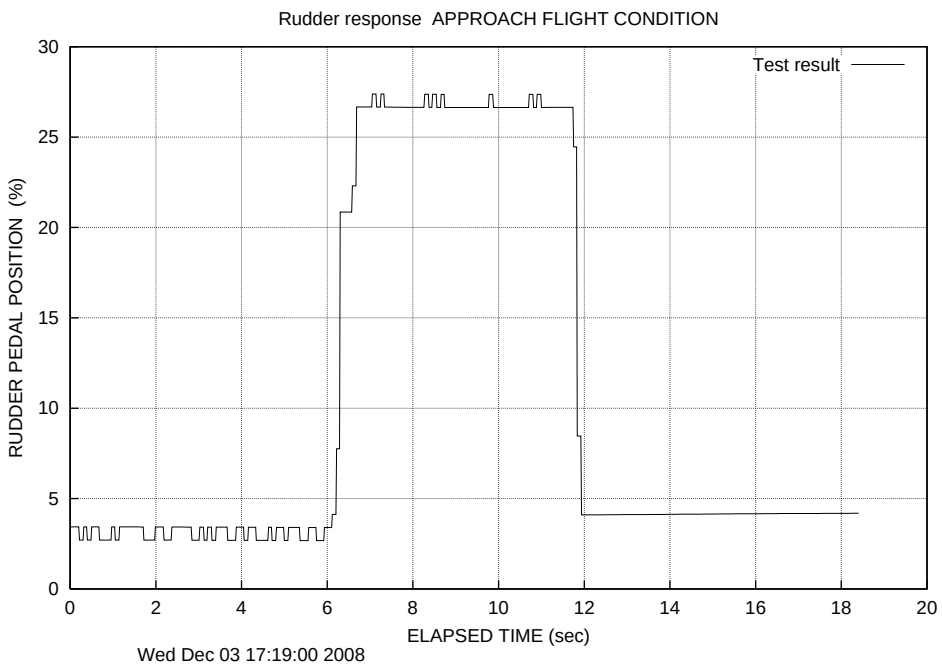

Rudder response APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
2
1.5
1
0.5
0
-0.5
-1
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:59 2008

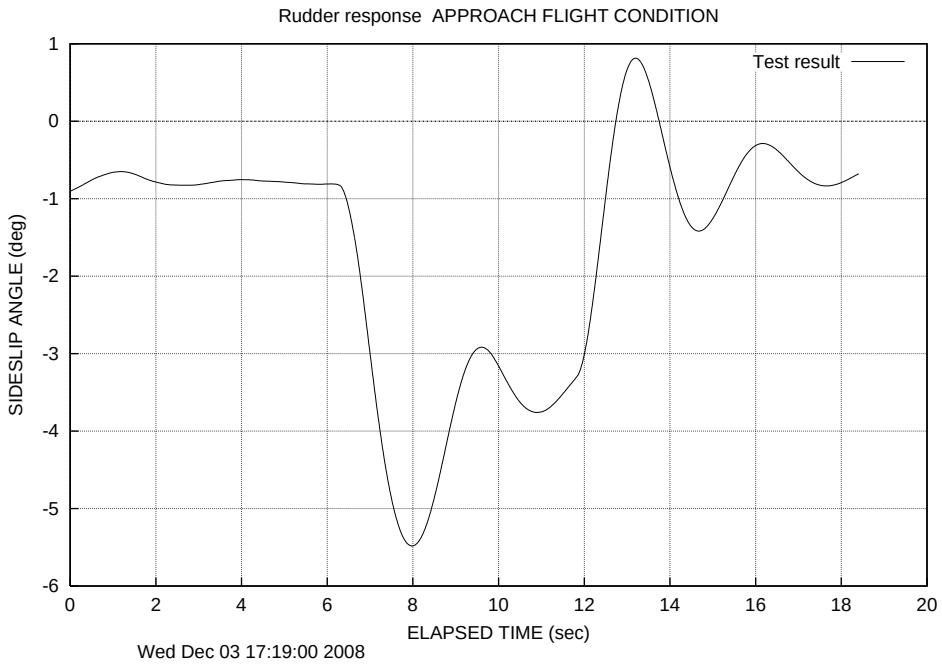

Rudder response APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4460
4455
4450
4445
4440
4435
4430
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:18:59 2008

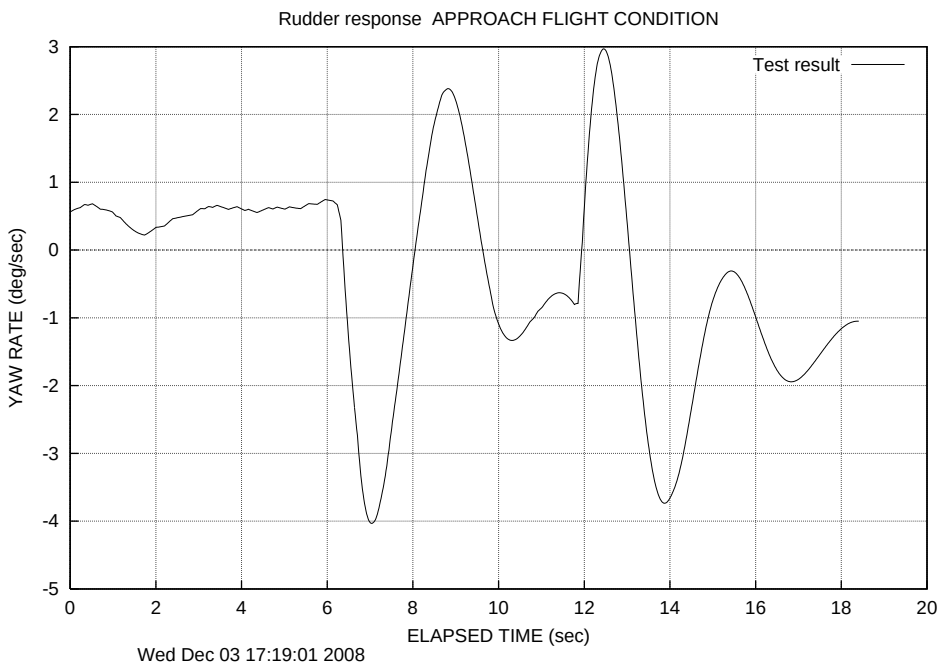

Rudder response APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008
0
1
2
3
4
5
6
0
2
4
6
8
10
12
14
16
18
20

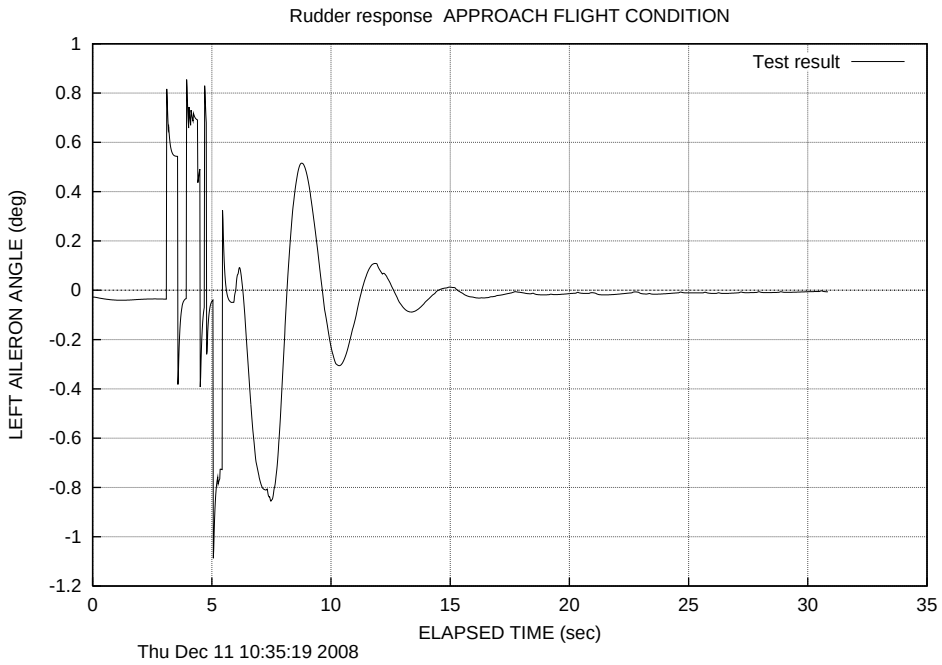

Rudder response APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
0
2
4
6
8
10
12
14
16
18
20

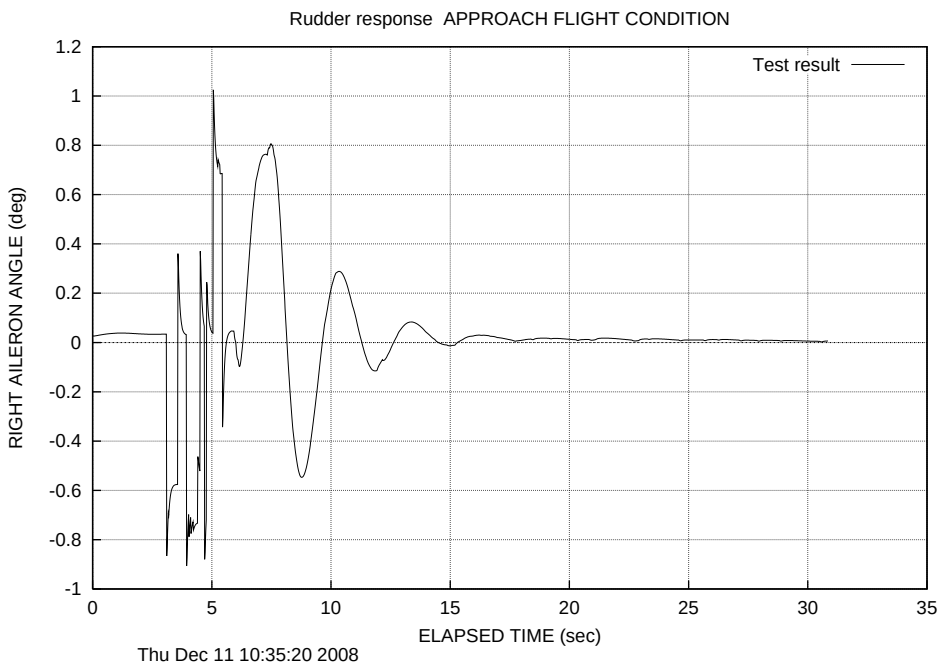

Rudder response APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008

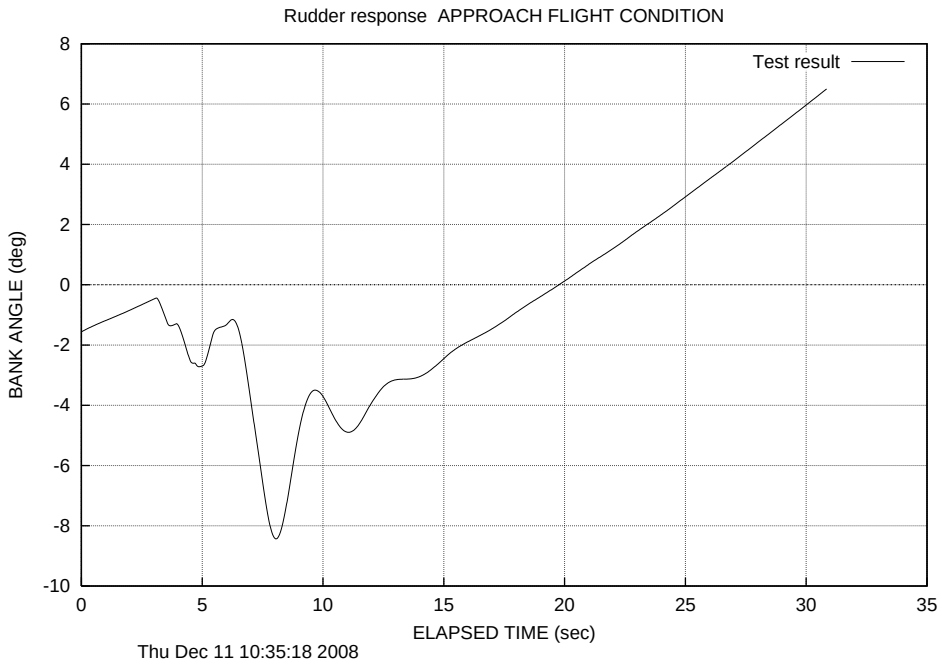

Rudder response APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
30
25
20
15
10
5
0
0
2
4
6
8
10
12
14
16
18
20
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008

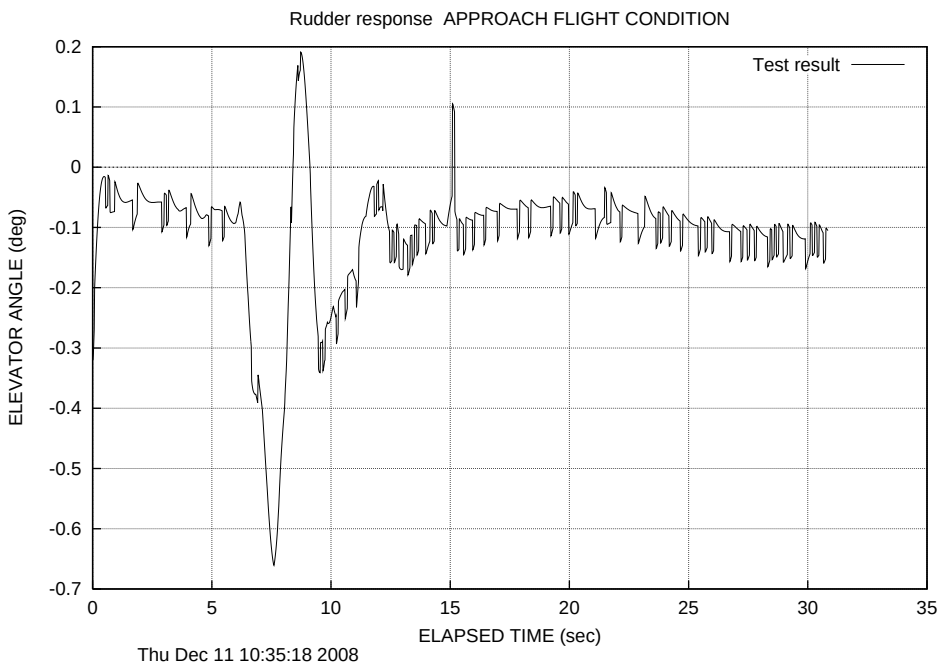

Rudder response APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:19:00 2008
1
0
-1
-2
-3
-4
-5
-6
0
2
4
6
8
10
12
14
16
18
20

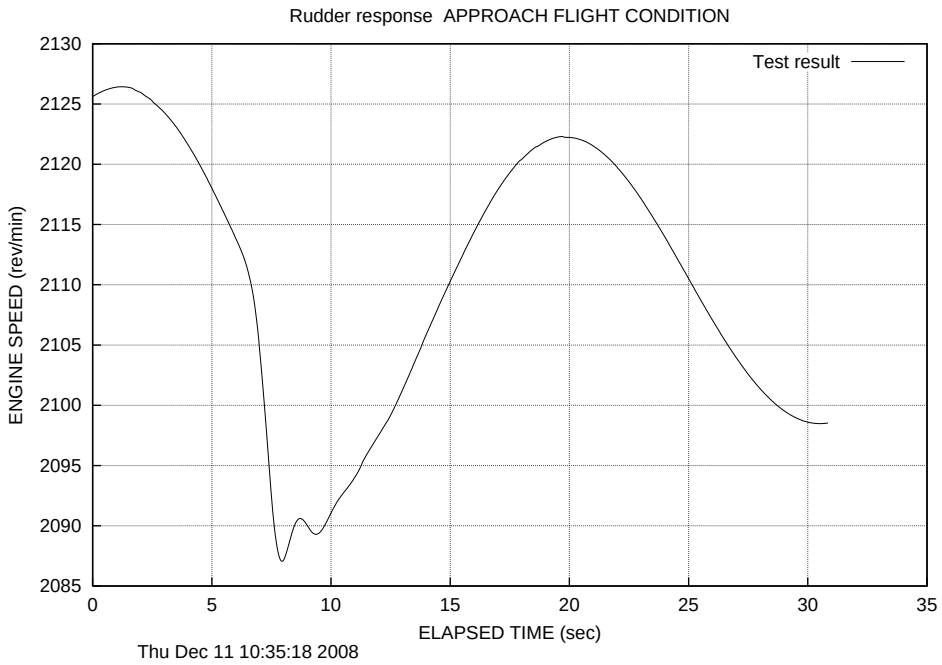

Rudder response APPROACH FLIGHT CONDITION
Test result
YAW RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 17:19:01 2008
3
2
1
0
-1
-2
-3
-4
-5
0
2
4
6
8
10
12
14
16
18
20

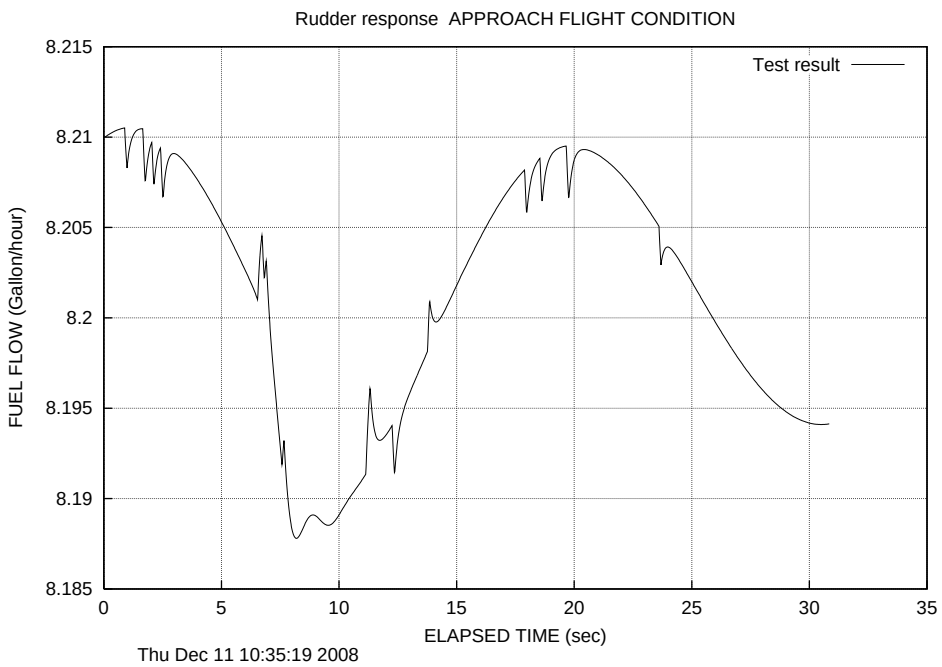

Rudder response APPROACH FLIGHT CONDITION
Test result
LEFT AILERON ANGLE (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:35:19 2008

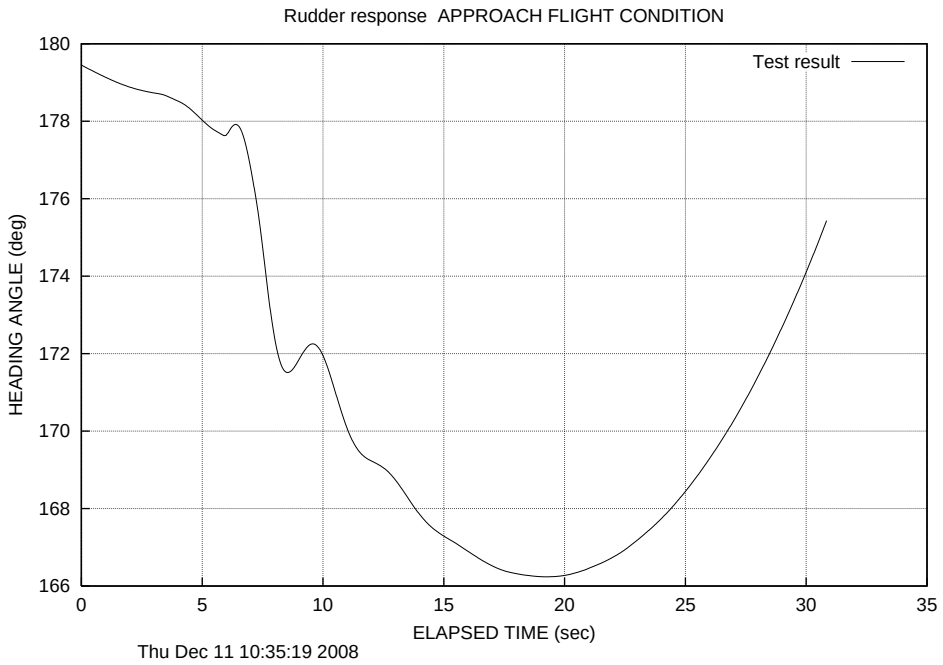

Rudder response APPROACH FLIGHT CONDITION
Test result
RIGHT AILERON ANGLE (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:35:20 2008

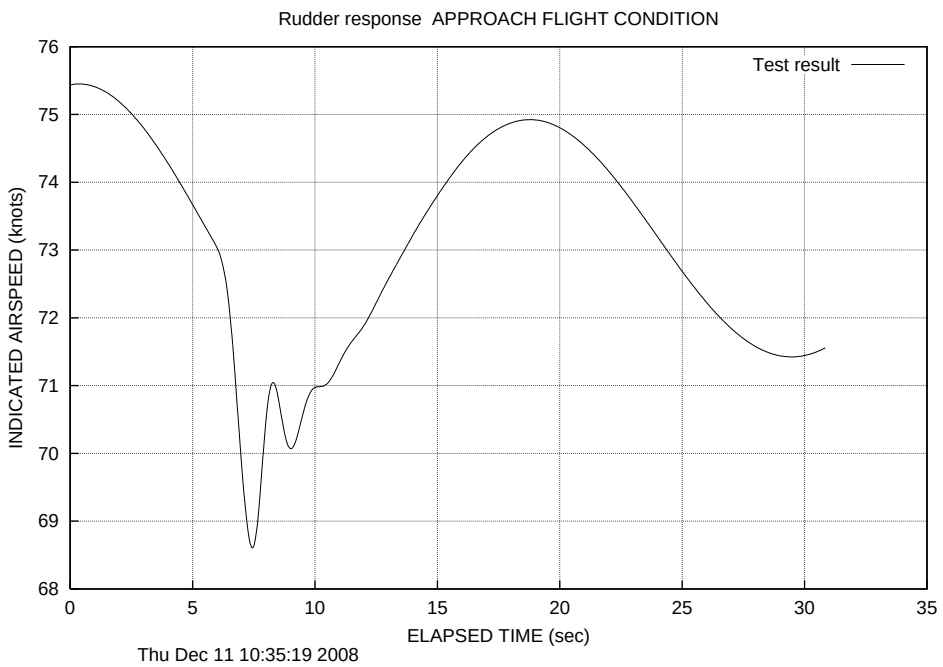

Rudder response APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
8
6
4
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:18 2008

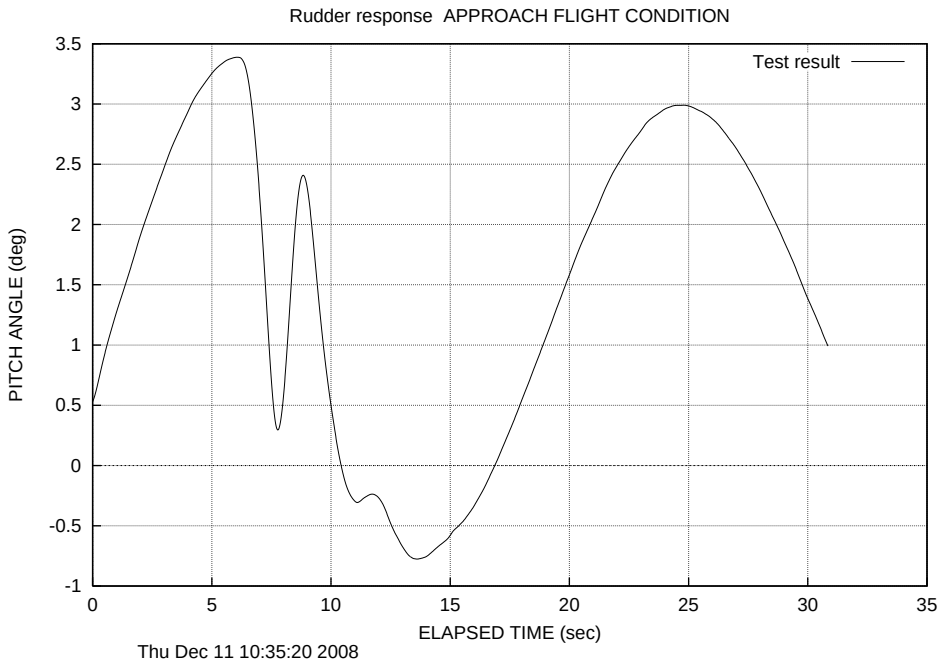

Rudder response APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:18 2008

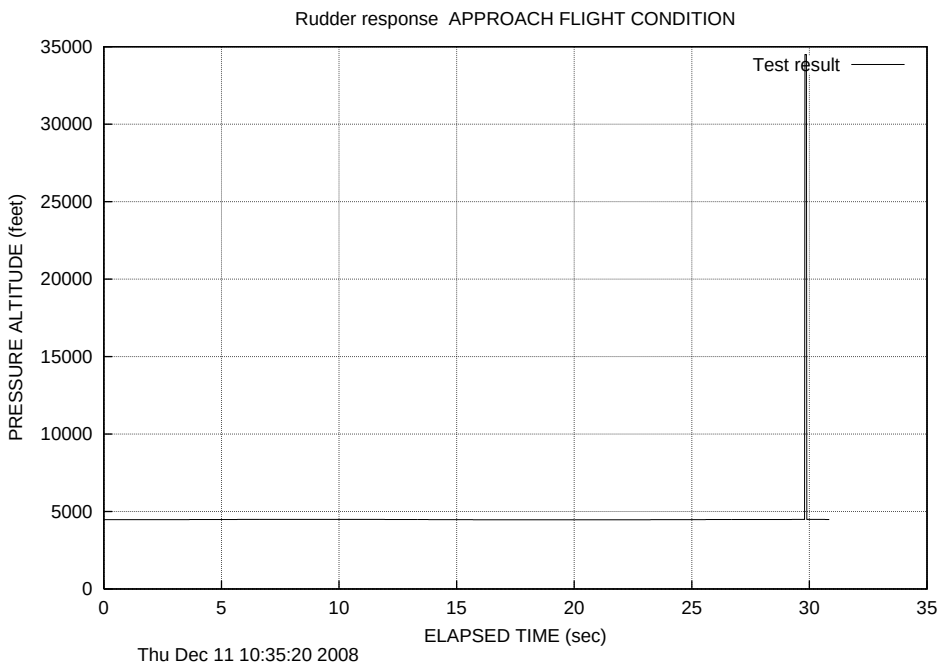

Rudder response APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2130
2125
2120
2115
2110
2105
2100
2095
2090
2085
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:18 2008

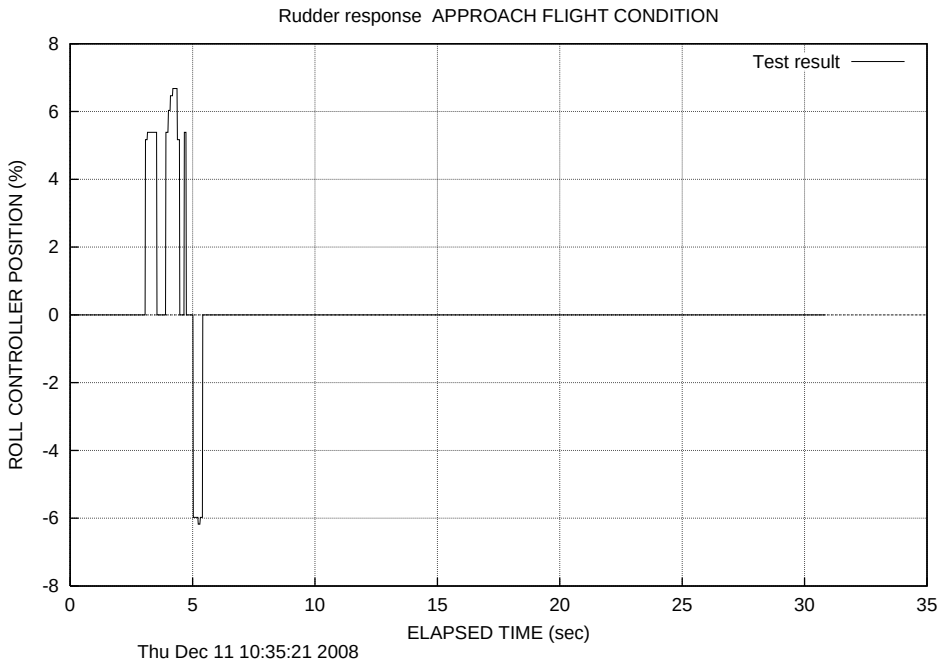

Rudder response APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.215
8.21
8.205
8.2
8.195
8.19
8.185
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:19 2008

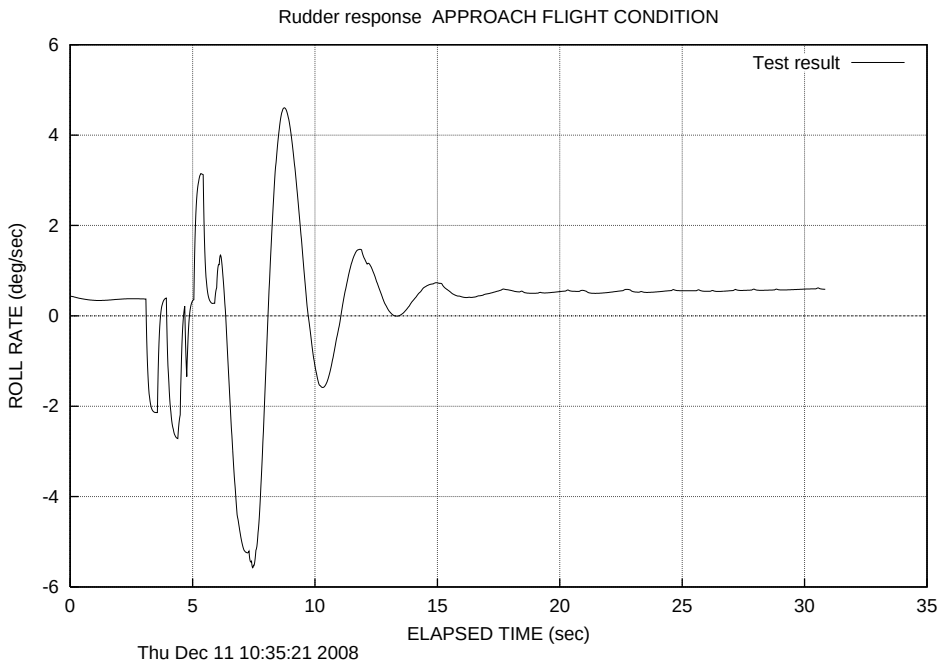

Rudder response APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
180
178
176
174
172
170
168
166
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:19 2008

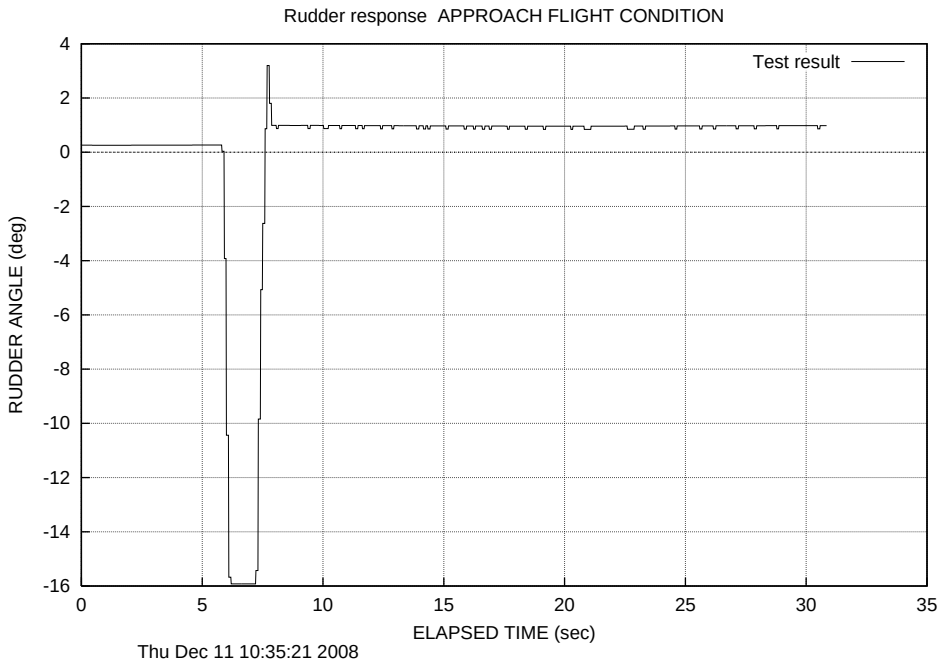

Rudder response APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
76
75
74
73
72
71
70
69
68
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:19 2008

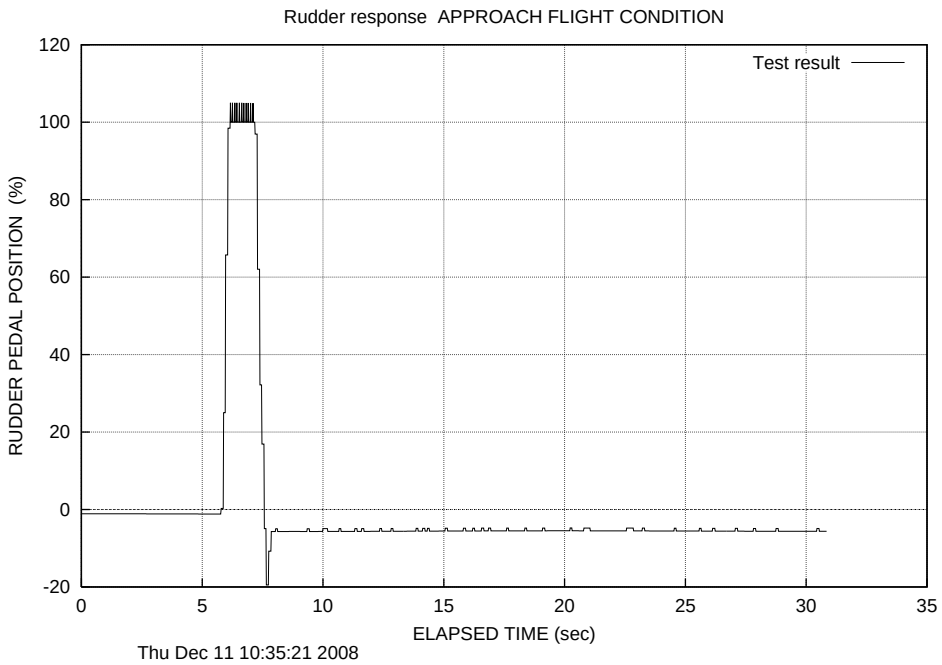

Rudder response APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:20 2008

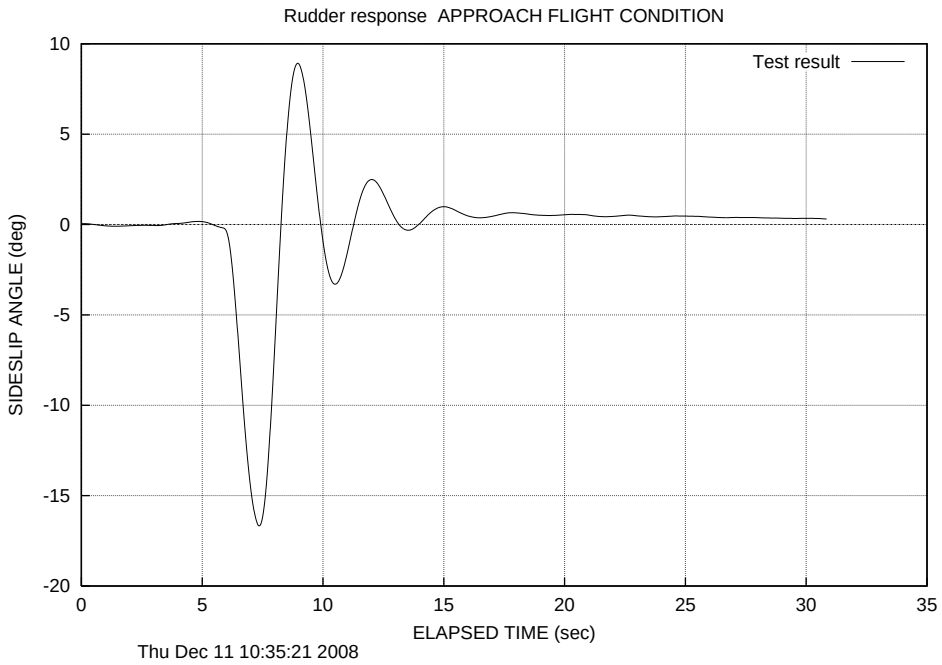

Rudder response APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
35000
30000
25000
20000
15000
10000
5000
0
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:20 2008

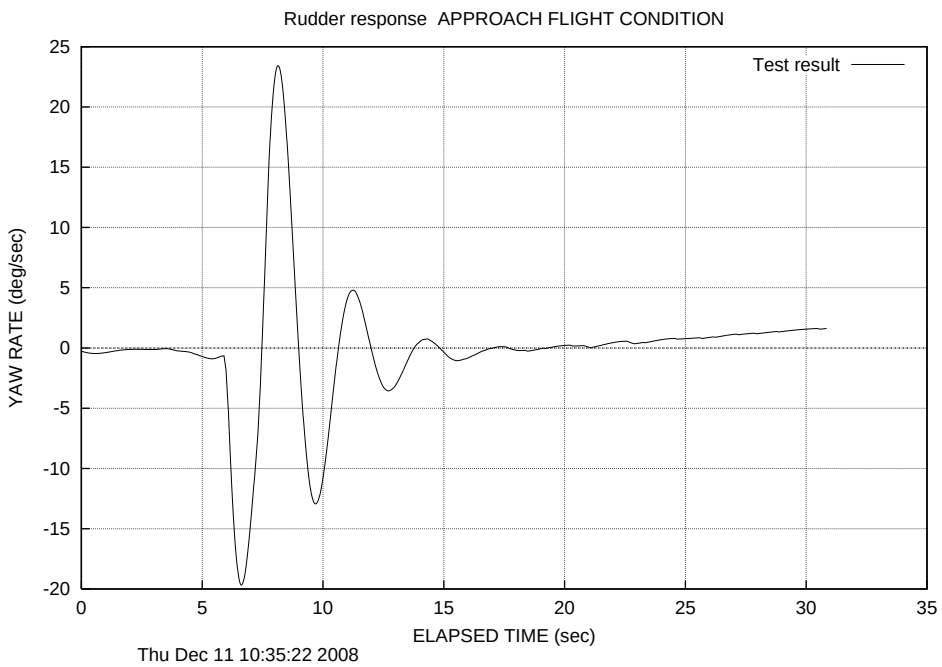

Rudder response APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
8
6
4
2
0
-2
-4
-6
-8
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:21 2008


Rudder response APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:21 2008


Rudder response APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:21 2008


Rudder response APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
120
100
80
60
40
20
0
-20
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:35:21 2008





Source data Section 3.18 of [1]

Comparison of results	The rudder response test shows compliance towards the Validation Reference Data result as described in Section 3.17 of [1].

6.23 Dutch roll (2c7)

Test objective

To demonstrate that the simulator lateral/directional dynamic stability characteristics of the simulator in the Dutch roll mode conform to the class of aeroplane.

Demonstration procedure

Starting from the wings-level trimmed condition, initiate a 'Dutch roll' oscillation using rapid pedal input in both directions, allowing the aeroplane to respond freely for at least six cycles of the oscillation. Record the pertinent lateral-directional parameters to enable a mathematical analysis of the oscillations to be carried out.

References

[2], [3], [4]

Initial conditions

Approach flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-4.667	(%)
ROLL CONTROLLER POSITION	=	0.0	(%)
RUDDER PEDAL POSITION	=	0.364	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)

WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2196	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.6	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	0.4	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON

SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Cruise flight condition:

CONTROL INPUTS:

THROTTLE SETTING	=	38.01	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	0	(deg)
FLAP INDICATOR POSITION	=	0	(deg)
PITCH CONTROLLER POSITION	=	-8.233	(%)
ROLL CONTROLLER POSITION	=	0.258	(%)
RUDDER PEDAL POSITION	=	1.091	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	86.5	(kts)
RATE OF CLIMB	=	200	(fpm)
PRESSURE ALTITUDE	=	4510	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	3.5	(deg)
BANK ANGLE	=	-1.5	(deg)
ANGLE OF ATTACK	=	2.1	(deg)
SIDESLIP ANGLE	=	0.1	(deg)
PITCH RATE	=	0.7	(deg/sec)
ROLL RATE	=	-1.4	(deg/sec)
YAW RATE	=	-0.6	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2421	(rpm)
EXHAUST GAS TEMPERATURE	=	1084	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	-1.7	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	-0.1	(deg)
WING FLAP ANGLE	=	0.0	(deg)

SWITCHES/BRAKES:

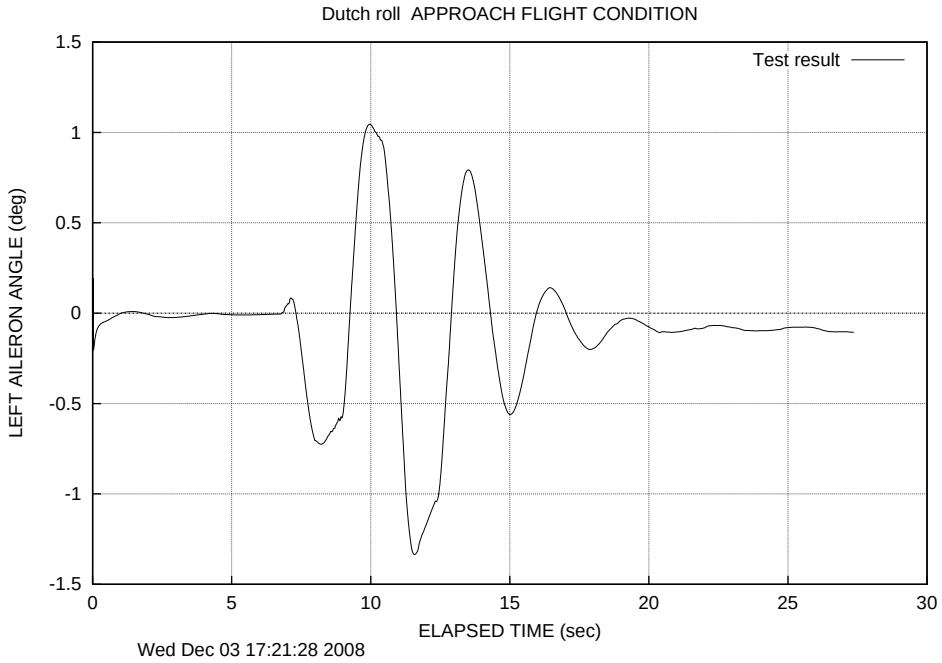
ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

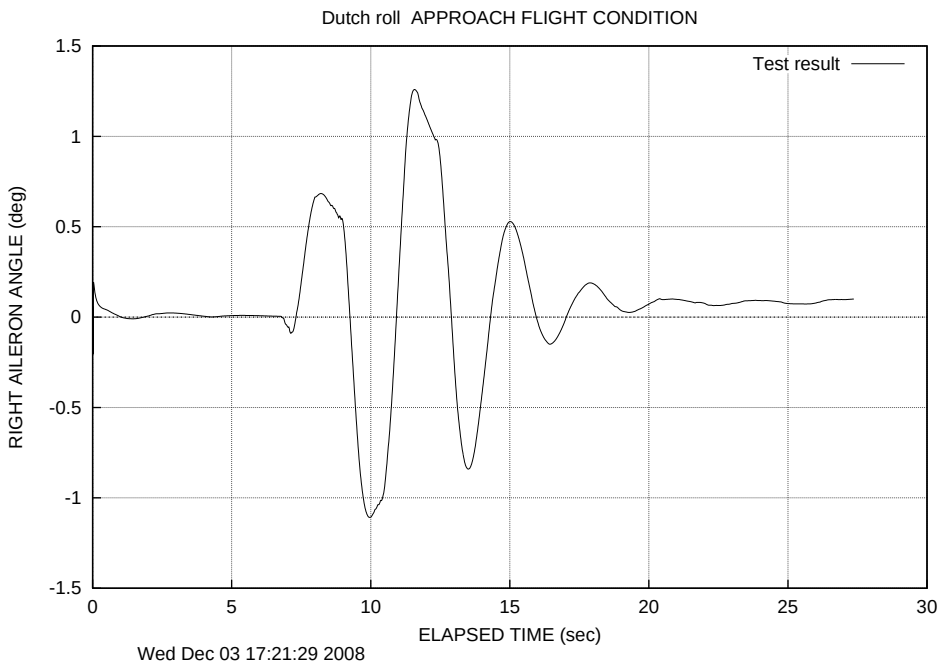
Manual test procedures

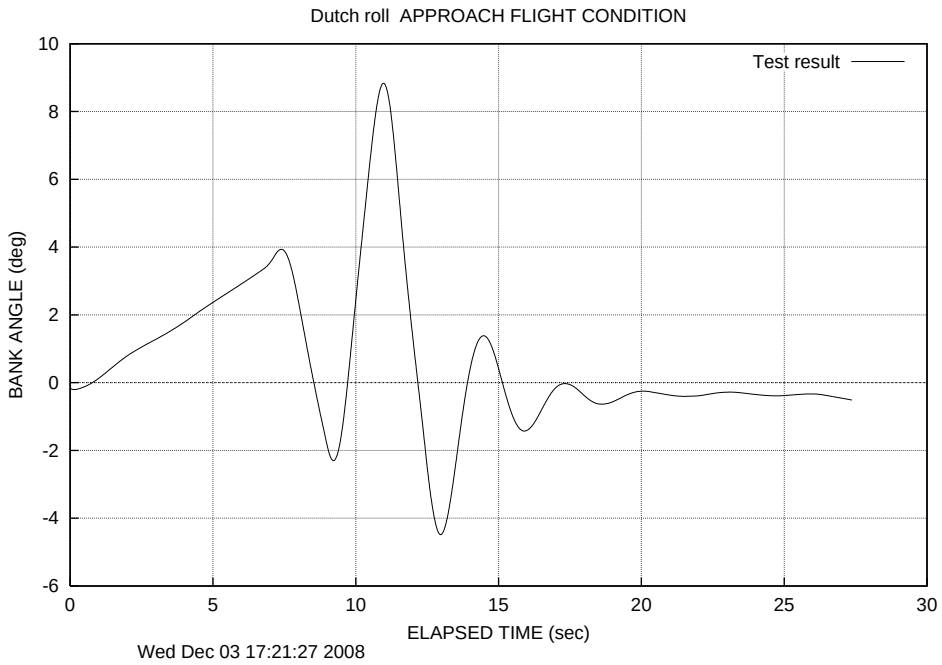
Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `619_FSTD_2d7_Approach.sit` or `619_FSTD_2d7_Cruise.sit` for the Approach or Cruise flight condition respectively. Set all inputs to the values shown here as initial conditions. Then press 'start'.

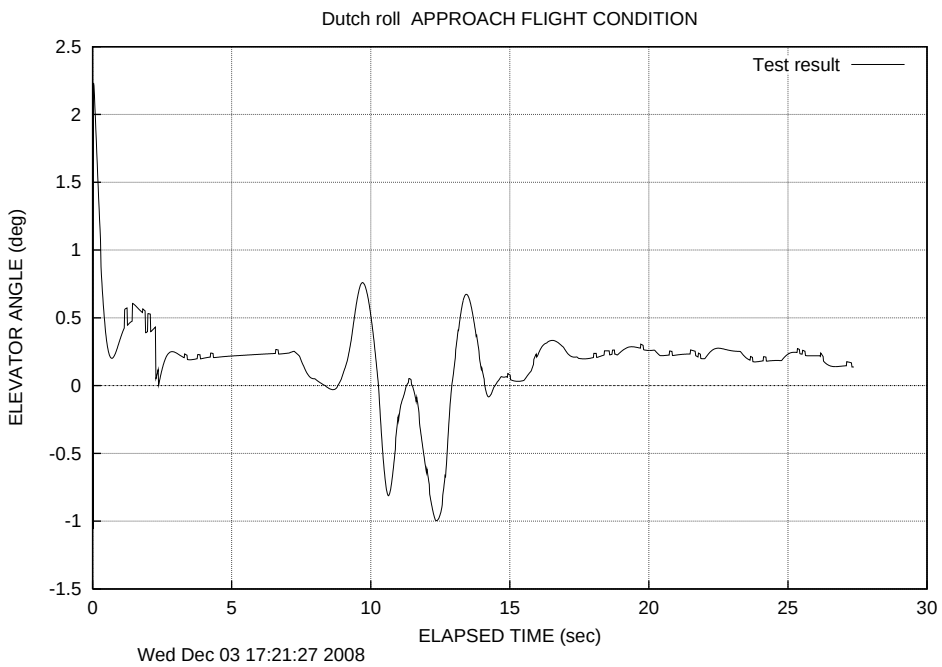
	Starting after 5 seconds with the rudder pedal position at the prescribed trimmed initial condition: 1. In a time frame of 5 seconds, from the initial rudder pedal position, push the left pedal such that it reaches 80% of its full travel, immediately followed by push the right pedal such that it reaches -80% of its full travel before pushing the left pedal such that it reaches 80% of its full travel again. 2. After a total of 10 seconds have elapsed, release the rudder pedals and allow the aeroplane to respond freely. 3. Stop recording after a total of 25 seconds have elapsed.
Evaluated parameters	AILERON ANGLE BANK ANGLE ELEVATOR ANGLE ENGINE SPEED FUEL FLOW INDICATED AIRSPEED PRESSURE ALTITUDE ROLL CONTROLLER POSITION ROLL RATE RUDDER ANGLE RUDDER PEDAL POSITION SIDESLIP ANGLE YAW RATE
Expected results	The Dutch roll is expected to be very well damped. See section 3.19 of [1].
Tolerances	CT&M
Test result	

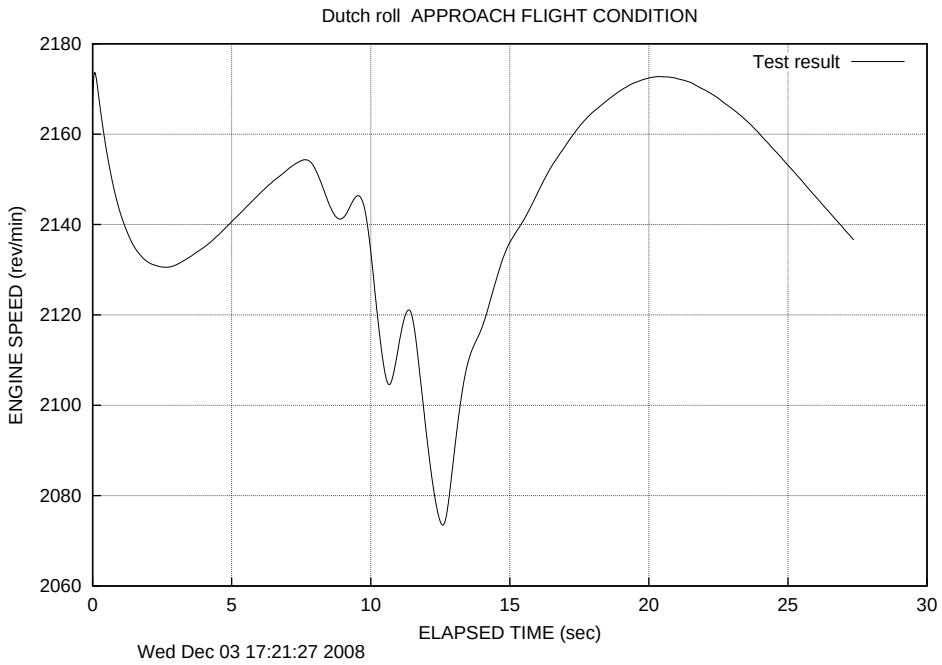
Approach flight condition:

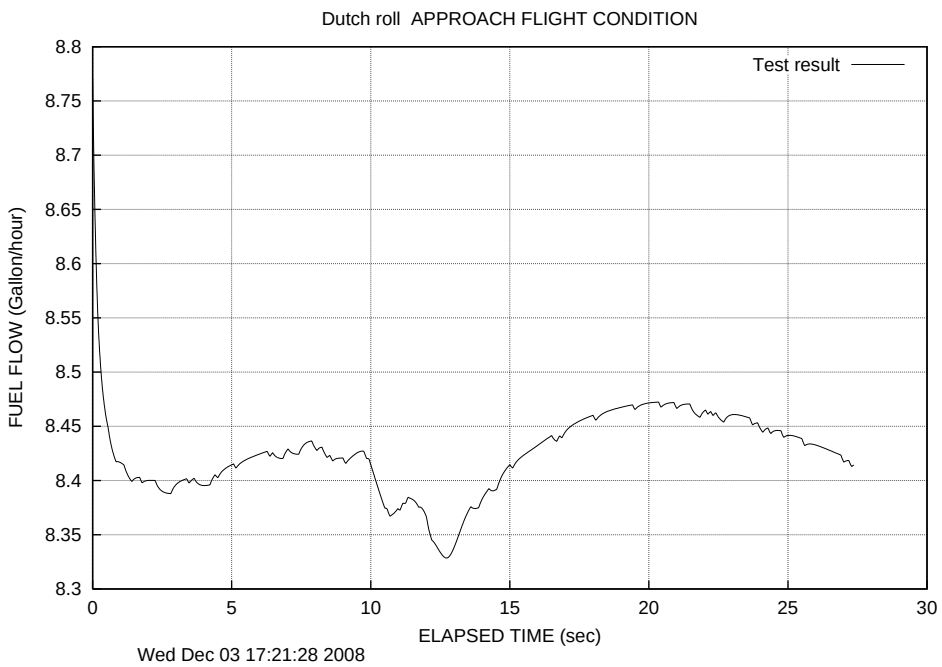


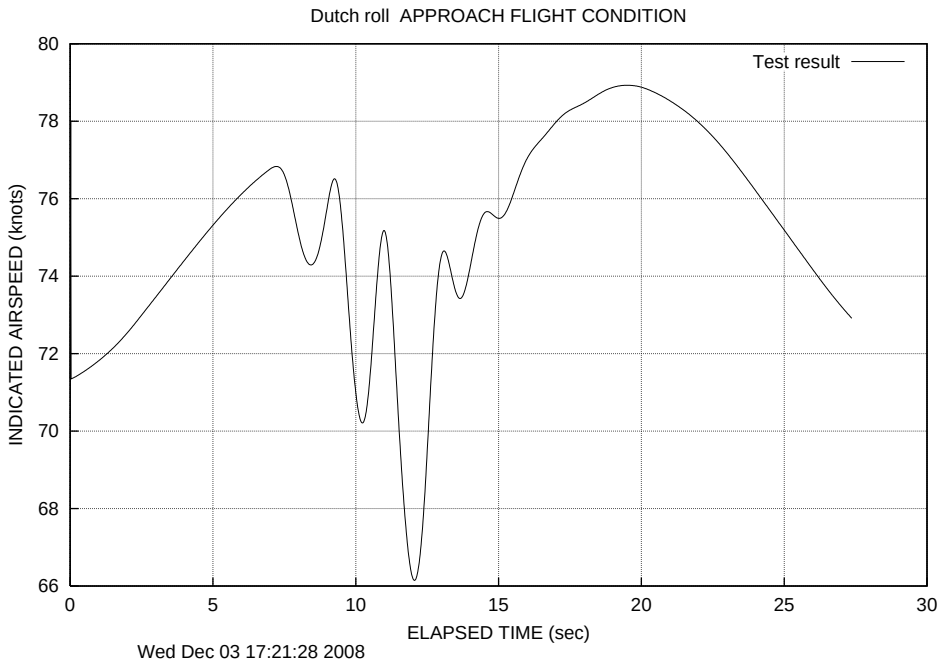


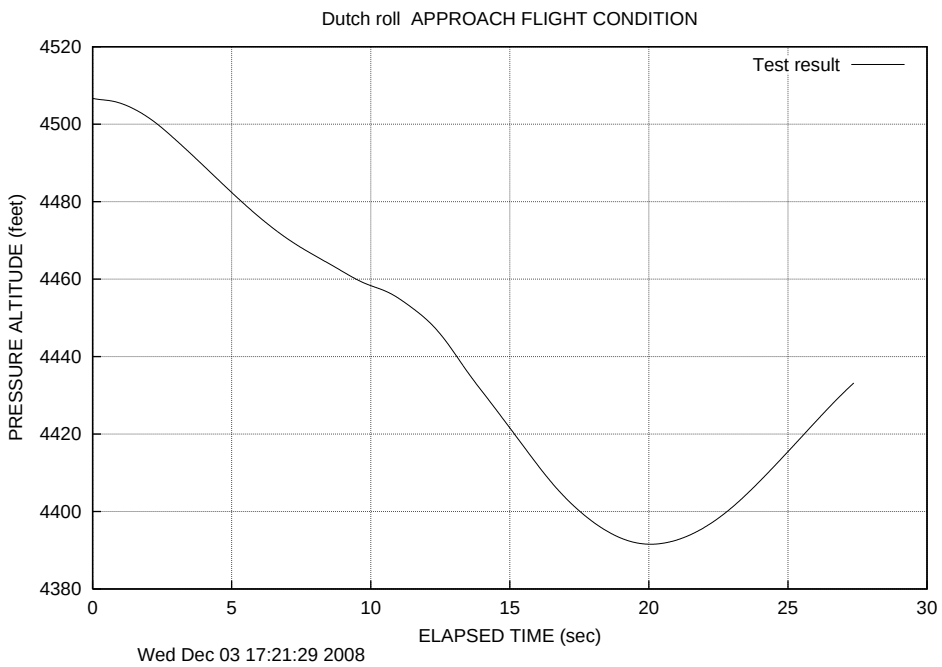

Dutch roll APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:21:27 2008
10
8
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30

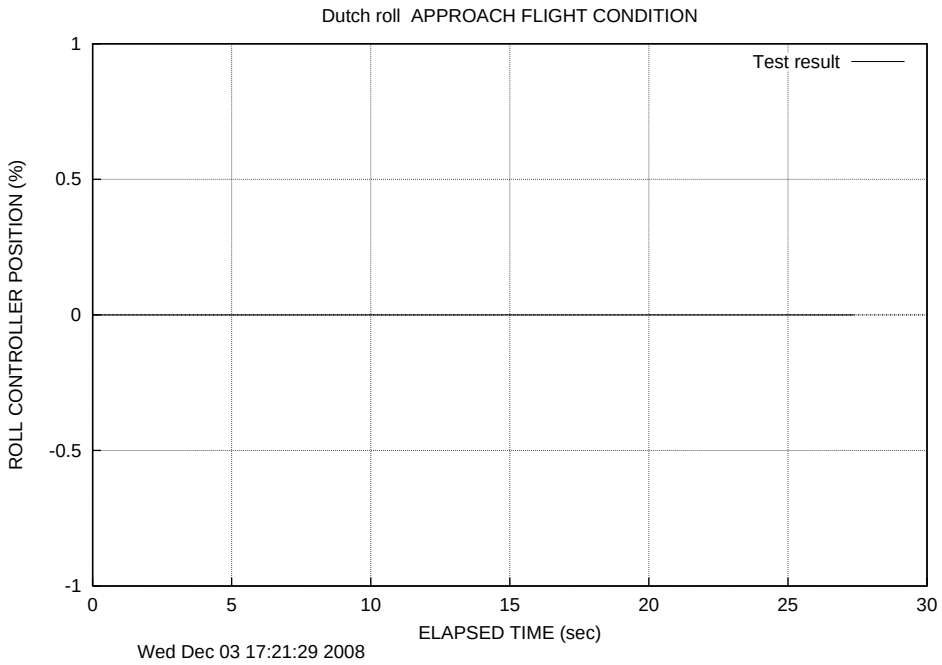

Dutch roll APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:21:27 2008
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25
30

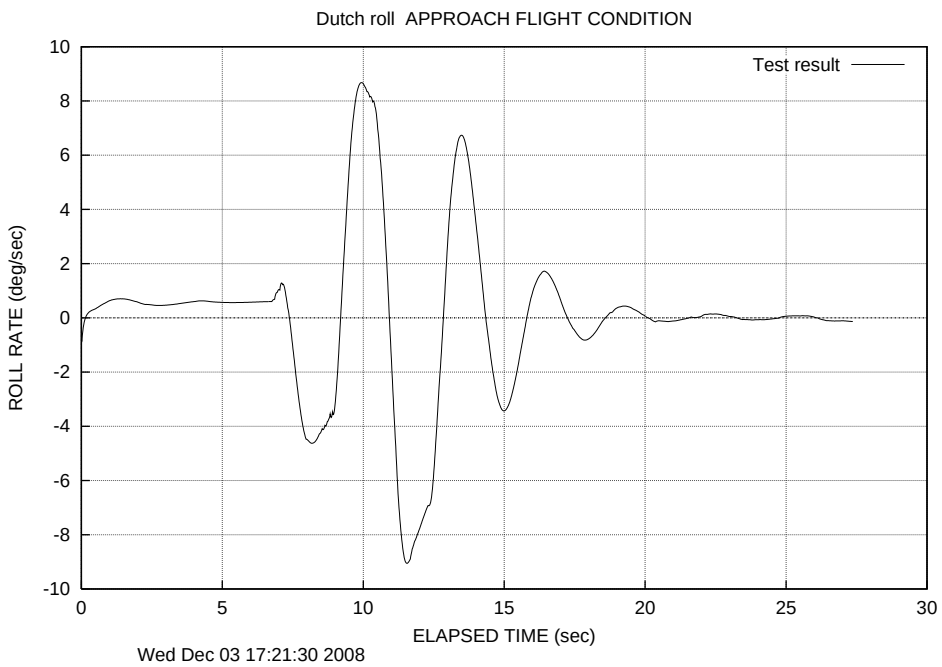

Dutch roll APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2180
2160
2140
2120
2100
2080
2060
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:27 2008

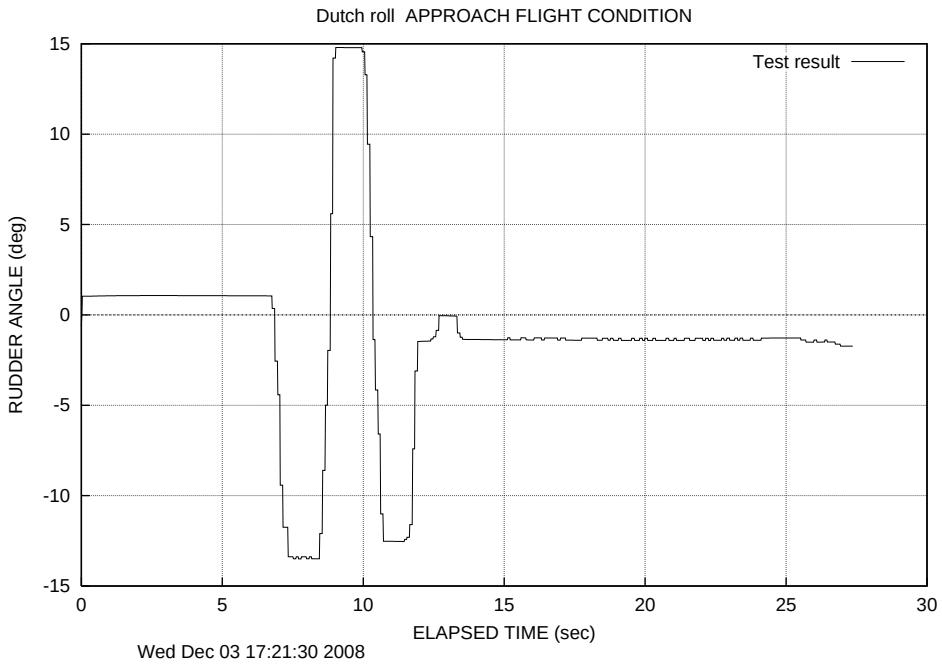

Dutch roll APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.8
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:28 2008

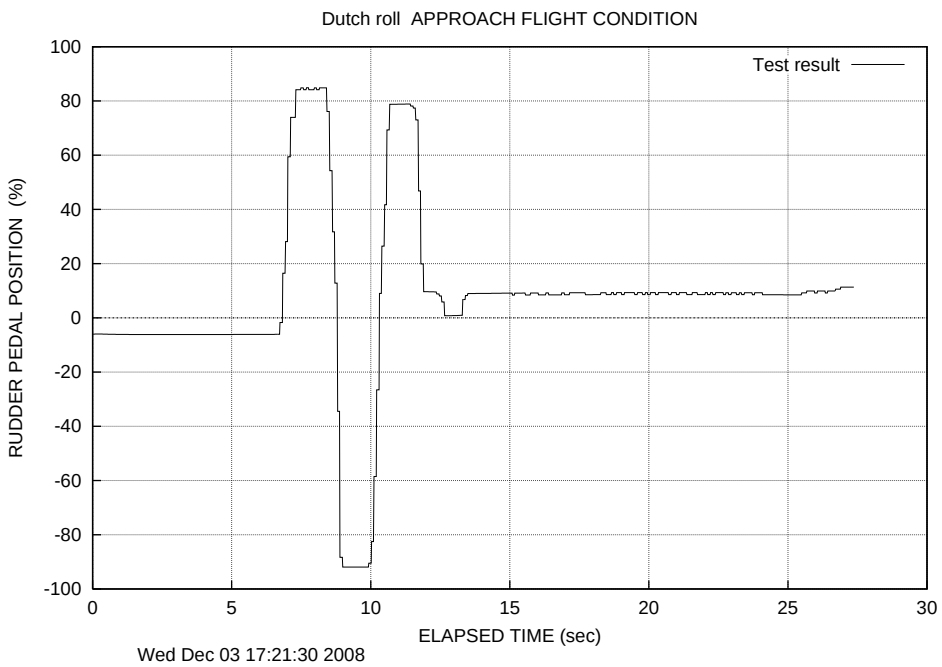

Dutch roll APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
80
78
76
74
72
70
68
66
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:28 2008

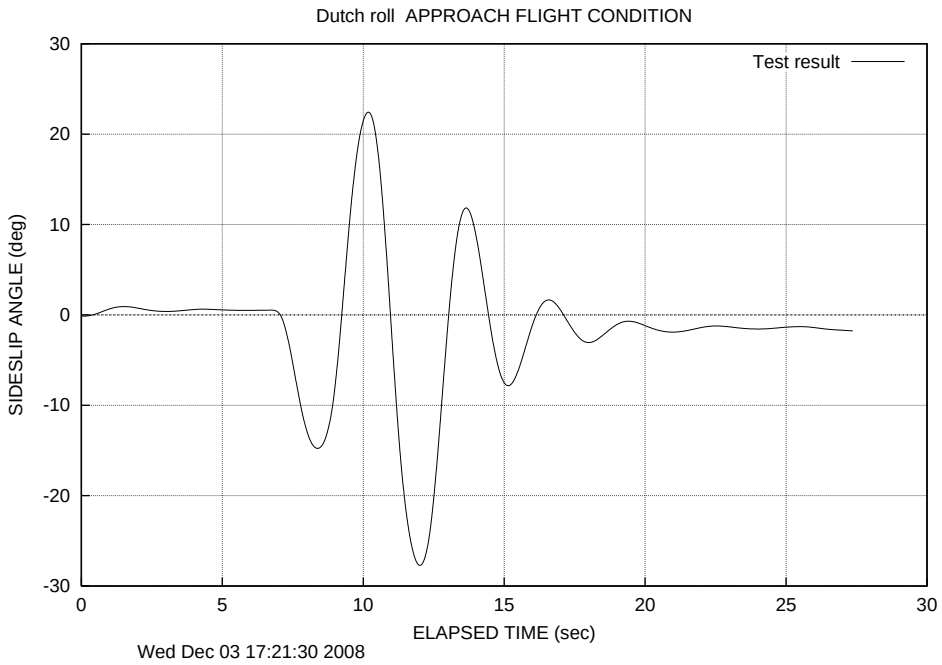

Dutch roll APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4520
4500
4480
4460
4440
4420
4400
4380
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:29 2008

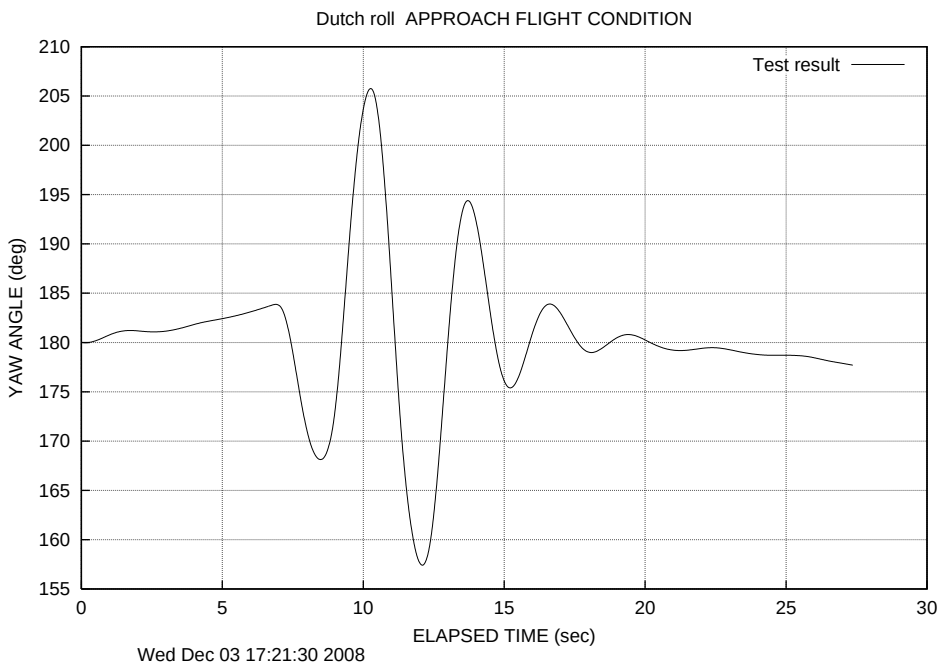

Dutch roll APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
1
0.5
0
-0.5
-1
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:29 2008


Dutch roll APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:30 2008

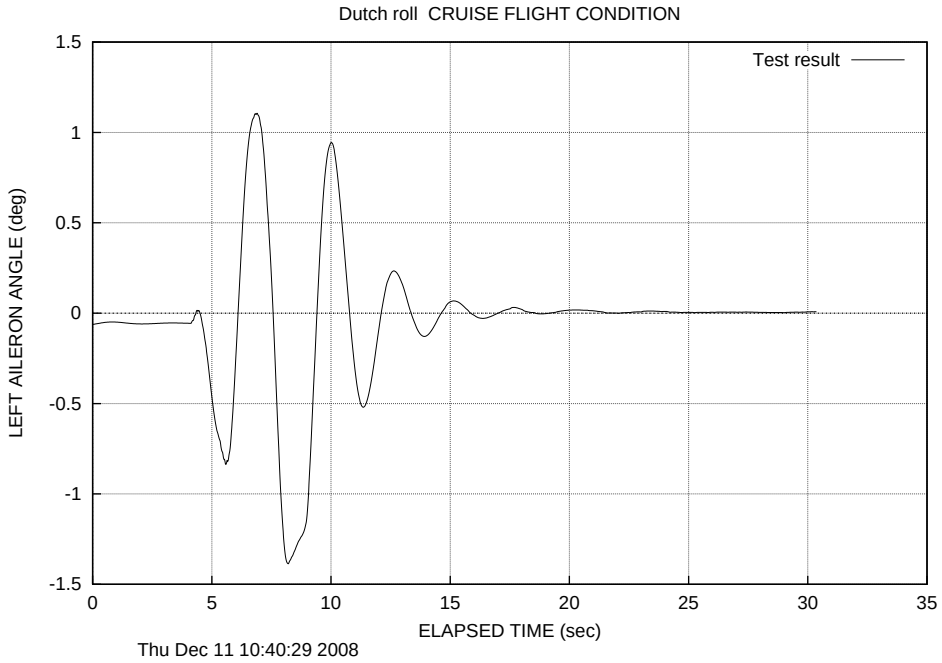

Dutch roll APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
15
10
5
0
-5
-10
-15
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:30 2008

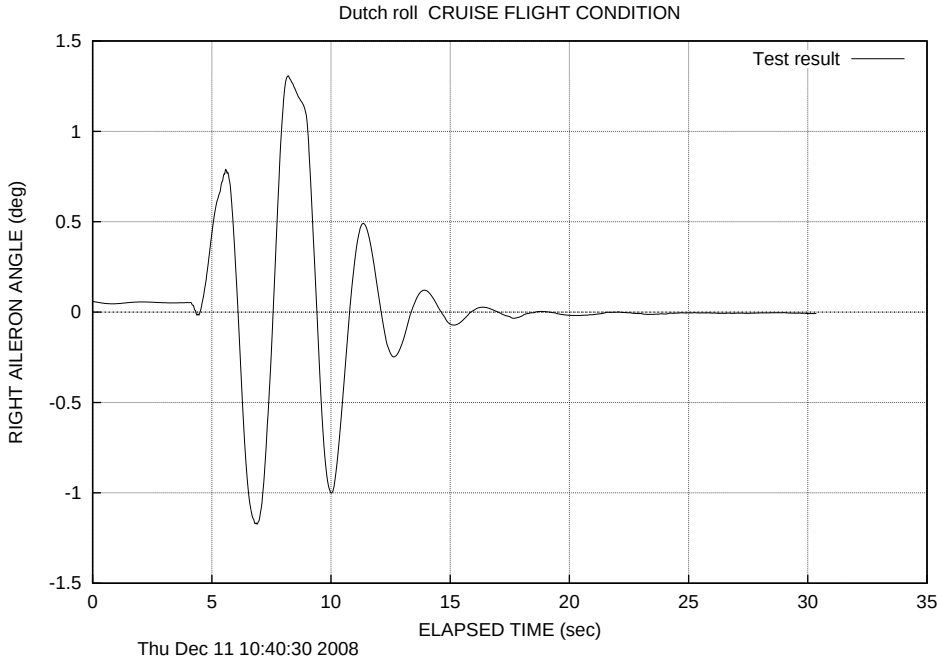

Dutch roll APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
100
80
60
40
20
0
-20
-40
-60
-80
-100
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:30 2008

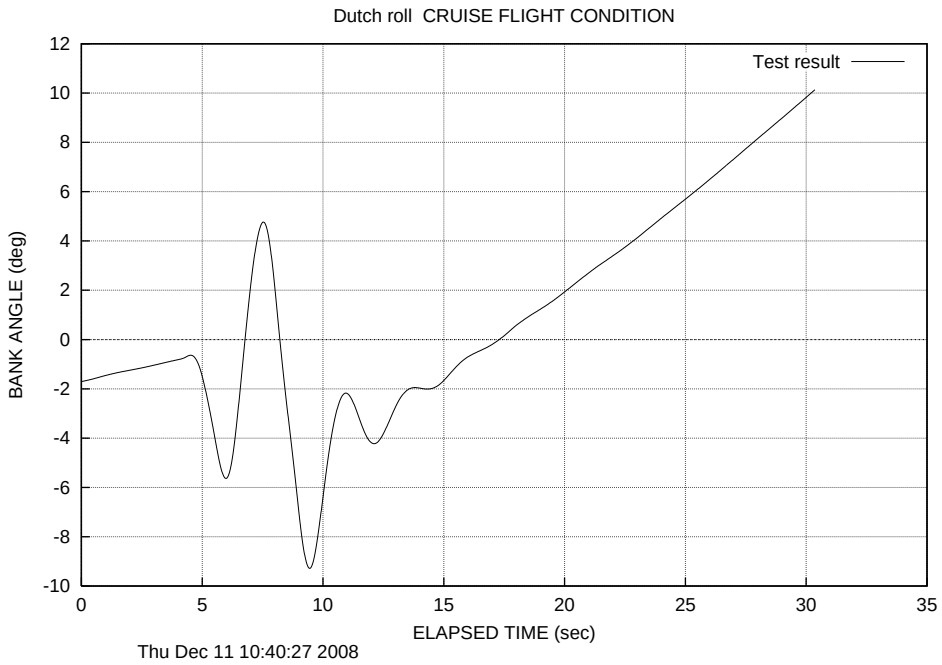

Dutch roll APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
30
20
10
0
-10
-20
-30
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:30 2008

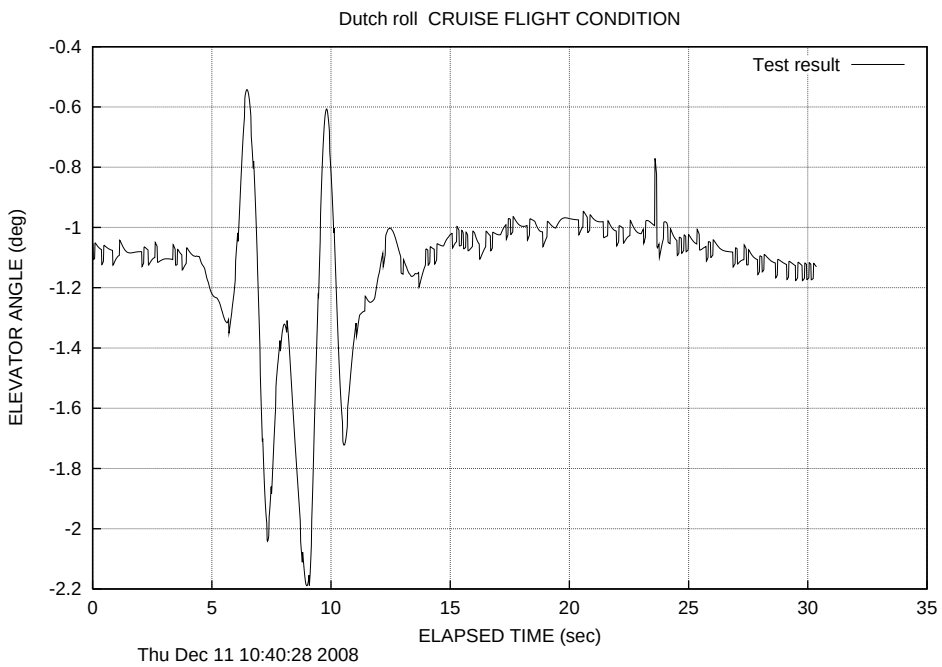

Dutch roll APPROACH FLIGHT CONDITION
Test result
YAW ANGLE (deg)
210
205
200
195
190
185
180
175
170
165
160
155
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:21:30 2008

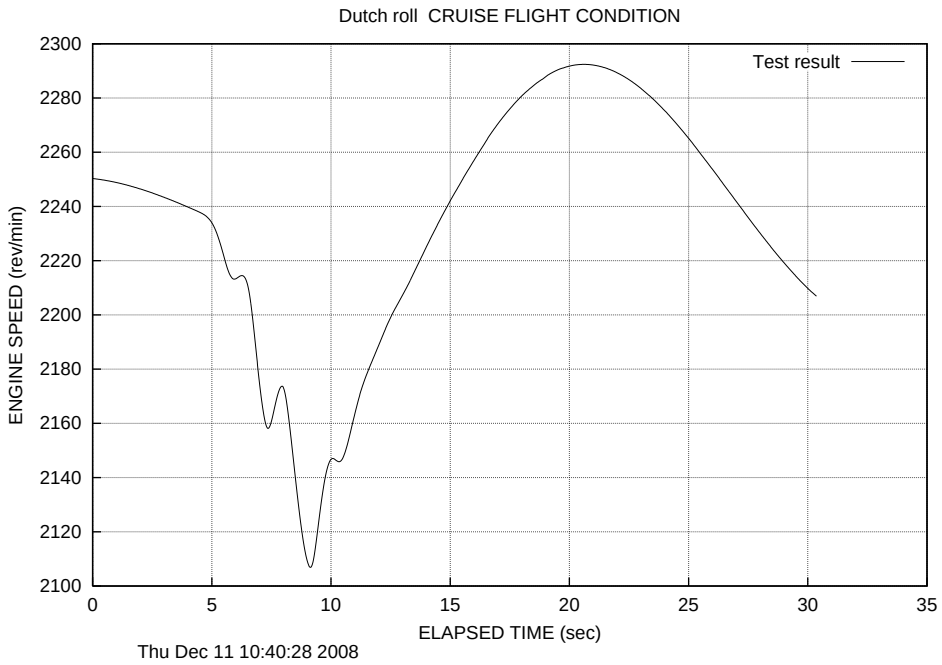
Cruise flight condition:

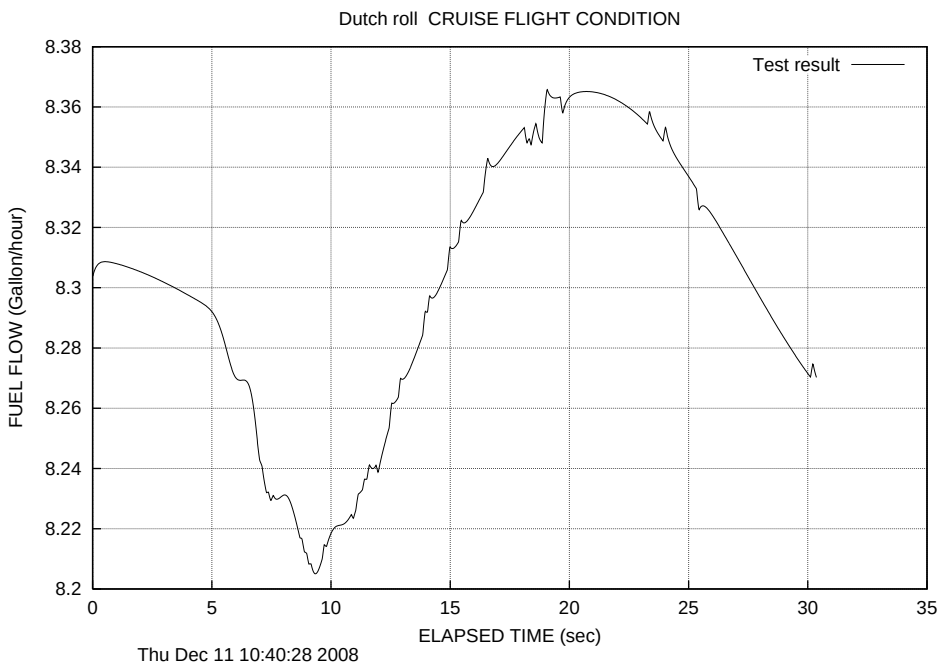


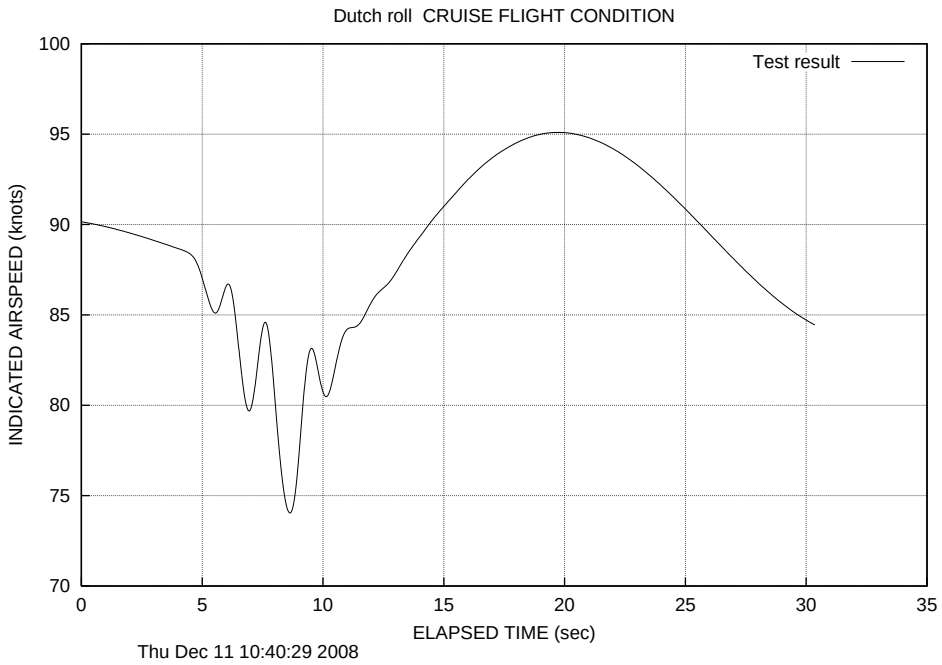


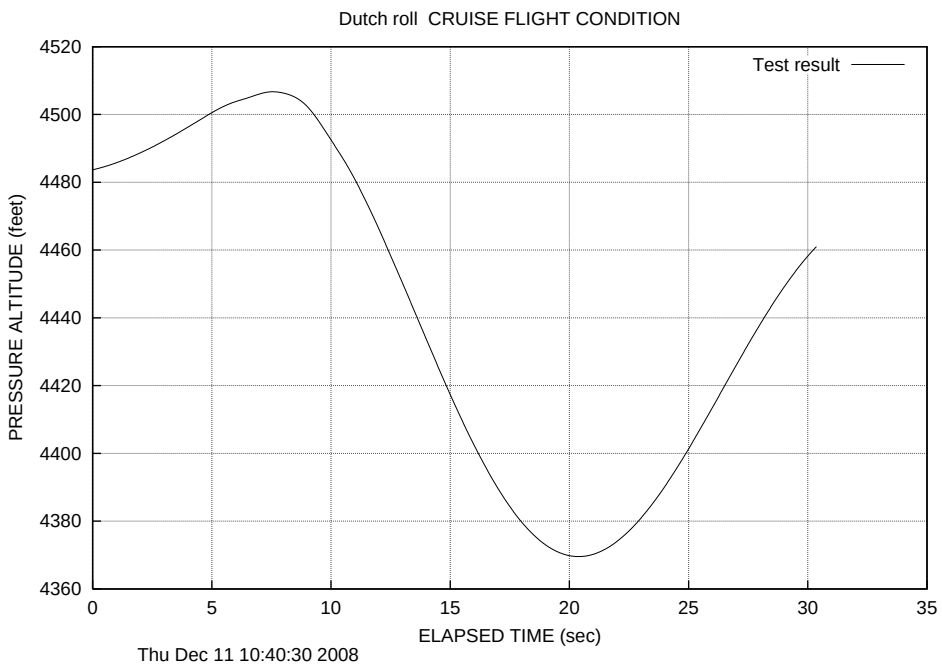

Dutch roll CRUISE FLIGHT CONDITION
Test result
BANK ANGLE (deg)
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:27 2008

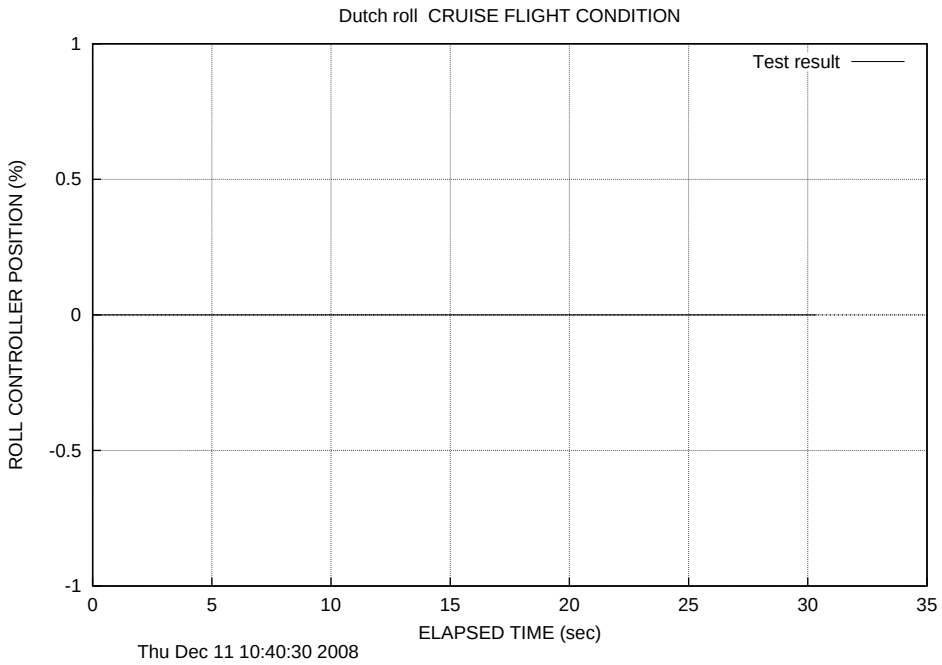

Dutch roll CRUISE FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:28 2008

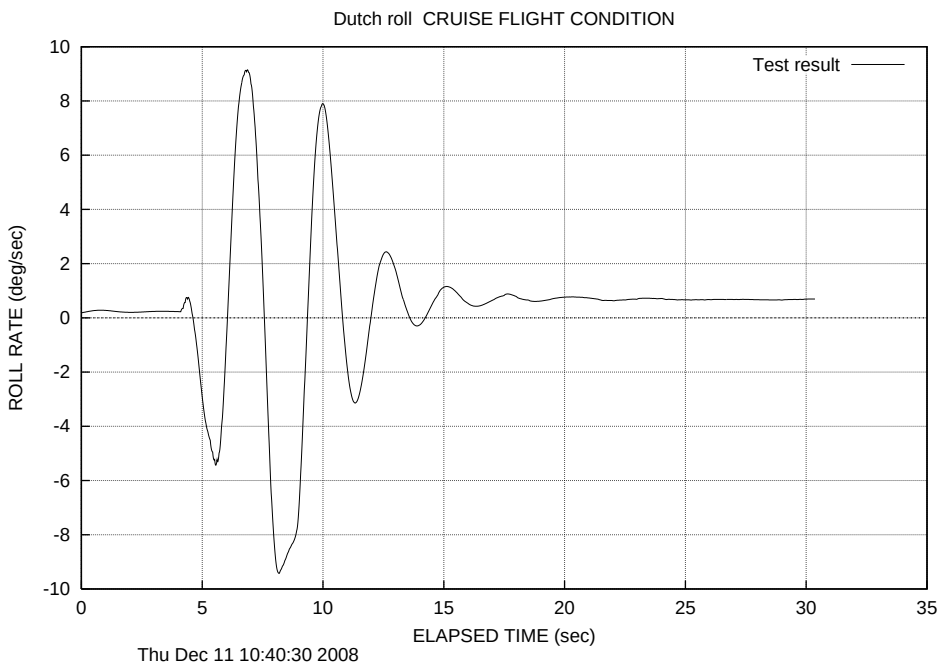

Dutch roll CRUISE FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2300
2280
2260
2240
2220
2200
2180
2160
2140
2120
2100
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:28 2008

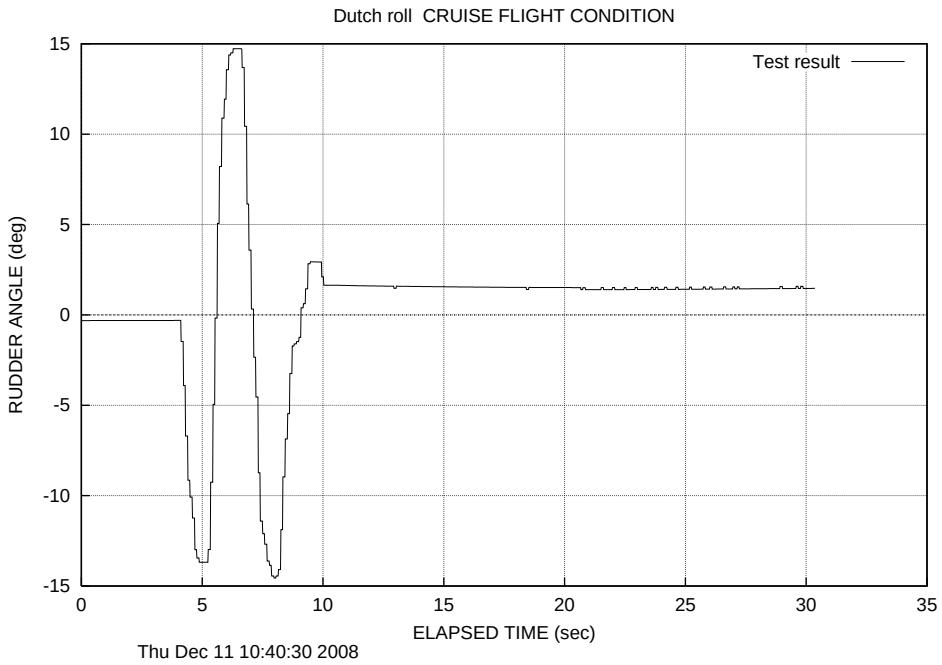

Dutch roll CRUISE FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.38
8.36
8.34
8.32
8.3
8.28
8.26
8.24
8.22
8.2
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:28 2008

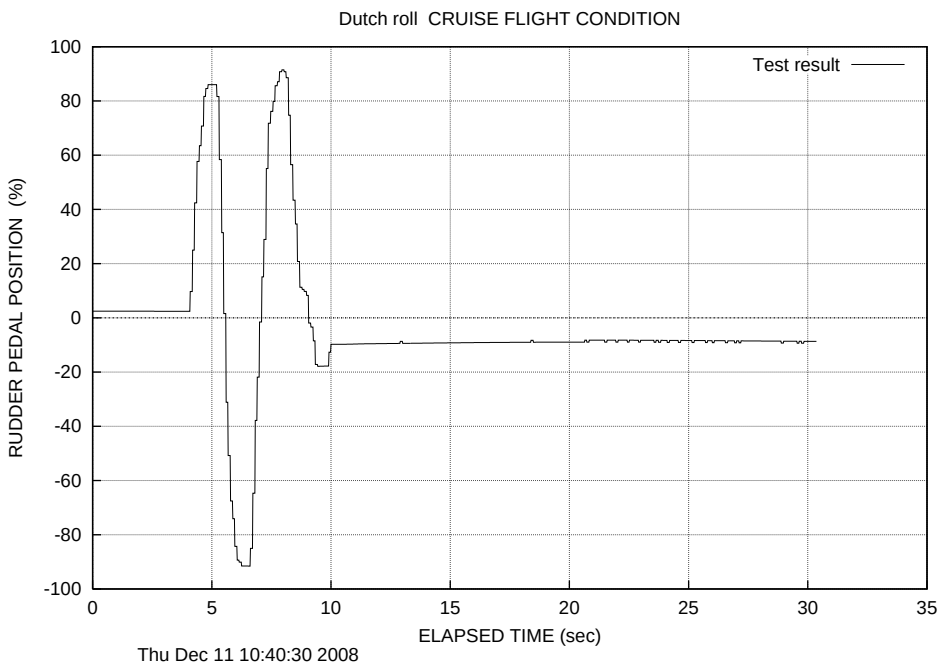

Dutch roll CRUISE FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
100
95
90
85
80
75
70
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:29 2008

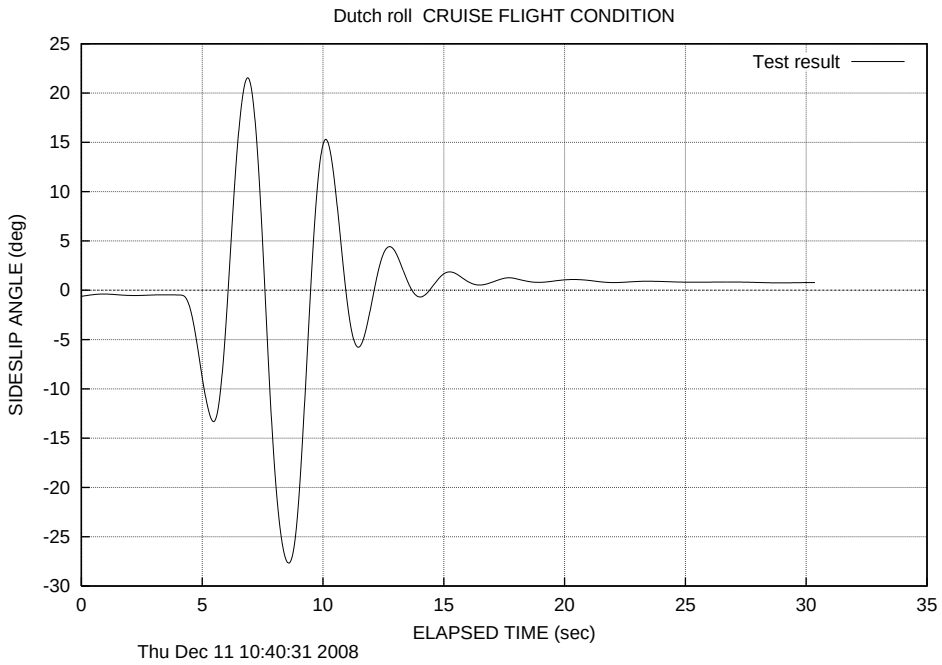

Dutch roll CRUISE FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4520
4500
4480
4460
4440
4420
4400
4380
4360
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:30 2008

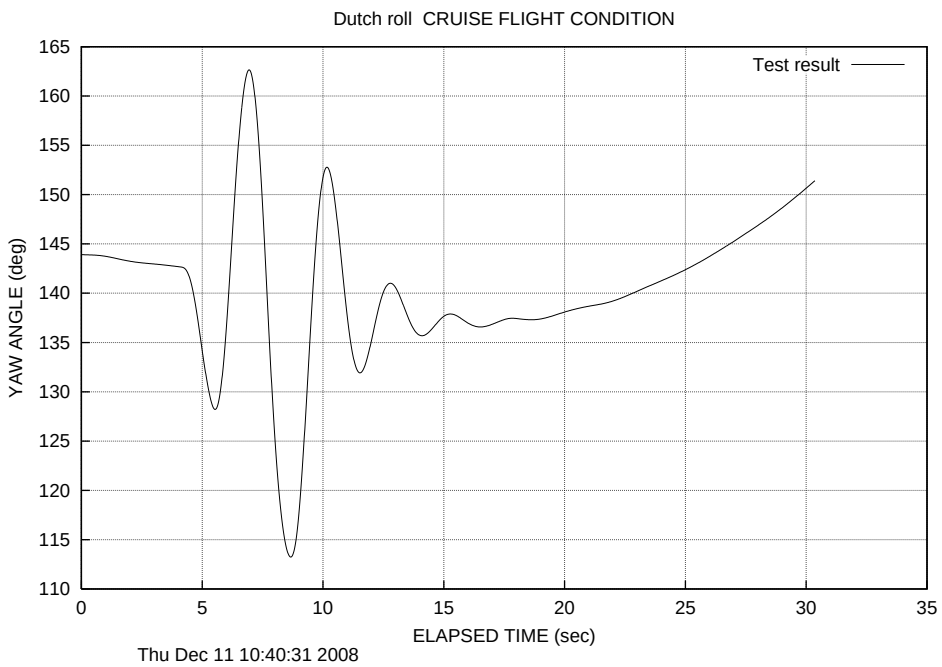

Dutch roll CRUISE FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
1
0.5
0
-0.5
-1
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:30 2008


Dutch roll CRUISE FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
10
8
6
4
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:30 2008


Dutch roll CRUISE FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
15
10
5
0
-5
-10
-15
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:30 2008


Dutch roll CRUISE FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
100
80
60
40
20
0
-20
-40
-60
-80
-100
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Thu Dec 11 10:40:30 2008


Dutch roll CRUISE FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:40:31 2008


Dutch roll CRUISE FLIGHT CONDITION
Test result
YAW ANGLE (deg)
ELAPSED TIME (sec)
Thu Dec 11 10:40:31 2008

Source data	Section 3.19 of [1]
Comparison of results	The simulator test shows Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.19 of [1].

6.24 Steady state sideslip (2c8)

Test objective

To demonstrate that the simulator exhibits the correct interrelationship of steady state lateral/directional flight characteristics in conformance with the class of aeroplane.

Demonstration procedure

Establish a steady-state sideslip condition using a constant rudder pedal position and sufficient lateral control to maintain a constant heading. The steady-state sideslip condition should be performed for at least two rudder pedal displacements, one of which should be near the maximum available rudder position. The test should be conducted in both directions.

References

[2], [3], [4]

Initial conditions

Approach flight condition (Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-2.667	(%)
ROLL CONTROLLER POSITION	=	0.515	(%)
RUDDER PEDAL POSITION	=	1.091	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)

WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2178	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	0.9	(deg)
LEFT AILERON ANGLE	=	0.0	(deg)
RIGHT AILERON ANGLE	=	0.0	(deg)
RUDDER ANGLE	=	0.1	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON

SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Approach flight condition (Full Left):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	1.639	(%)
ROLL CONTROLLER POSITION	=	-1.983	(%)
RUDDER PEDAL POSITION	=	-5.454	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2249	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	1.7	(deg)
LEFT AILERON ANGLE	=	-0.4	(deg)
RIGHT AILERON ANGLE	=	0.4	(deg)
RUDDER ANGLE	=	1.0	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions **Approach flight condition (Right):**

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)

TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	4.098	(%)
ROLL CONTROLLER POSITION	=	-4.816	(%)
RUDDER PEDAL POSITION	=	1.818	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)
EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2236	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	2.1	(deg)
LEFT AILERON ANGLE	=	-1.2	(deg)
RIGHT AILERON ANGLE	=	1.1	(deg)
RUDDER ANGLE	=	-0.1	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Initial conditions

Approach flight condition (Full Right):

CONTROL INPUTS:

THROTTLE SETTING	=	38.18	(mm)
MIXTURE SETTING	=	55	(mm)
TRIMWHEEL POSITION	=	1.100	(-)
FLAP LEVER POSITION	=	10	(deg)
FLAP INDICATOR POSITION	=	10	(deg)
PITCH CONTROLLER POSITION	=	-1.333	(%)
ROLL CONTROLLER POSITION	=	3.350	(%)
RUDDER PEDAL POSITION	=	2.545	(%)

CENTER OF GRAVITY /WEIGHTS:

CENTER OF GRAVITY	=	43.1	(inch)

EMPTY WEIGHT	=	1608.4	(lb)
PAYLOAD WEIGHT	=	422.5	(lb)
TOTAL FUEL WEIGHT	=	209.2	(lb)
LEFT FUEL TANK WEIGHT	=	104.6	(lb)
RIGHT FUEL TANK WEIGHT	=	104.6	(lb)

ATMOSPHERE/WEATHER:

TEMPERATURE AT SEALEVEL	=	15	(deg C)
BARO PRESSURE AT SEALEVEL	=	1020	(mbar)
WIND SPEED	=	12	(kt)
WIND SPEED DIRECTION	=	240	(deg)

SPEED/ALTITUDE/TEMPERATURE:

INDICATED AIRSPEED	=	71.3	(kts)
RATE OF CLIMB	=	-106	(fpm)
PRESSURE ALTITUDE	=	4504	(ft)

EULER & AERO ANGLES/RATES:

PITCH ANGLE	=	1.4	(deg)
BANK ANGLE	=	-0.2	(deg)
ANGLE OF ATTACK	=	2.4	(deg)
SIDESLIP ANGLE	=	-0.1	(deg)
PITCH RATE	=	3.8	(deg/sec)
ROLL RATE	=	-0.8	(deg/sec)
YAW RATE	=	-0.5	(deg/sec)

ENGINE PARAMETERS:

ENGINE SPEED	=	2260	(rpm)
EXHAUST GAS TEMPERATURE	=	1090	(deg F)
FUEL FLOW	=	8.77	(gallon/hour)

CONTROL SURFACES:

ELEVATOR ANGLE	=	1.2	(deg)
LEFT AILERON ANGLE	=	0.5	(deg)
RIGHT AILERON ANGLE	=	-0.5	(deg)

RUDDER ANGLE	=	0.6	(deg)
WING FLAP ANGLE	=	10.0	(deg)

SWITCHES/BRAKES:

ENGINE STARTER KEY	=	BOTH
PARKING BRAKE	=	OFF
SWITCH MASTER ALT	=	ON
SWITCH MASTER BAT	=	ON
AVIONICS BUS 1	=	ON
AVIONICS BUS 2	=	ON
SWITCH FUEL PUMP	=	ON
SWITCH PITOTHEAT	=	ON
FUEL TANK SELECTOR	=	BOTH
SWITCH FUEL CUTOFF	=	OFF

Manual test procedures

Open the Qualification Test Panel as described in Chapter 5. Select the evaluation test, make sure to be in de pause mode and load file situation file `620_FSTD_2d8_Approach.sit`. Set all inputs to the values shown here as initial conditions. Then press 'start'.

Starting after 5 seconds with the rudder pedal position and the Yoke in roll control at the prescribed trimmed initial conditions:
1. From the initial rudder pedal position, push the left pedal such that it reaches 30% of its full travel. Use the Yoke in roll control to maintain the initial heading.
2. Stop recording after at least a total of 20 seconds have elapsed.

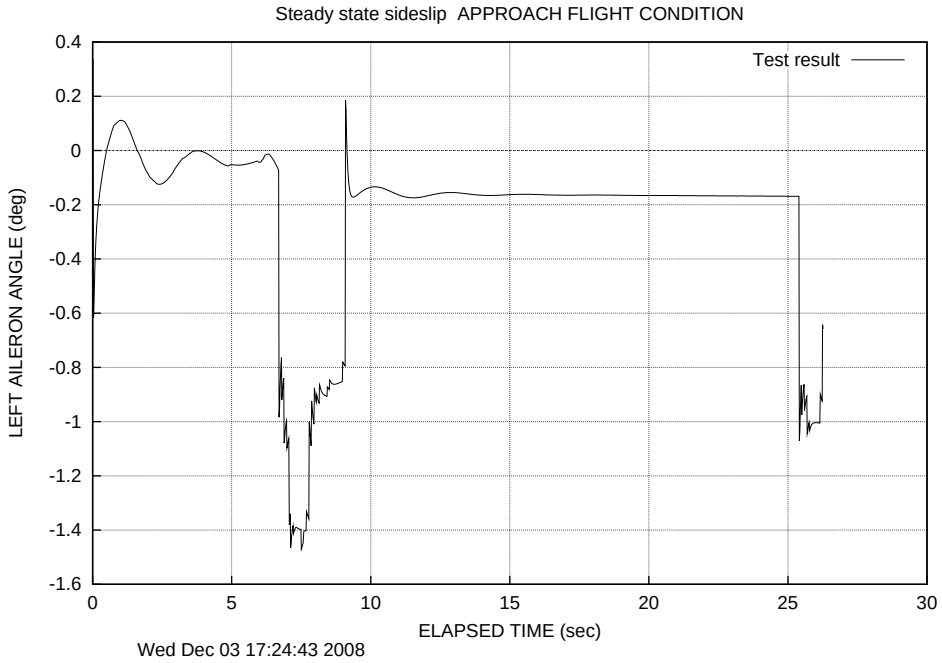
Repeat this manual test procedure for a full right rudder pedal travel, a 30% full left rudder pedal travel and a full left rudder pedal travel.

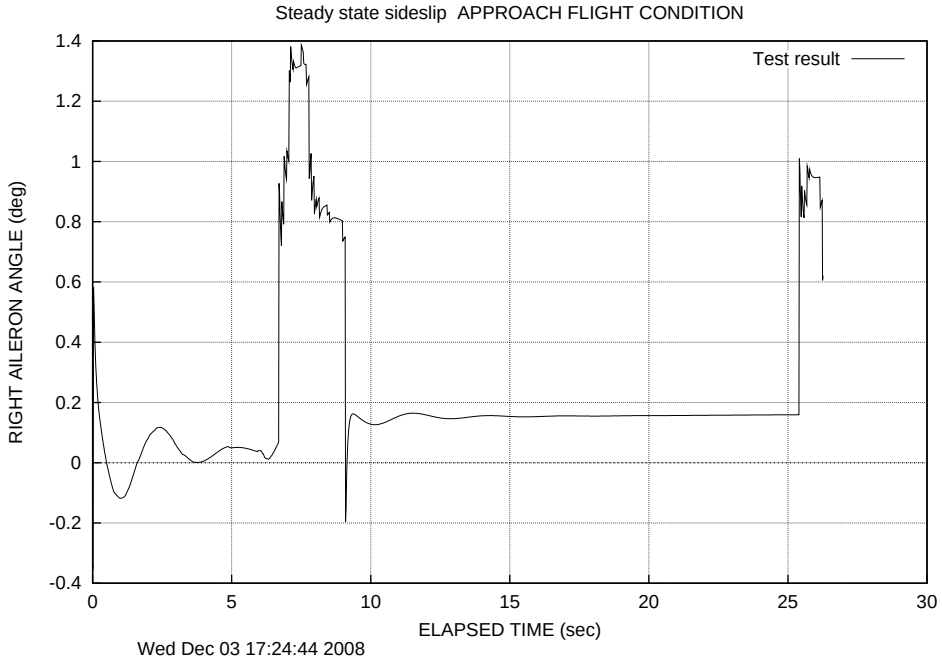
Evaluated parameters

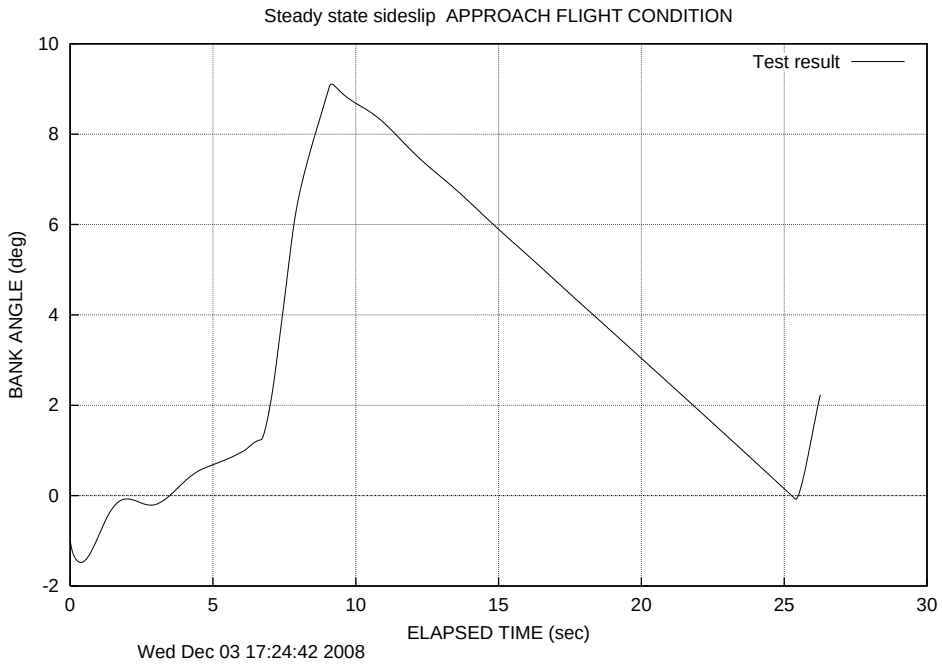
AILERON ANGLE
BANK ANGLE
ELEVATOR ANGLE
ENGINE SPEED
FUEL FLOW
HEADING ANGLE
INDICATED AIRSPEED
PITCH ANGLE
PRESSURE ALTITUDE
ROLL CONTROLLER POSITION
ROLL RATE
RUDDER ANGLE

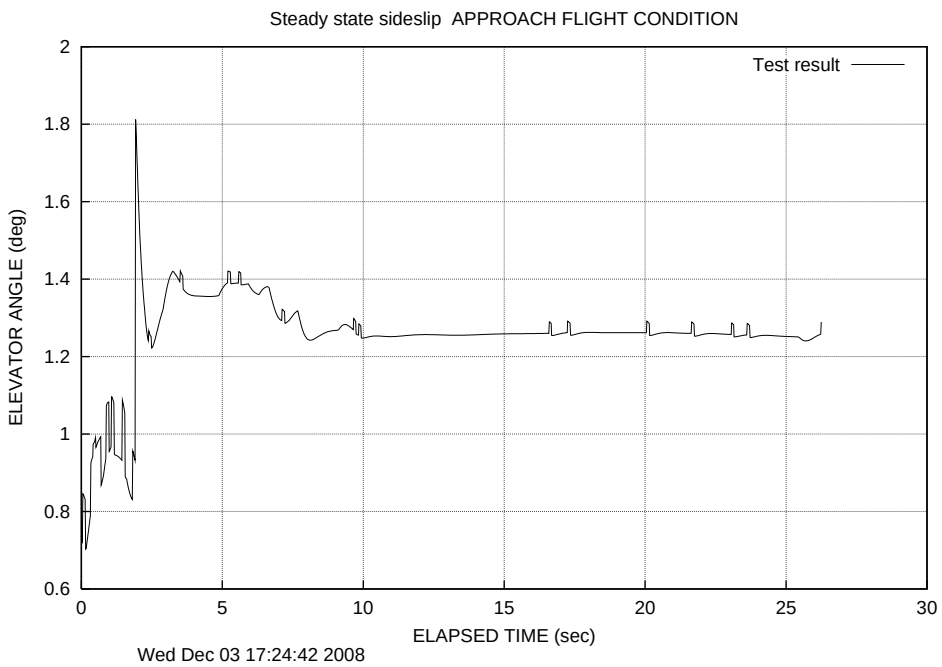
	RUDDER PEDAL POSITION SIDESLIP ANGLE YAW RATE
Expected results	For maintaining the wings level and to maintain the initial heading after a left rudder pedal input, the pilot is expected to need to move the Yoke in roll control to the right. After a right rudder pedal input, the pilot is expected to need to move the Yoke in roll control to the left. See section 3.20 of [1].
Tolerances	CT&M
Test result	For maintaining the wings level and to maintain the initial heading after a left rudder pedal input, the pilot needed to move the Yoke in roll control to the right. After a right rudder pedal input, the pilot needed to move the Yoke in roll control to the left.

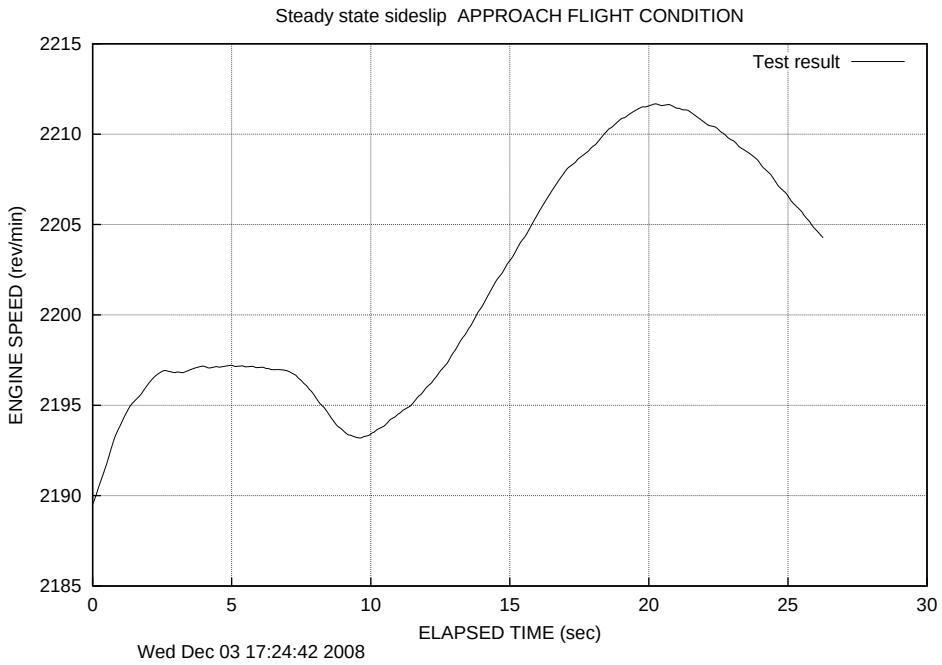
Left rudder pedal

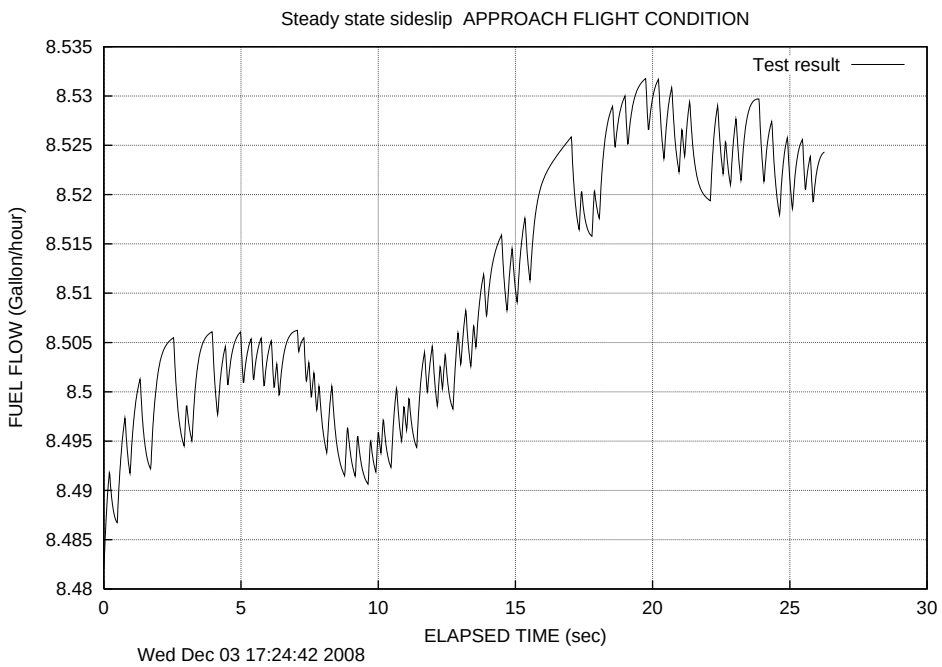


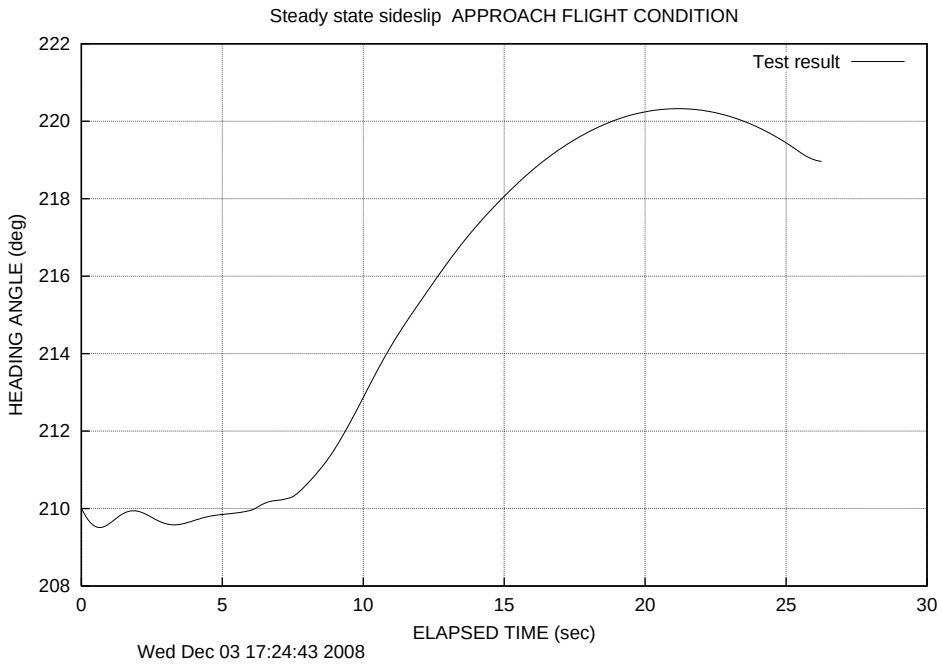


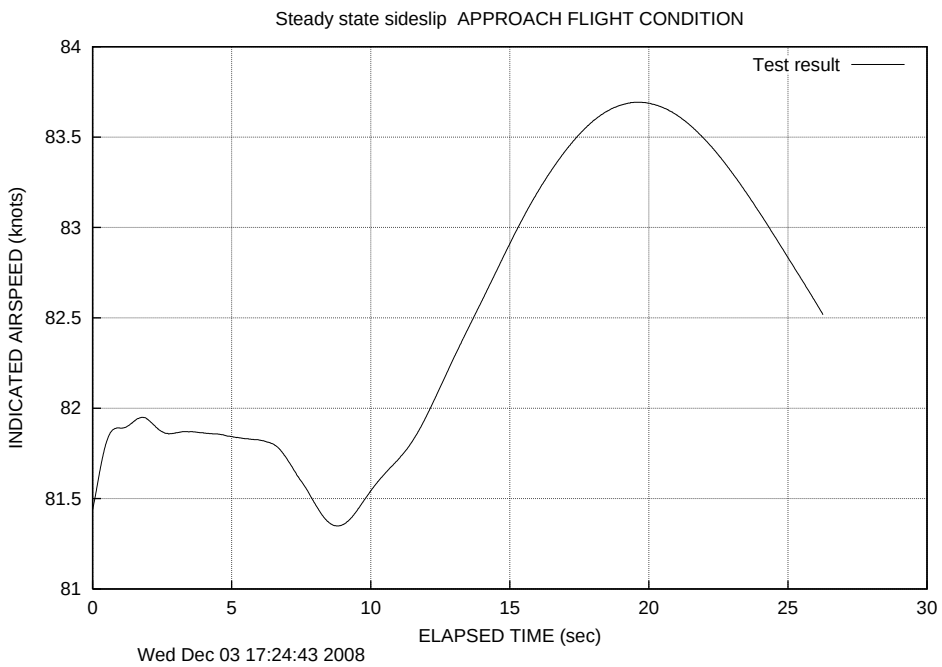

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:24:42 2008
10
8
6
4
2
0
-2
0
5
10
15
20
25
30

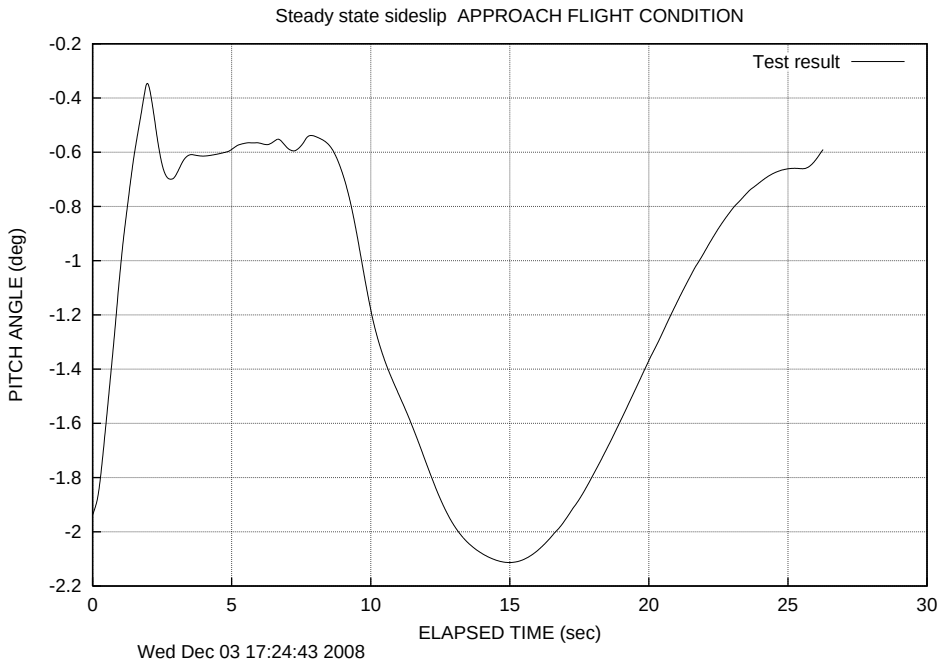

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:24:42 2008
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0
5
10
15
20
25
30

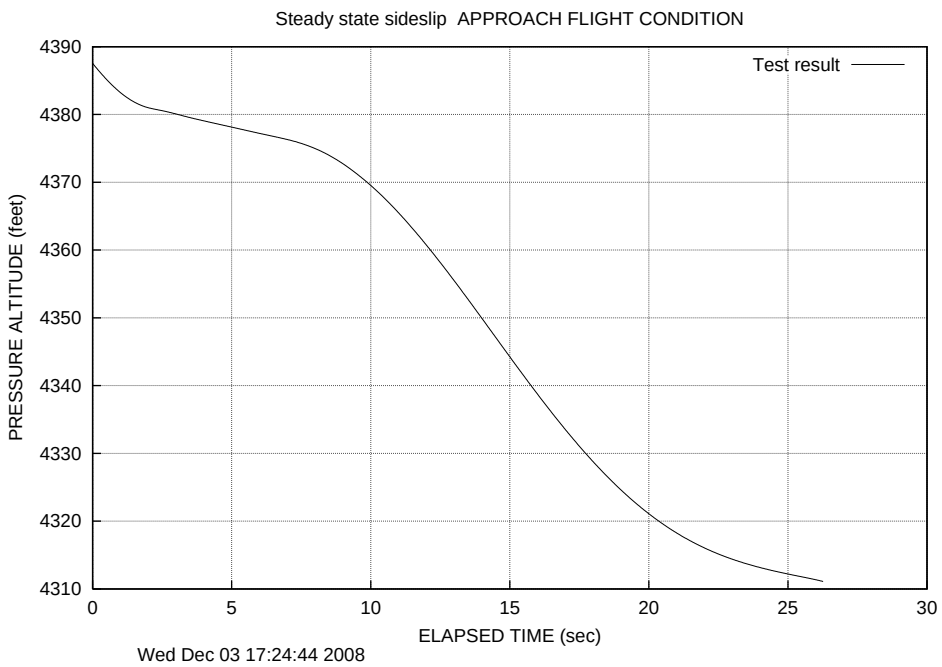

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2215
2210
2205
2200
2195
2190
2185
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:42 2008

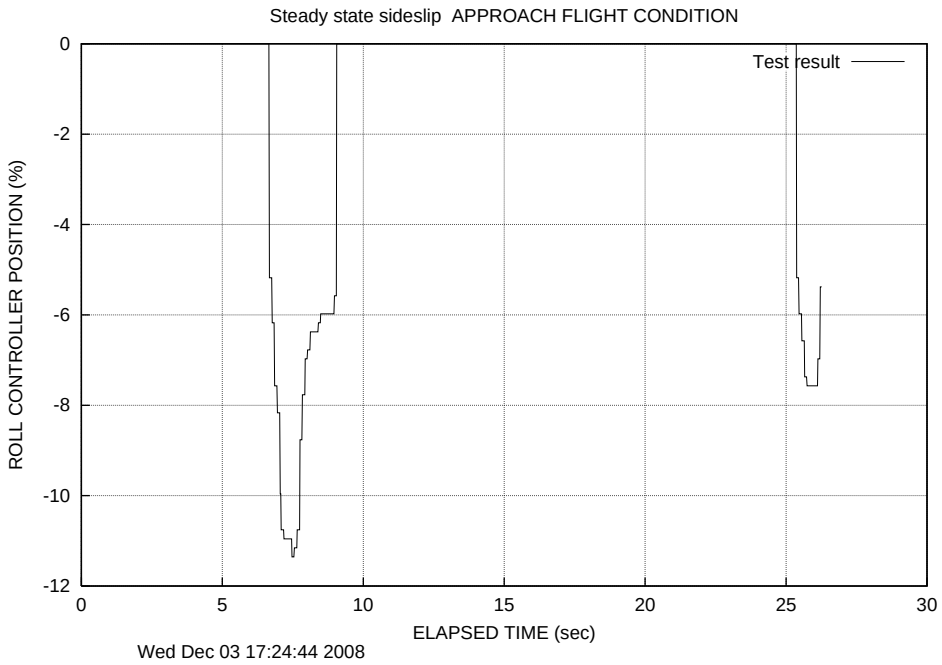

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.535
8.53
8.525
8.52
8.515
8.51
8.505
8.5
8.495
8.49
8.485
8.48
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:42 2008

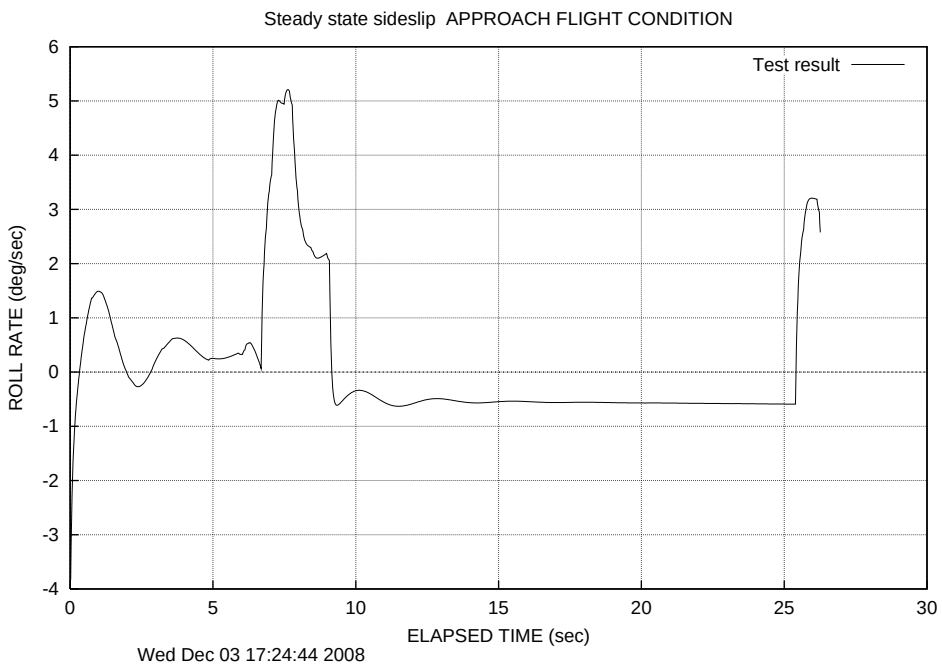

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
222
220
218
216
214
212
210
208
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:43 2008

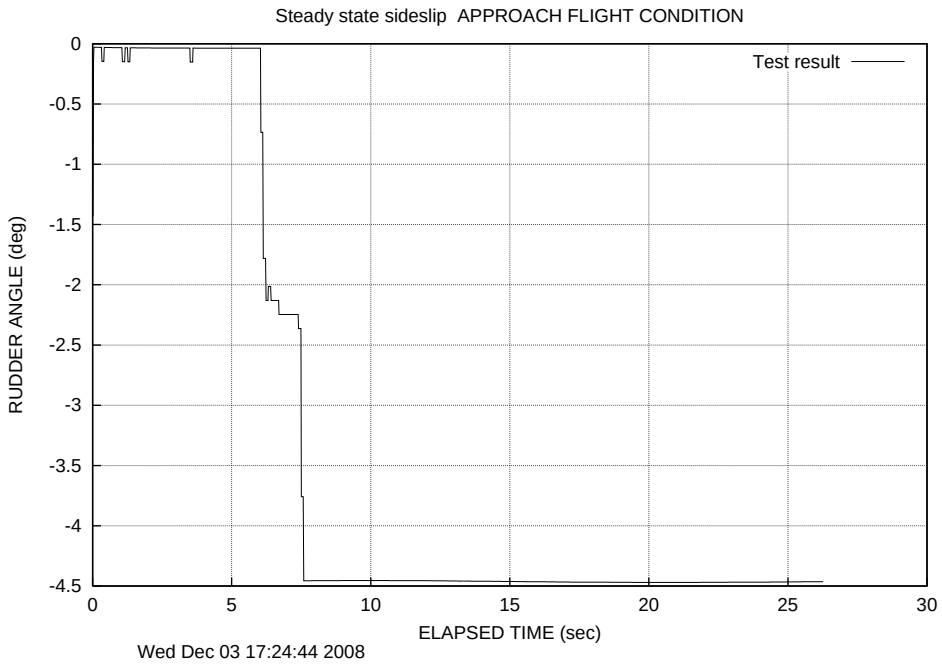

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
84
83.5
83
82.5
82
81.5
81
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:43 2008

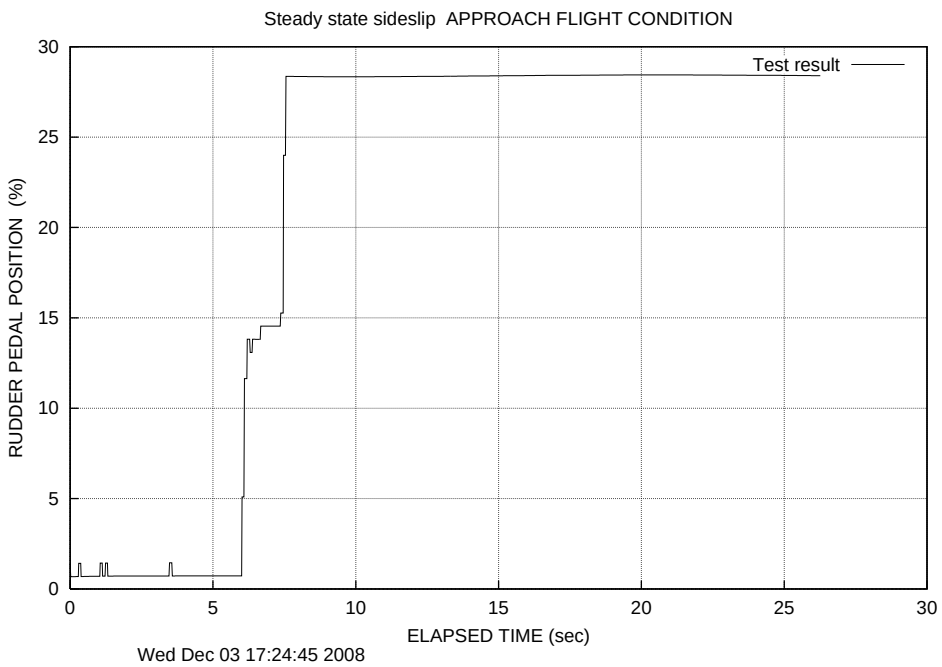

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:43 2008

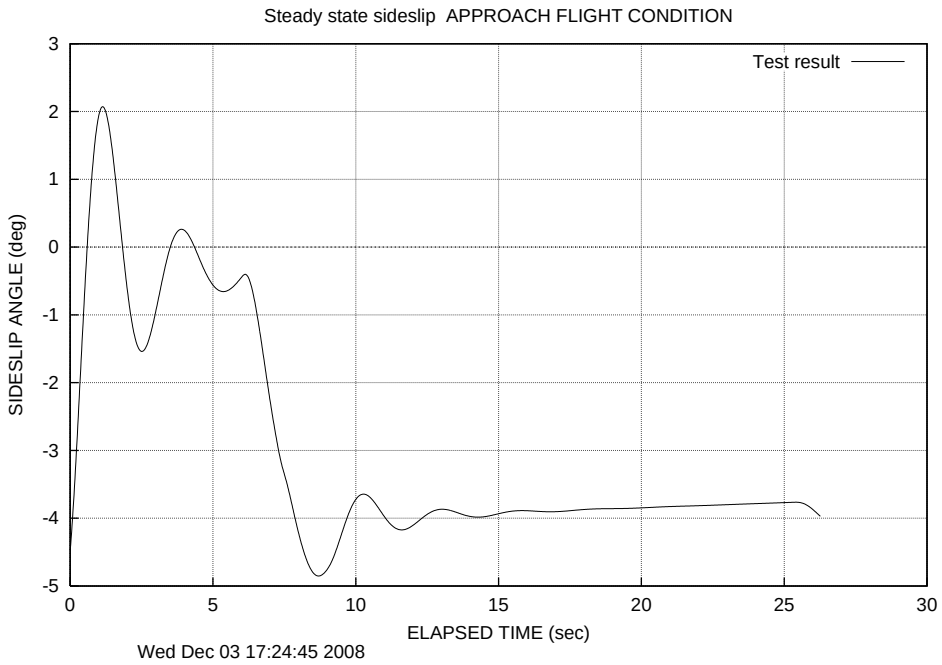

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4390
4380
4370
4360
4350
4340
4330
4320
4310
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:44 2008

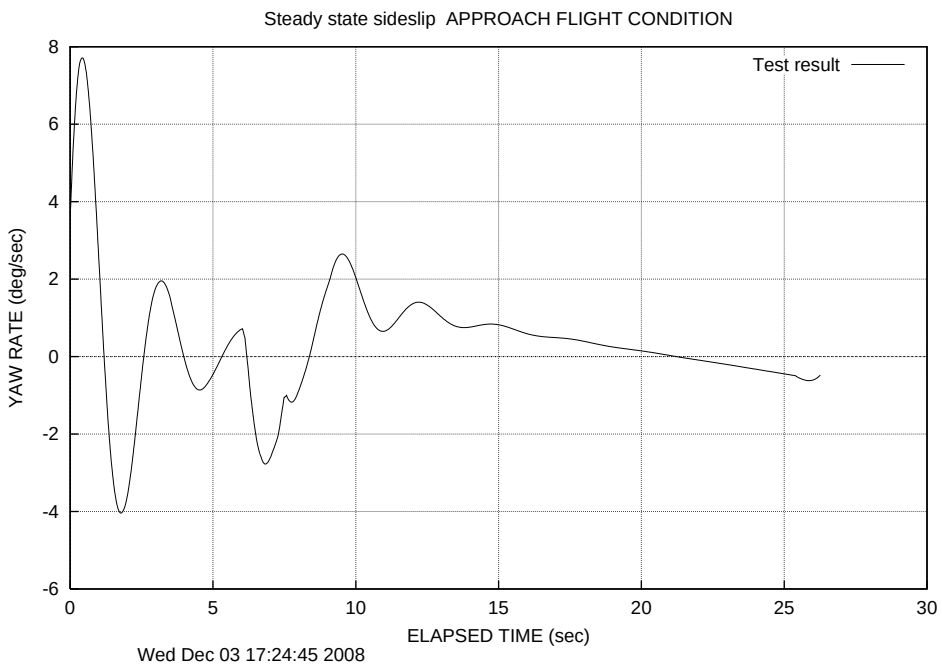

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
0
-2
-4
-6
-8
-10
-12
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:44 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
6
5
4
3
2
1
0
-1
-2
-3
-4
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:44 2008

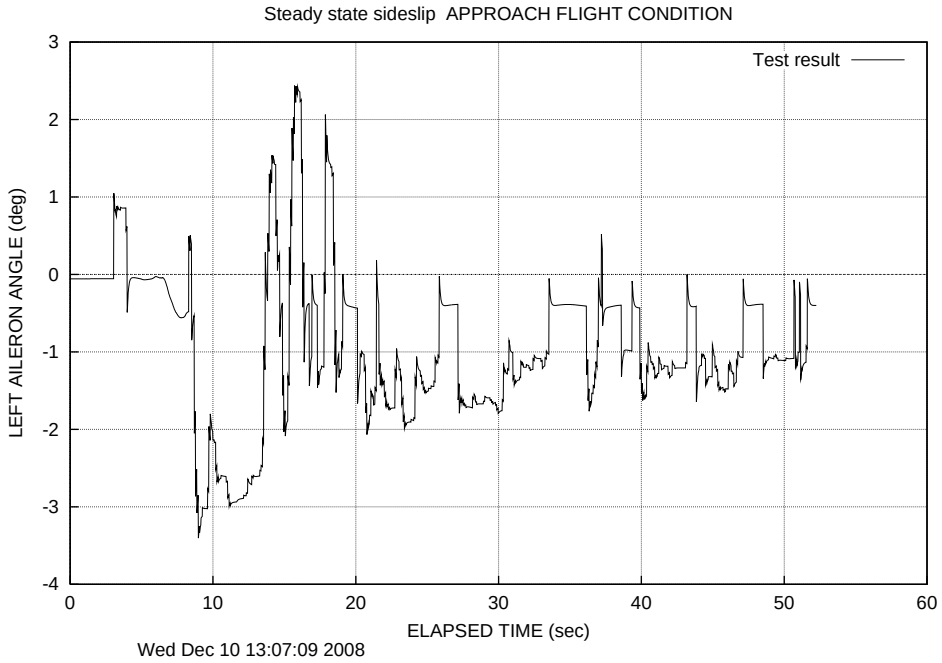

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:44 2008

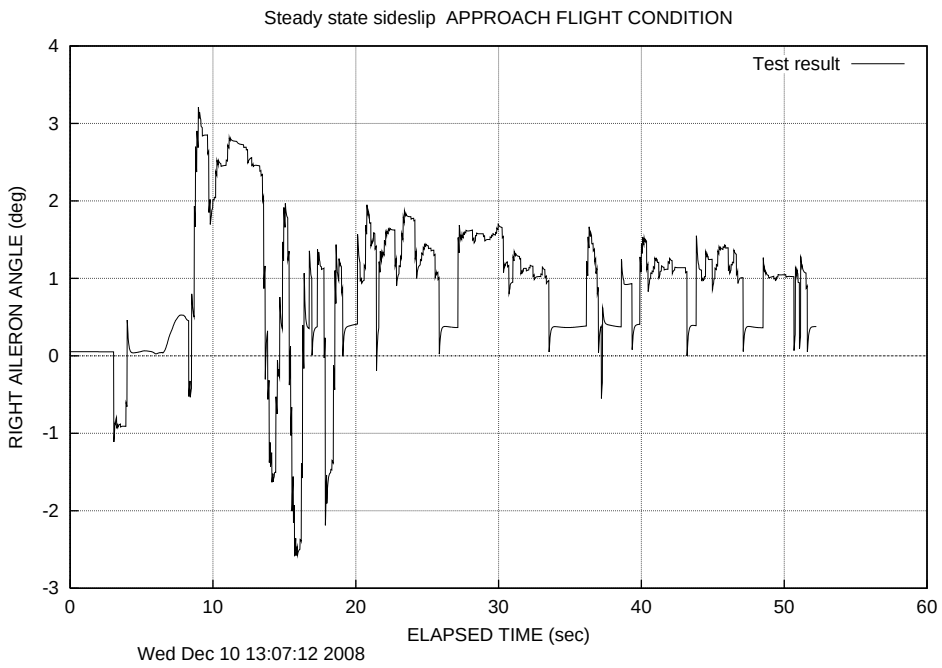

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
30
25
20
15
10
5
0
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:45 2008

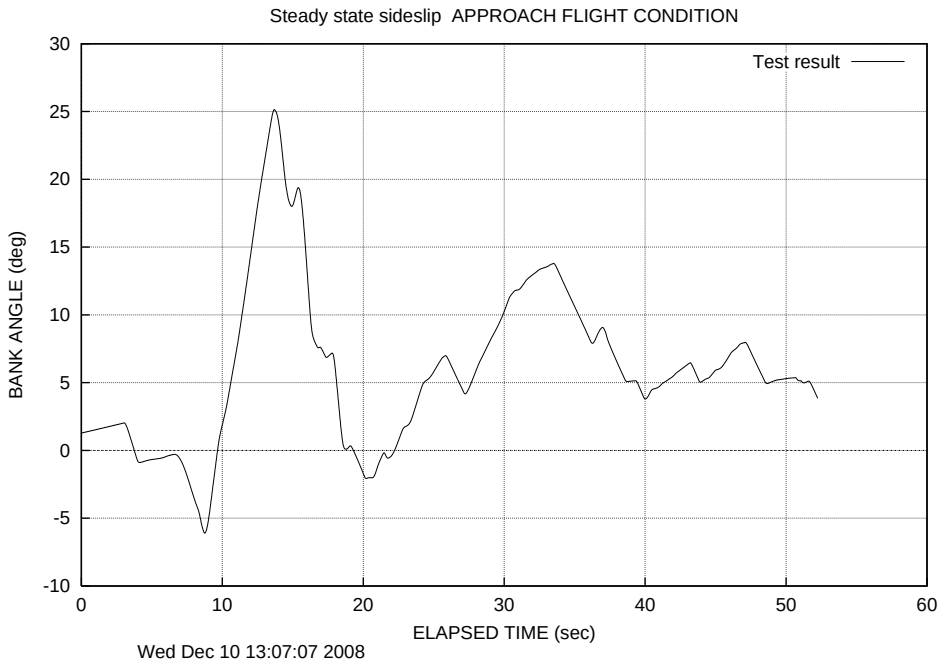

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
3
2
1
0
-1
-2
-3
-4
-5
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:45 2008

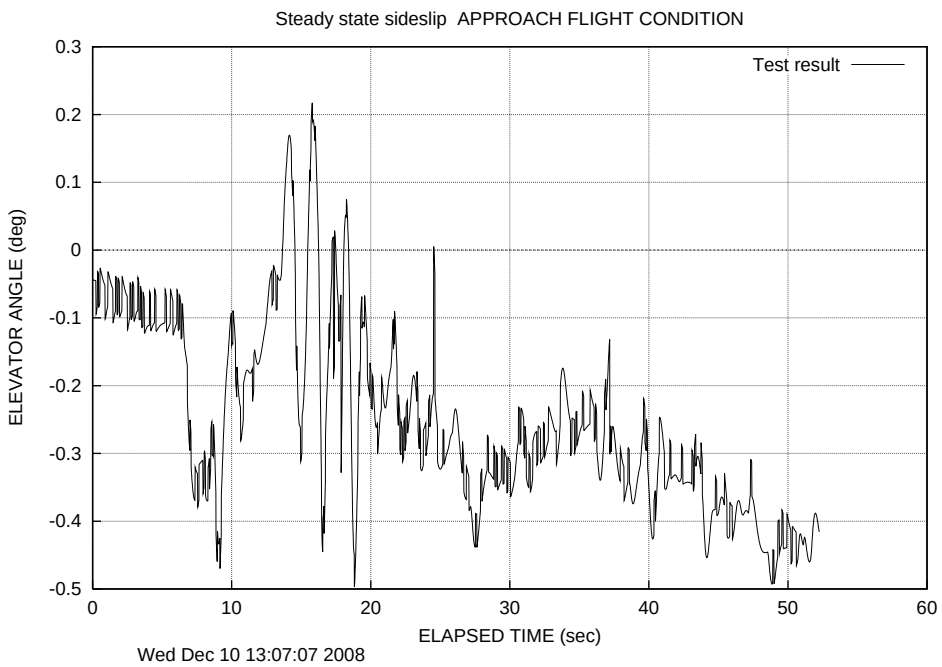

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
YAW RATE (deg/sec)
8
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30
ELAPSED TIME (sec)
Wed Dec 03 17:24:45 2008

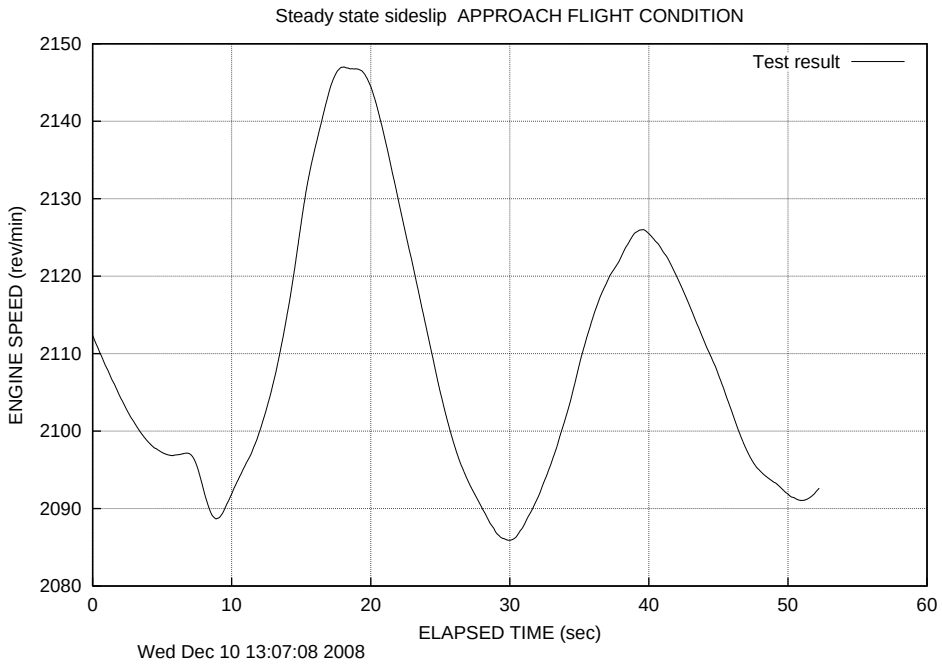
Left rudder pedal (full)

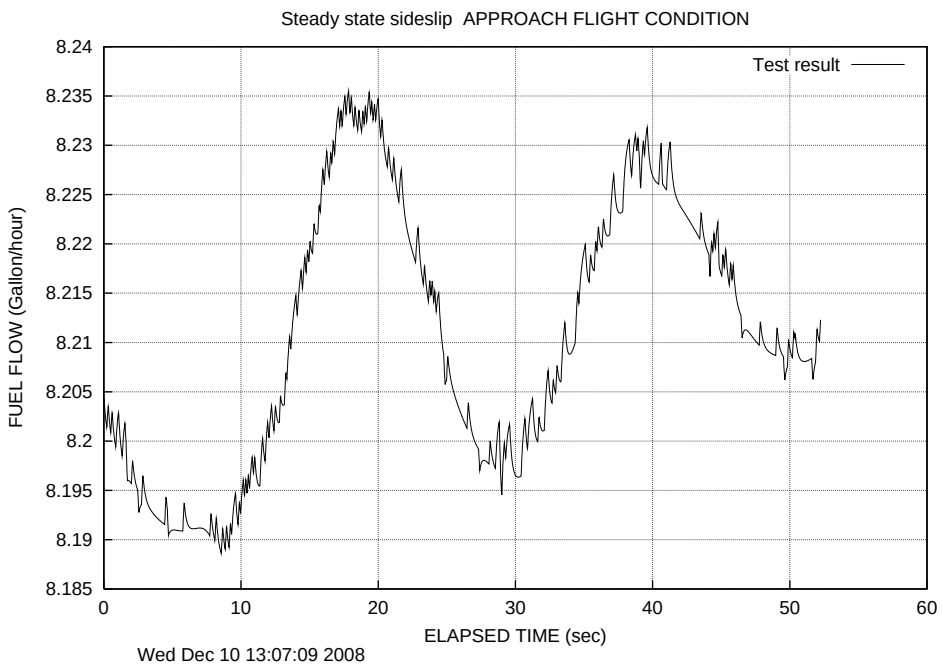


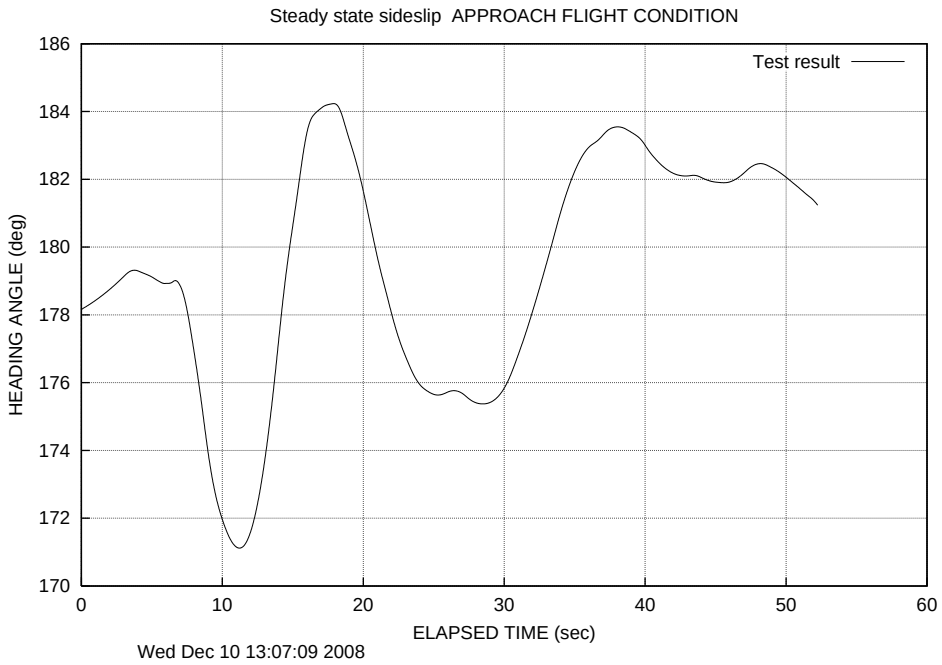


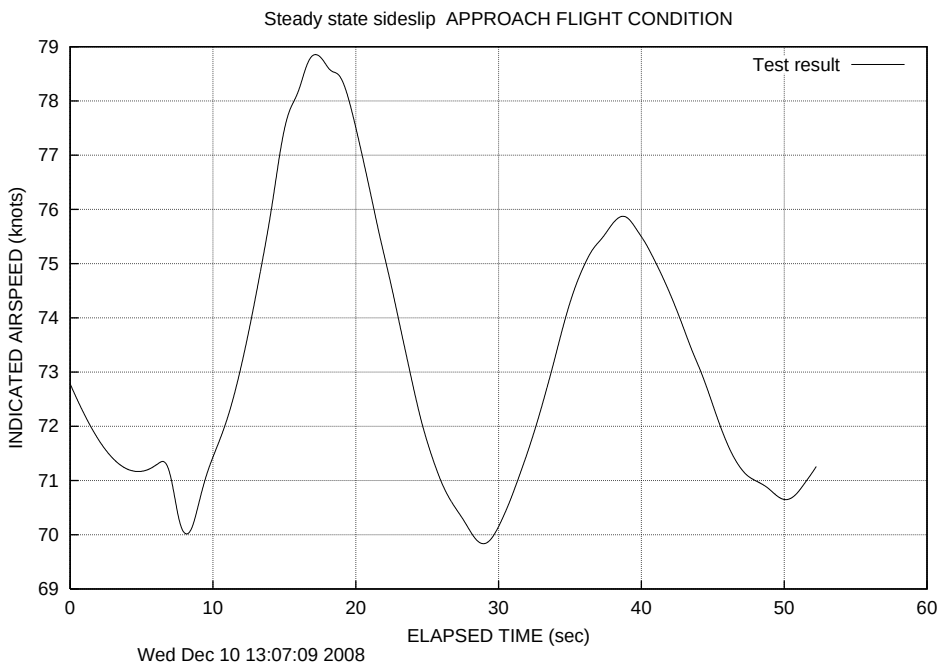

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
30
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:07 2008

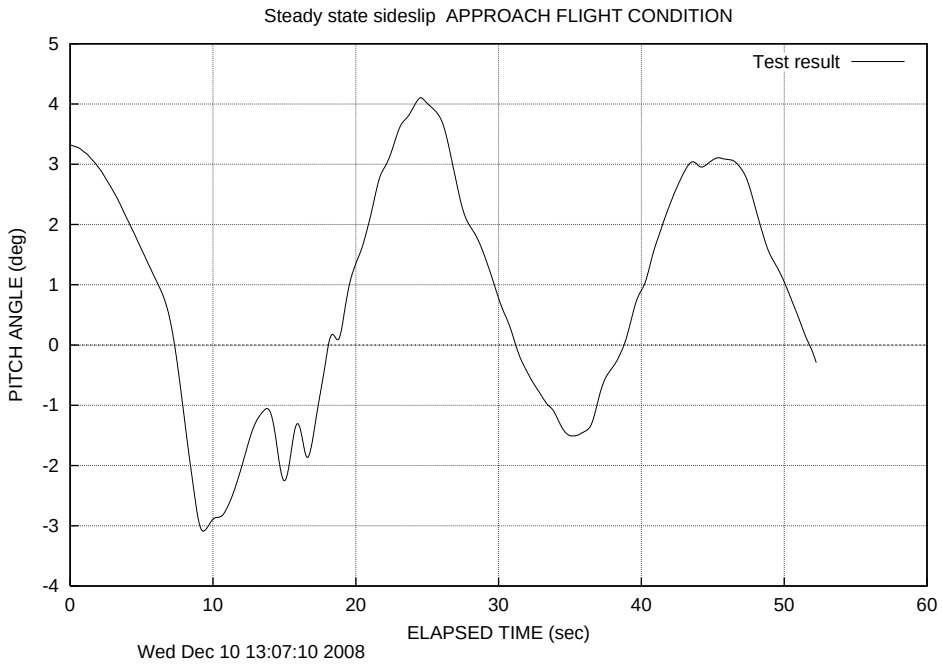

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:07 2008

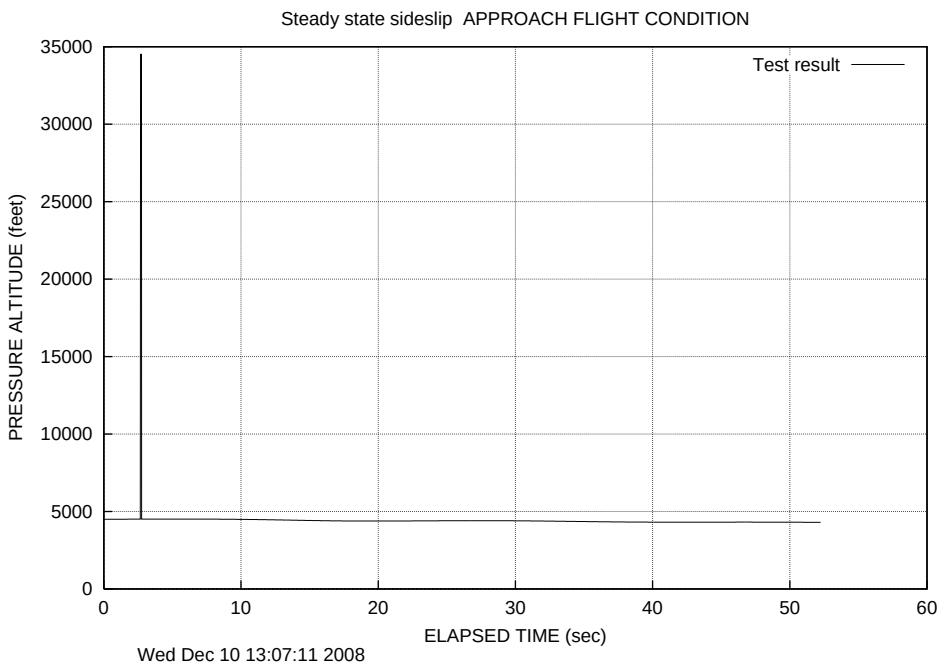

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2150
2140
2130
2120
2110
2100
2090
2080
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:08 2008

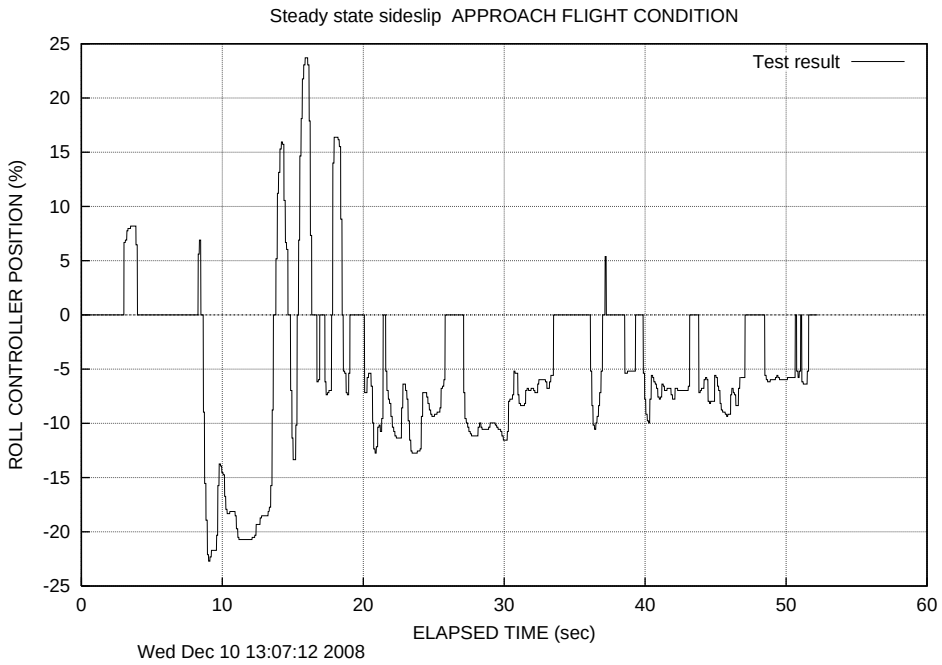

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.24
8.235
8.23
8.225
8.22
8.215
8.21
8.205
8.2
8.195
8.19
8.185
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:09 2008

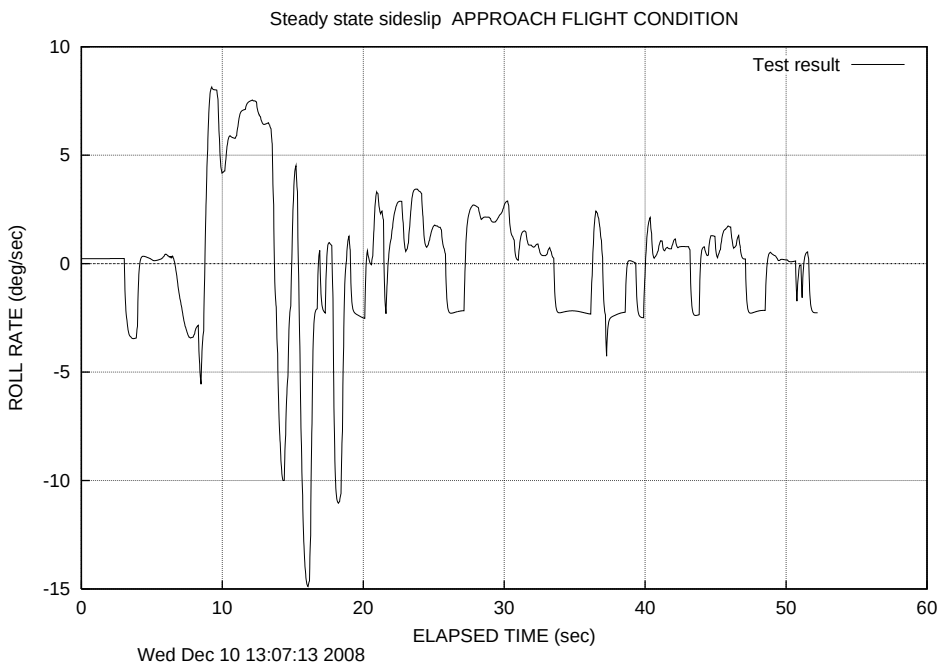

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
186
184
182
180
178
176
174
172
170
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:09 2008

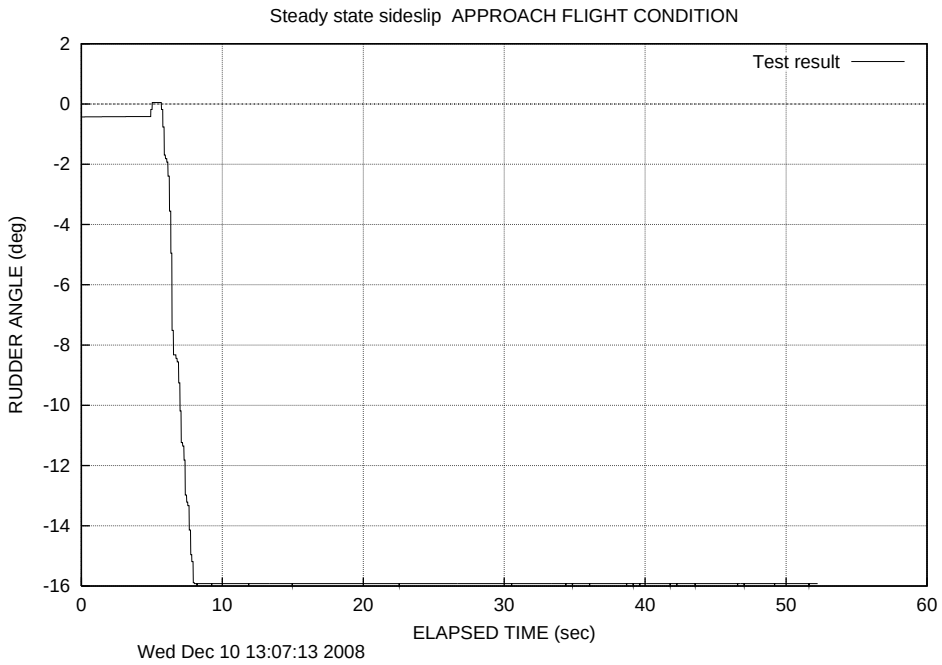

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
79
78
77
76
75
74
73
72
71
70
69
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:09 2008

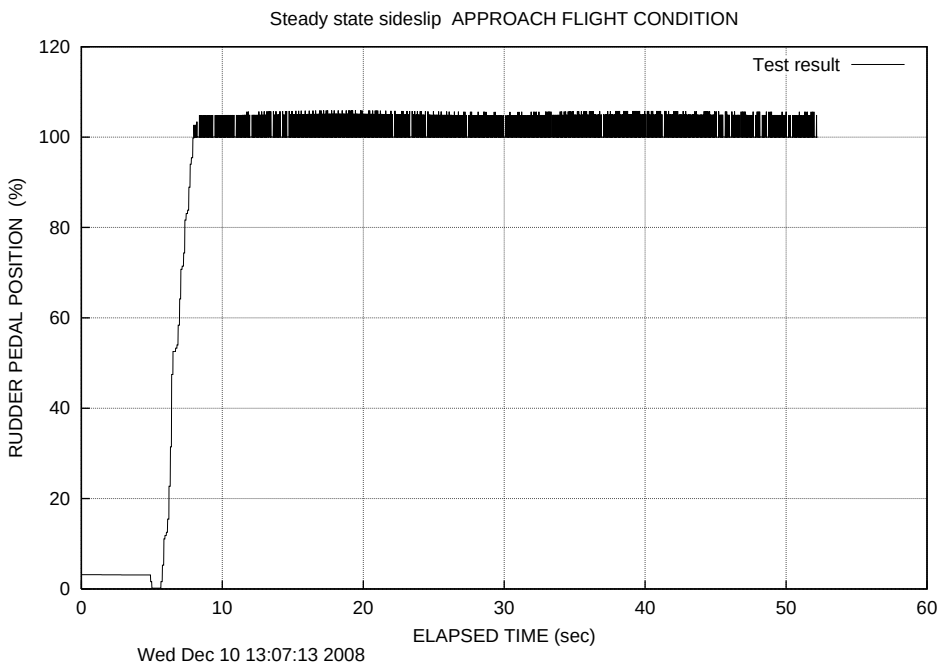

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
5
4
3
2
1
0
-1
-2
-3
-4
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:10 2008

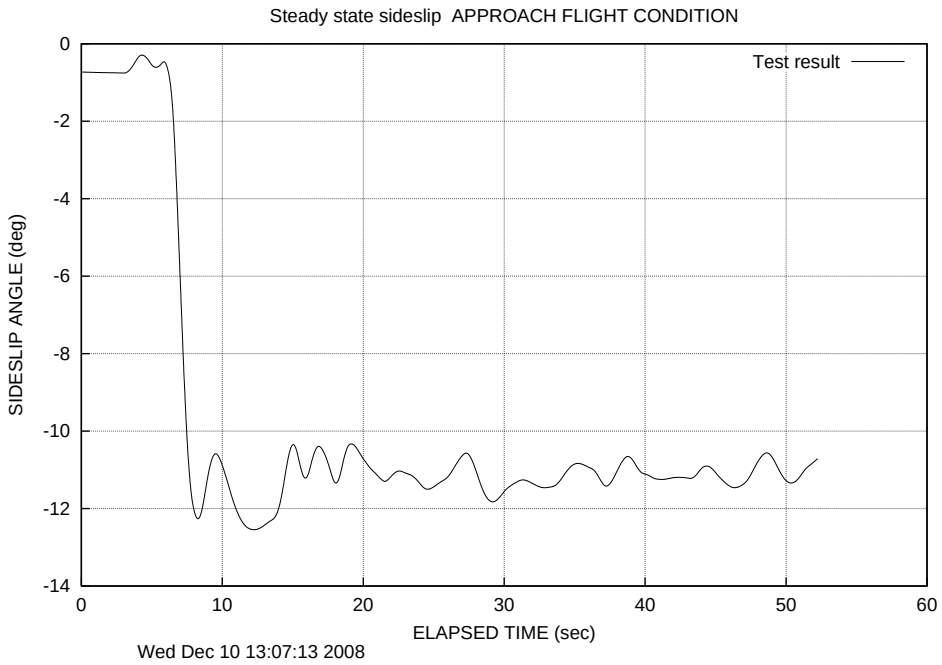

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
35000
30000
25000
20000
15000
10000
5000
0
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:11 2008

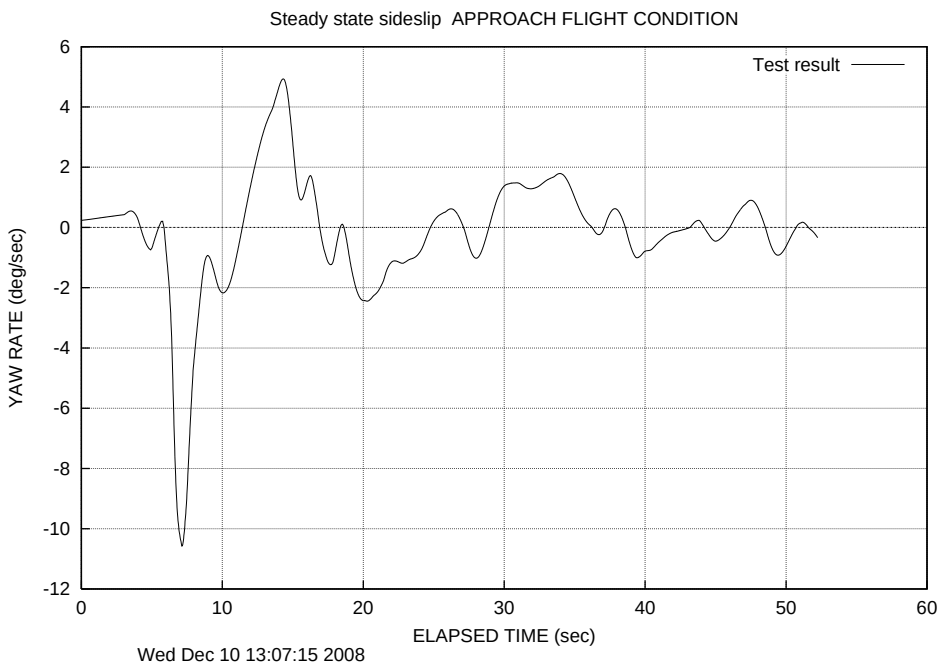

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:12 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
10
5
0
-5
-10
-15
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:13 2008

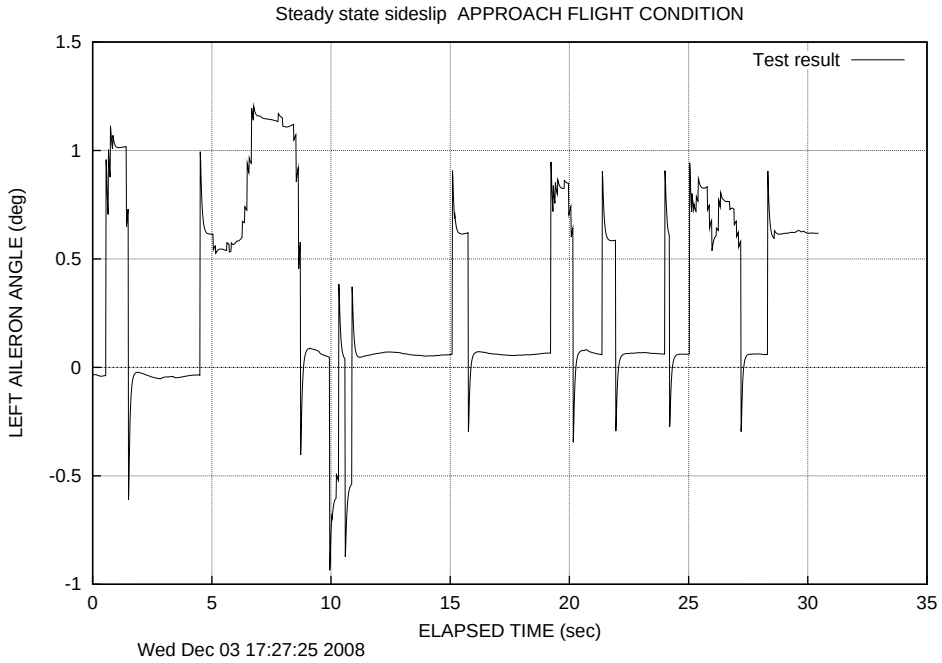

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:13 2008

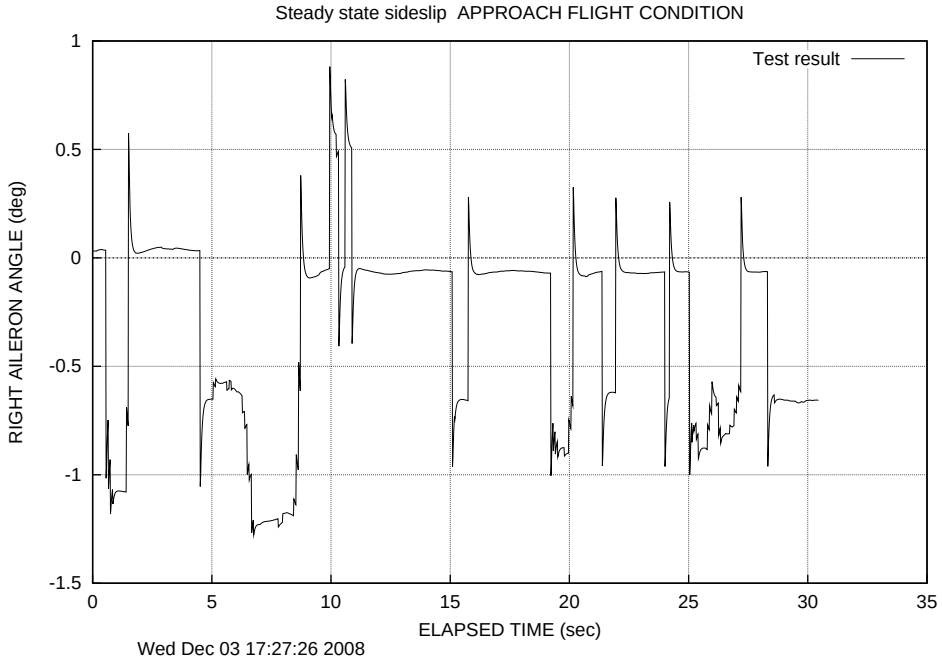

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
120
100
80
60
40
20
0
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:13 2008

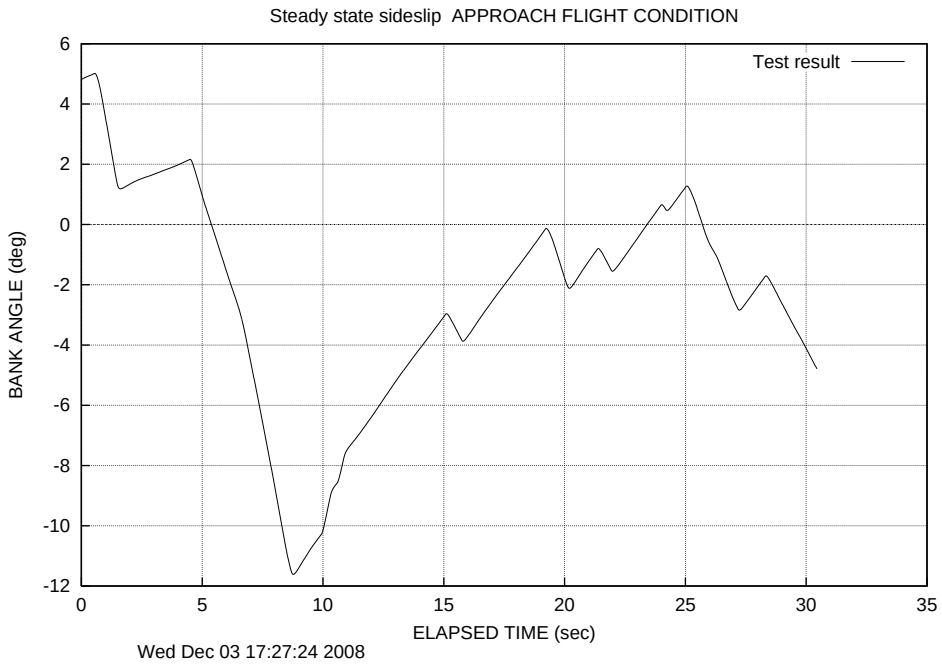

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
0
-2
-4
-6
-8
-10
-12
-14
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:13 2008

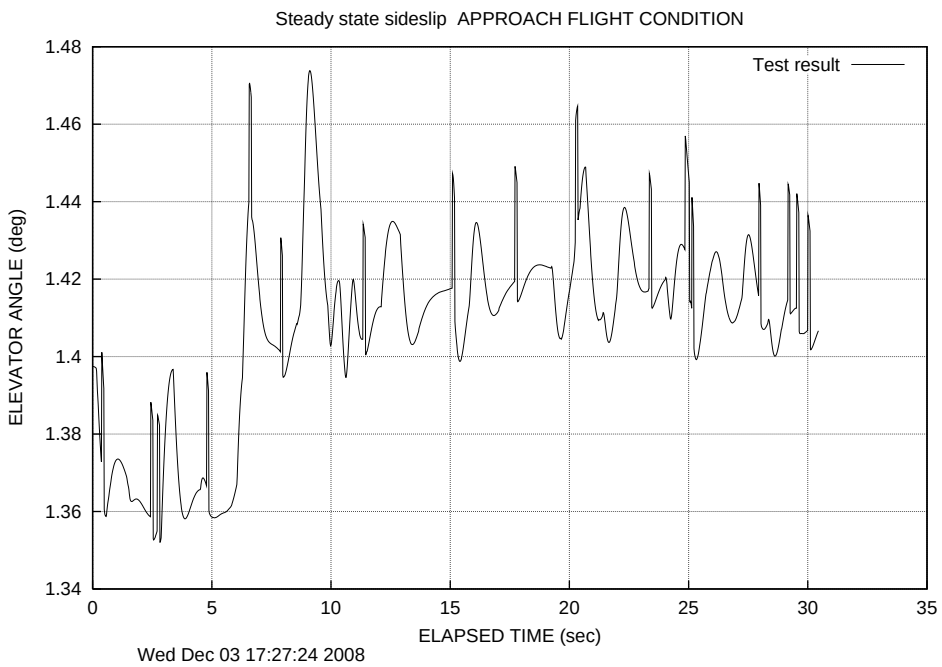

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
YAW RATE (deg/sec)
6
4
2
0
-2
-4
-6
-8
-10
-12
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:07:15 2008

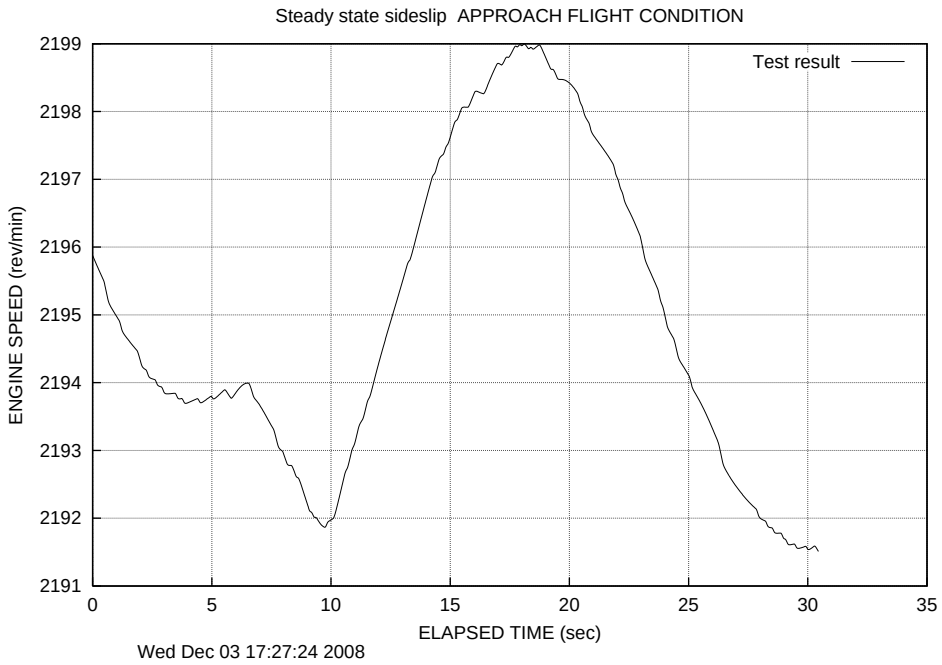
Right rudder pedal

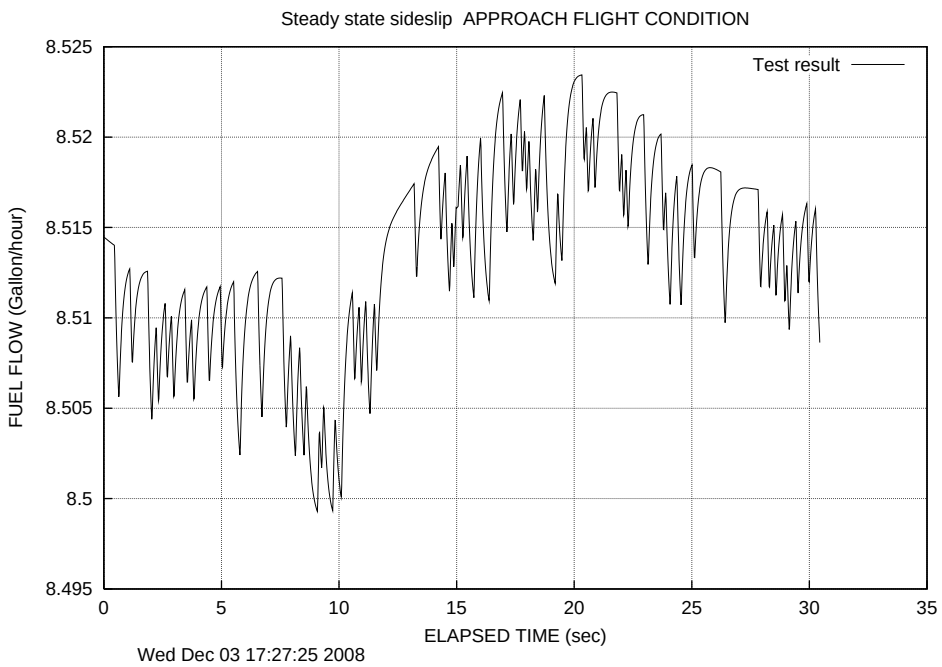


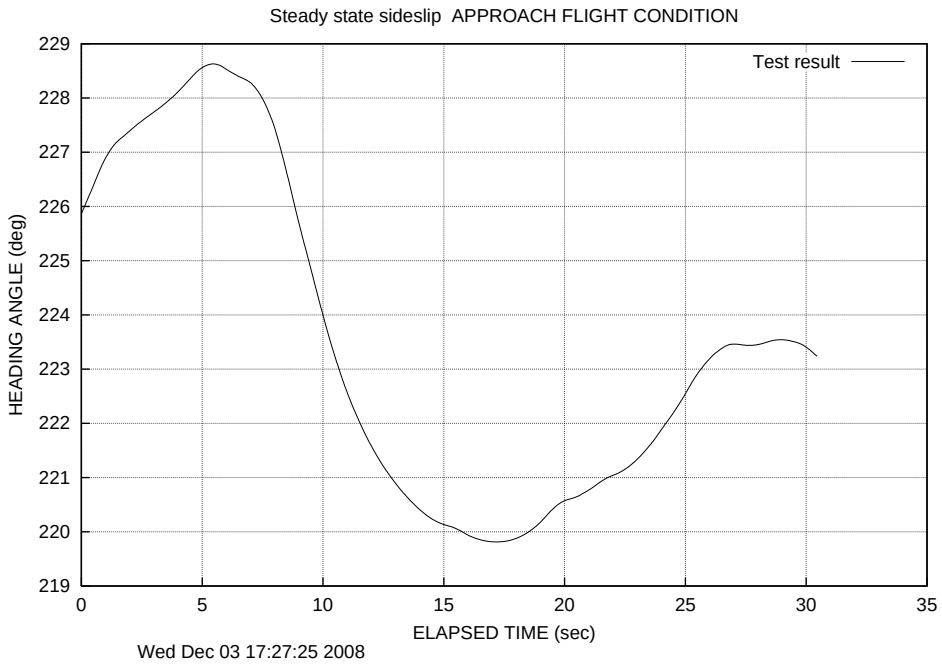


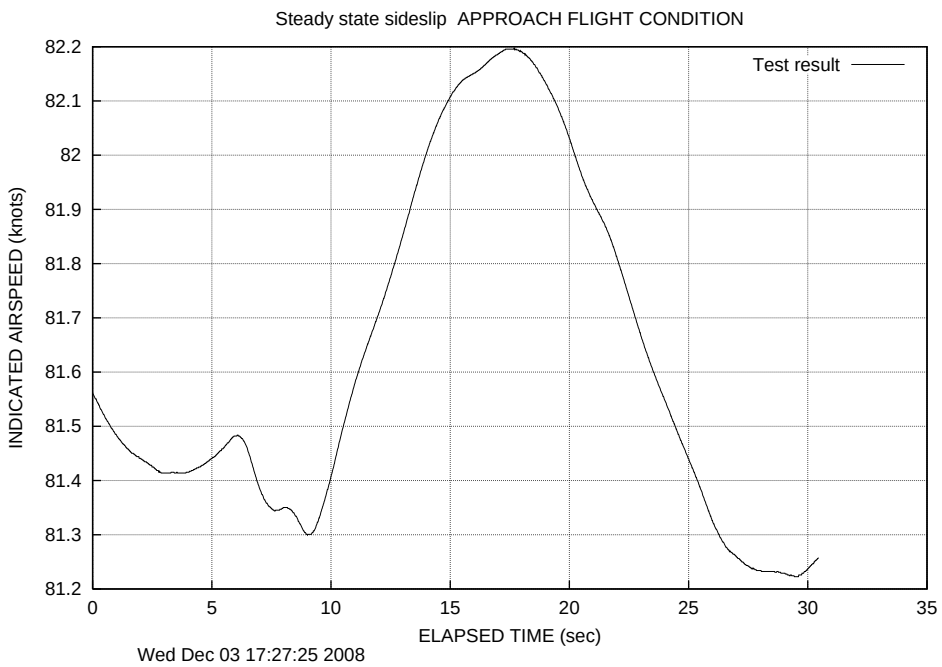

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
6
4
2
0
-2
-4
-6
-8
-10
-12
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:24 2008

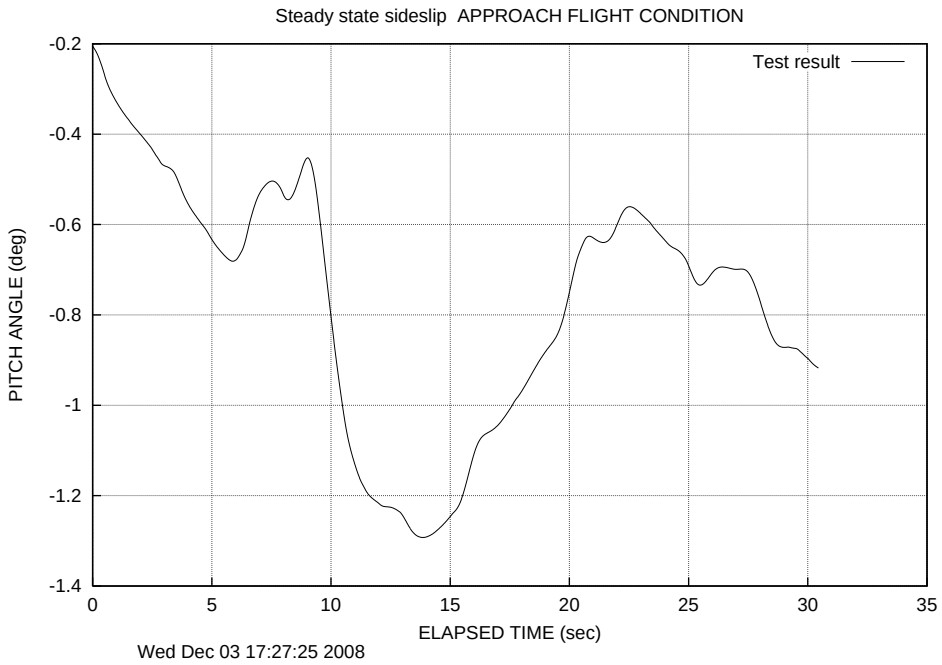

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
1.48
1.46
1.44
1.42
1.4
1.38
1.36
1.34
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:24 2008

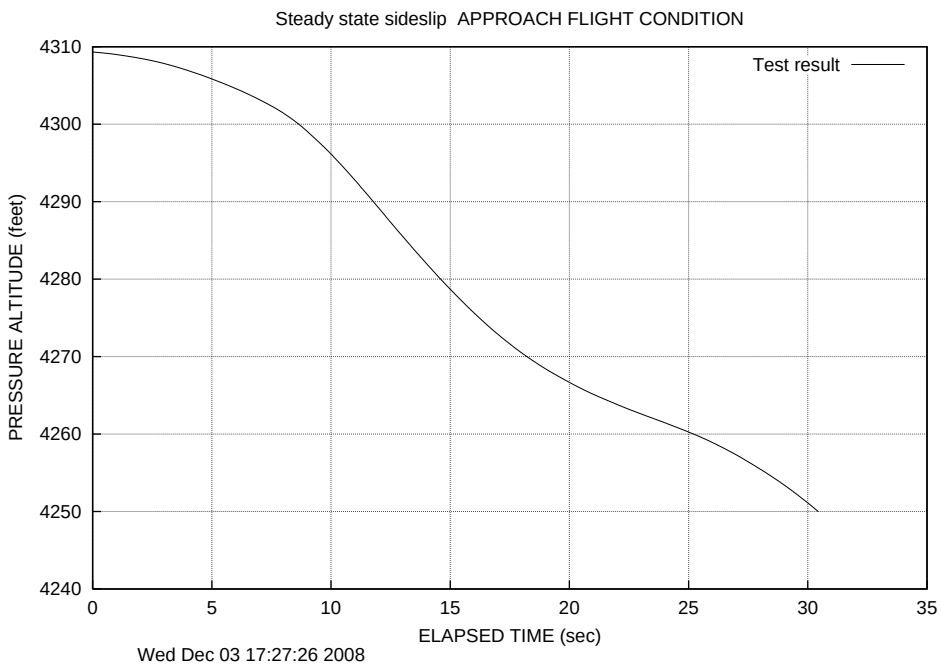

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2199
2198
2197
2196
2195
2194
2193
2192
2191
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:24 2008

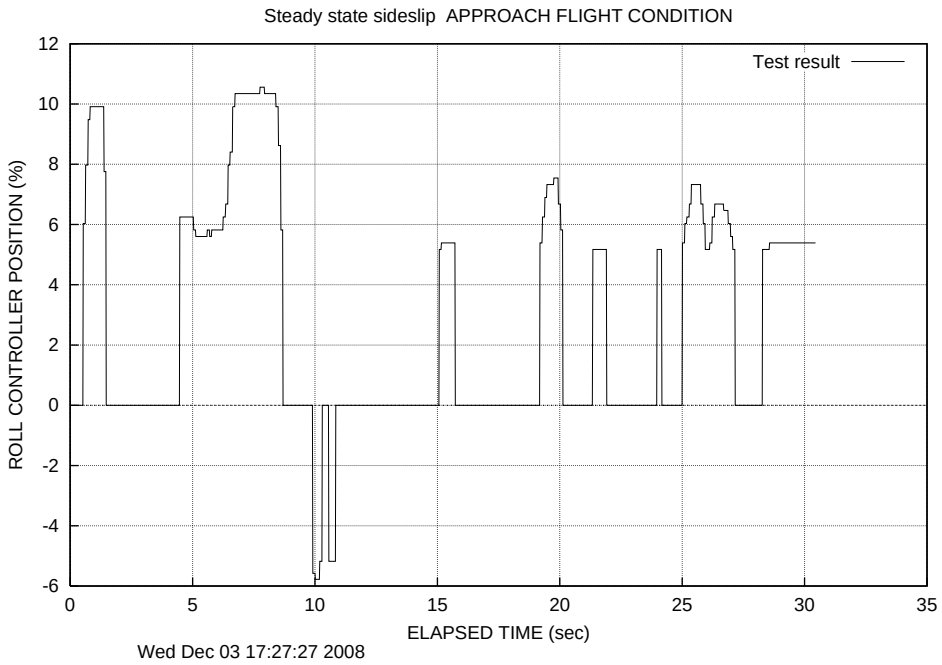

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.525
8.52
8.515
8.51
8.505
8.5
8.495
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:25 2008

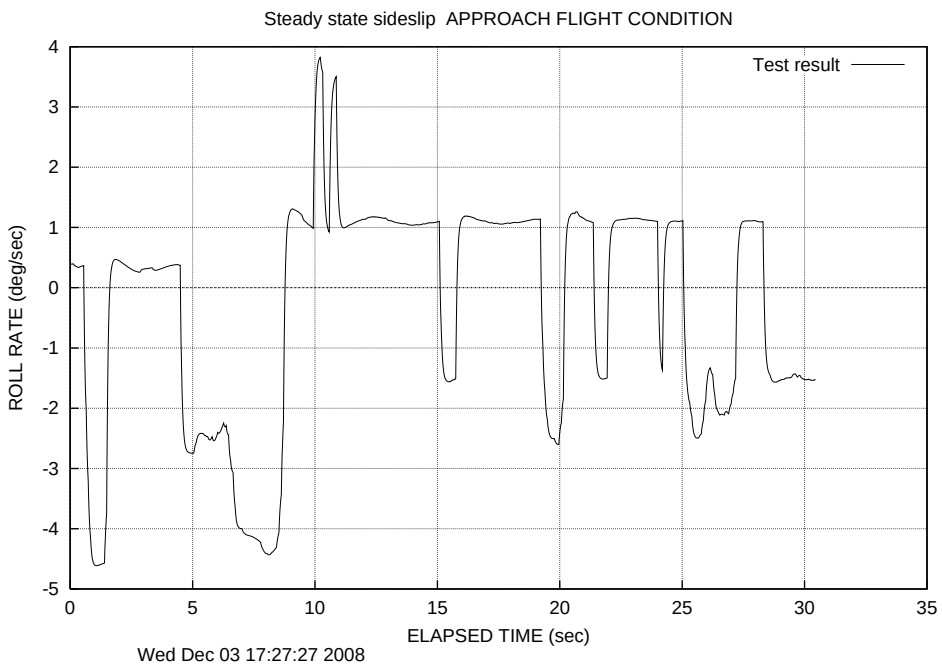

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
229
228
227
226
225
224
223
222
221
220
219
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:25 2008

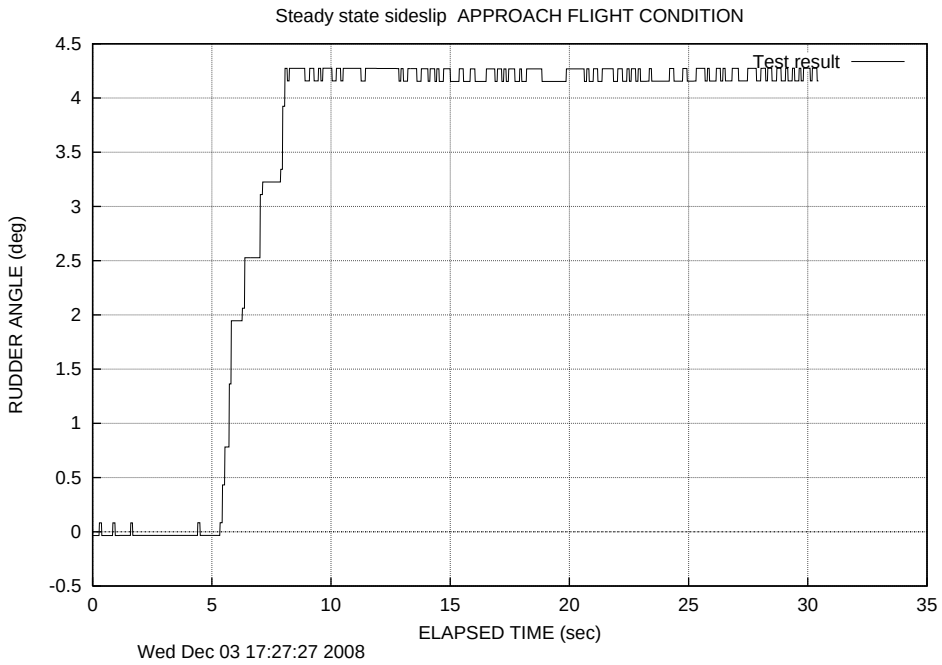

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
82.2
82.1
82
81.9
81.8
81.7
81.6
81.5
81.4
81.3
81.2
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:25 2008

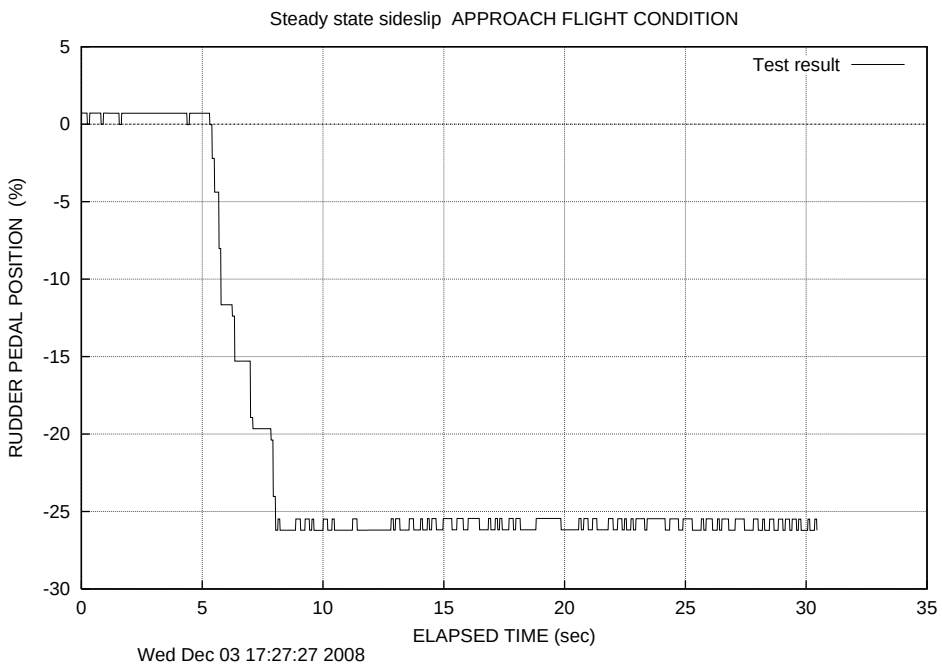

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:25 2008

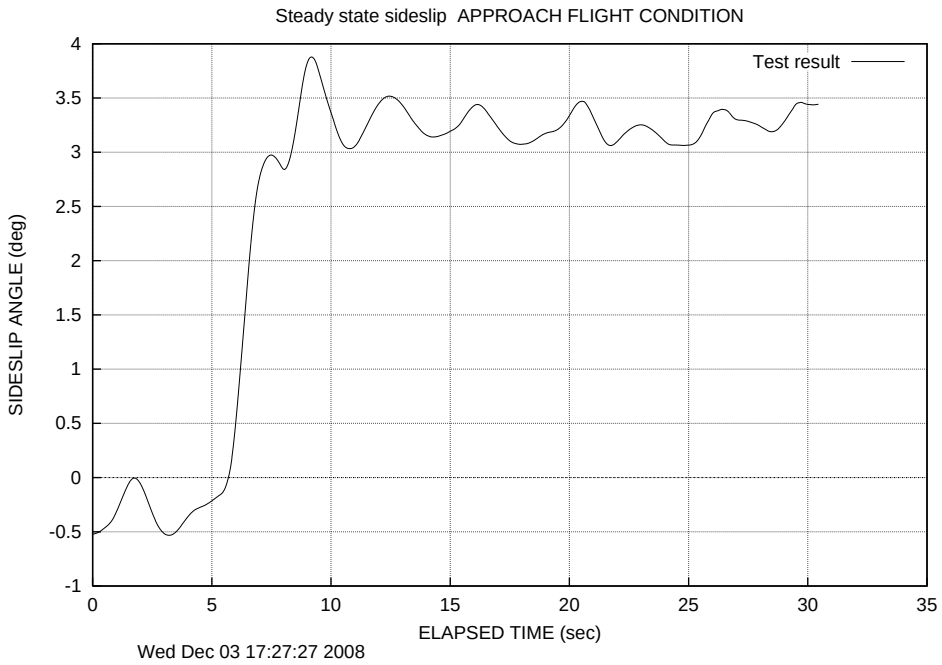

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4310
4300
4290
4280
4270
4260
4250
4240
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:26 2008

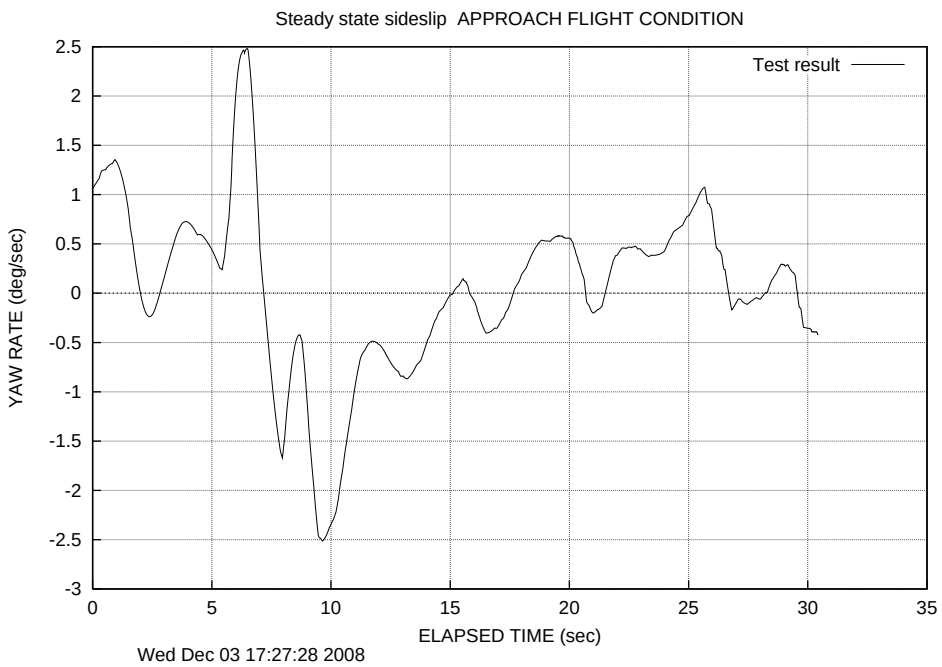

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
12
10
8
6
4
2
0
-2
-4
-6
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:27 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
4
3
2
1
0
-1
-2
-3
-4
-5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:27 2008

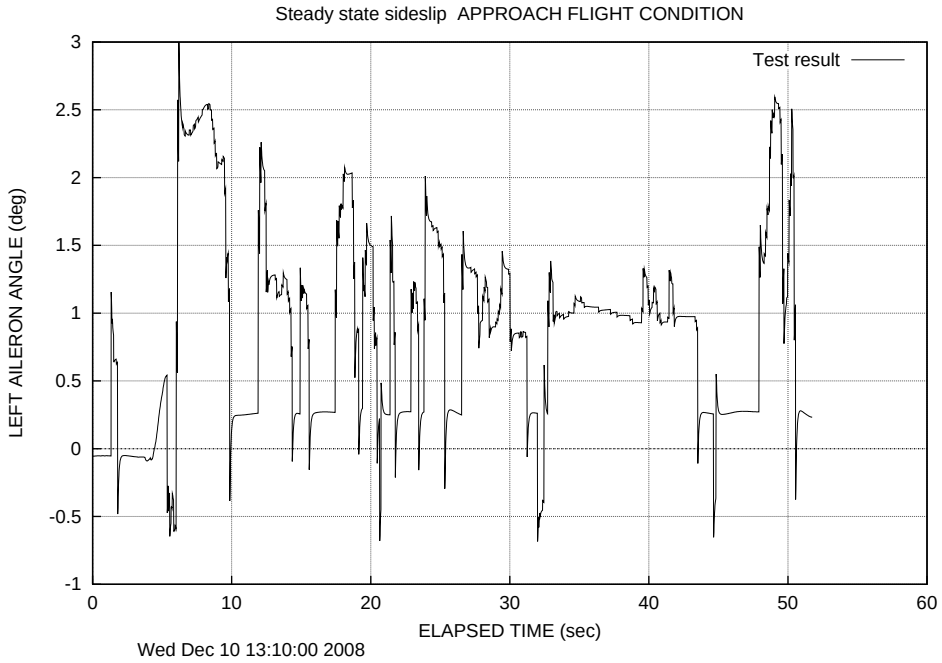

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:27 2008

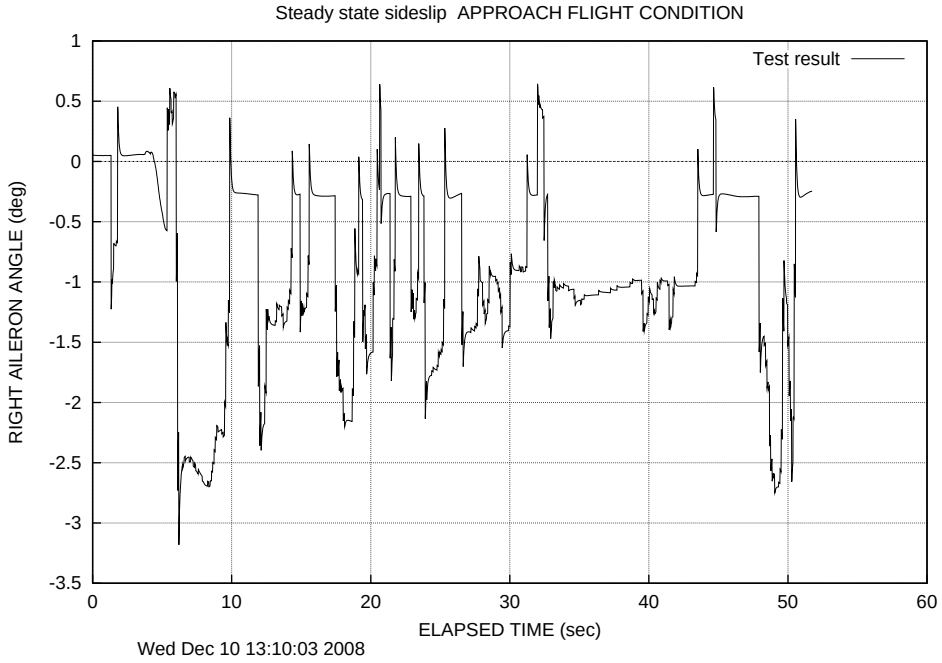

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
5
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
30
35
ELAPSED TIME (sec)
Wed Dec 03 17:27:27 2008

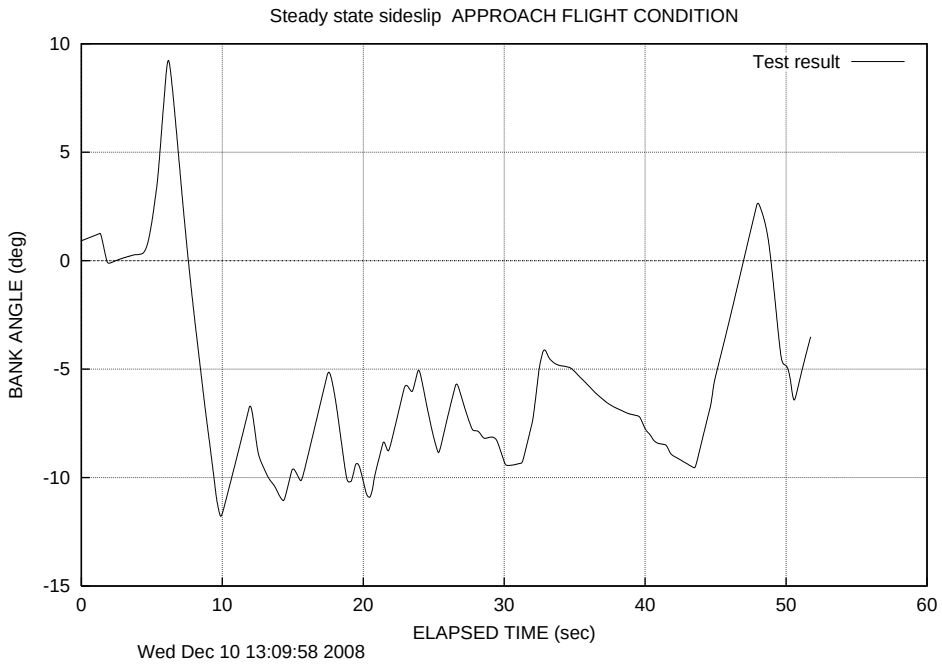

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 03 17:27:27 2008

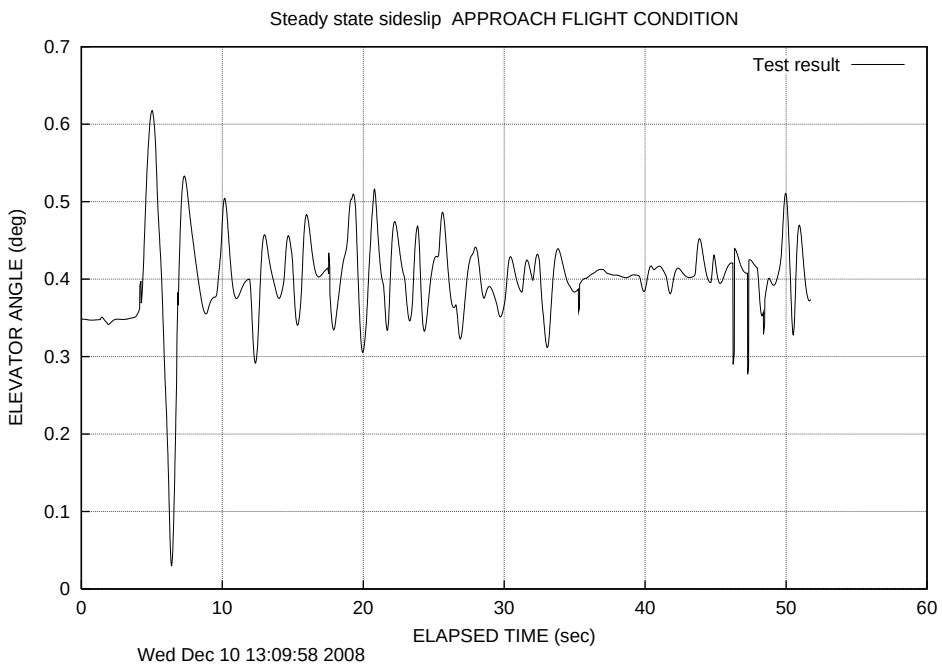

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
YAW RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 03 17:27:28 2008

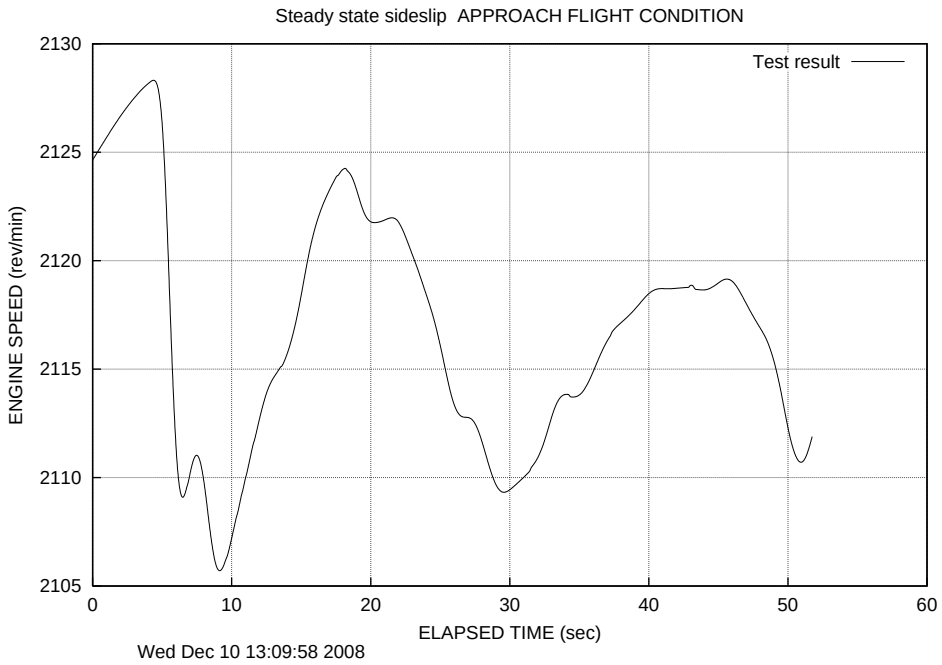
Right rudder pedal (full)

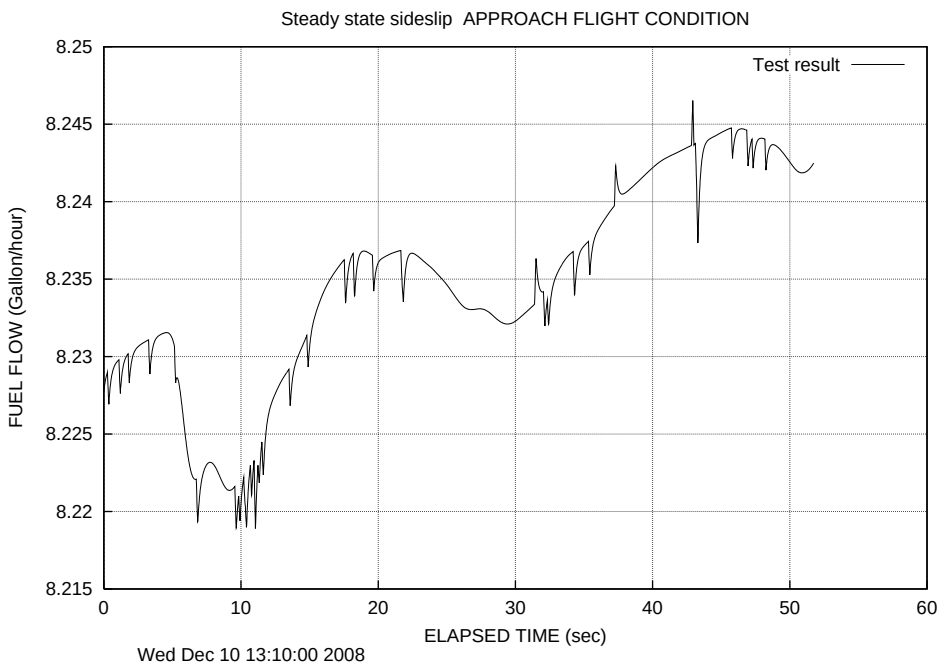


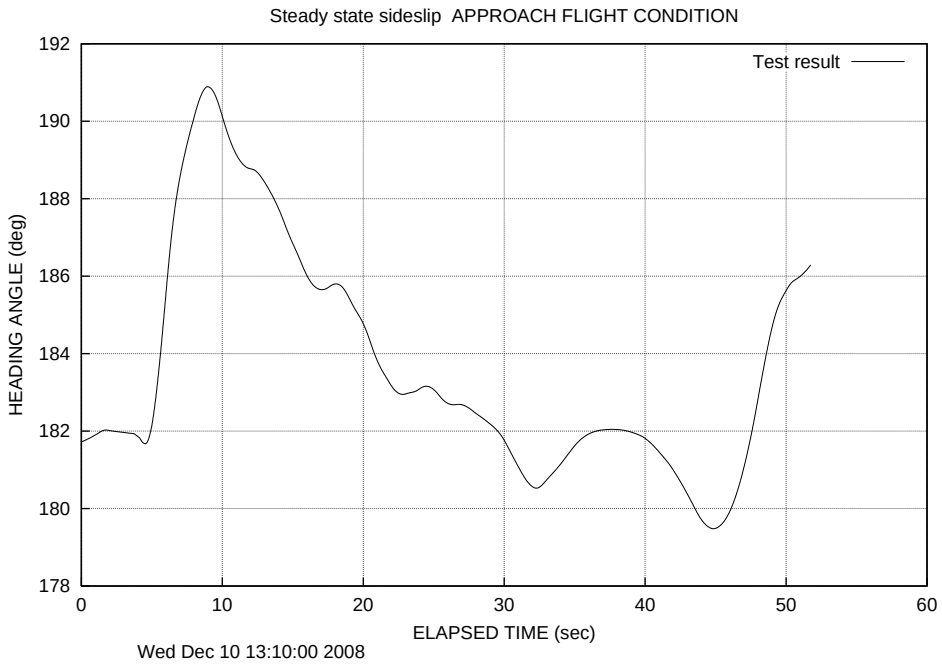


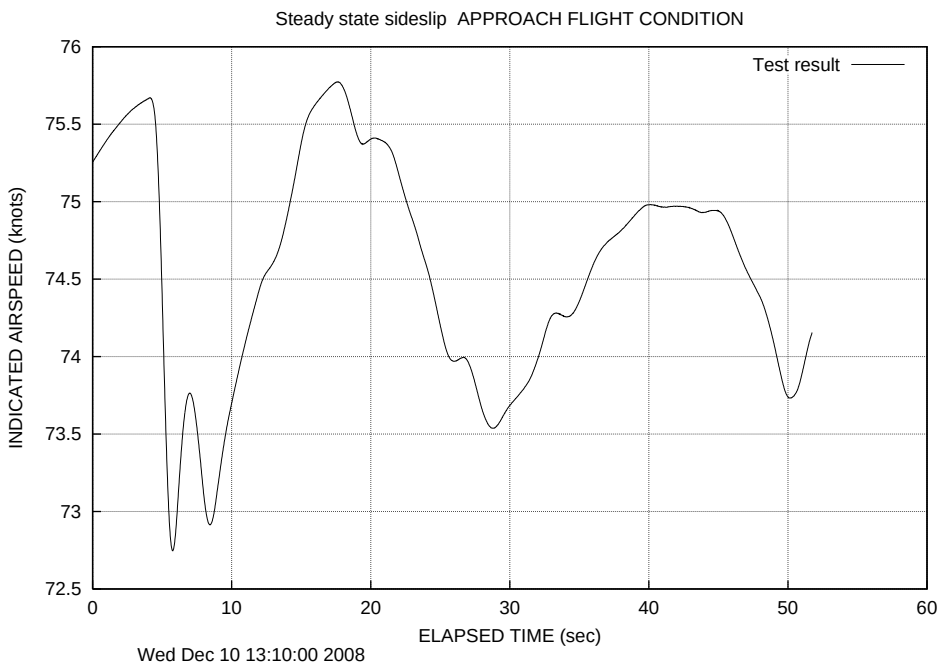

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
BANK ANGLE (deg)
10
5
0
-5
-10
-15
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:09:58 2008

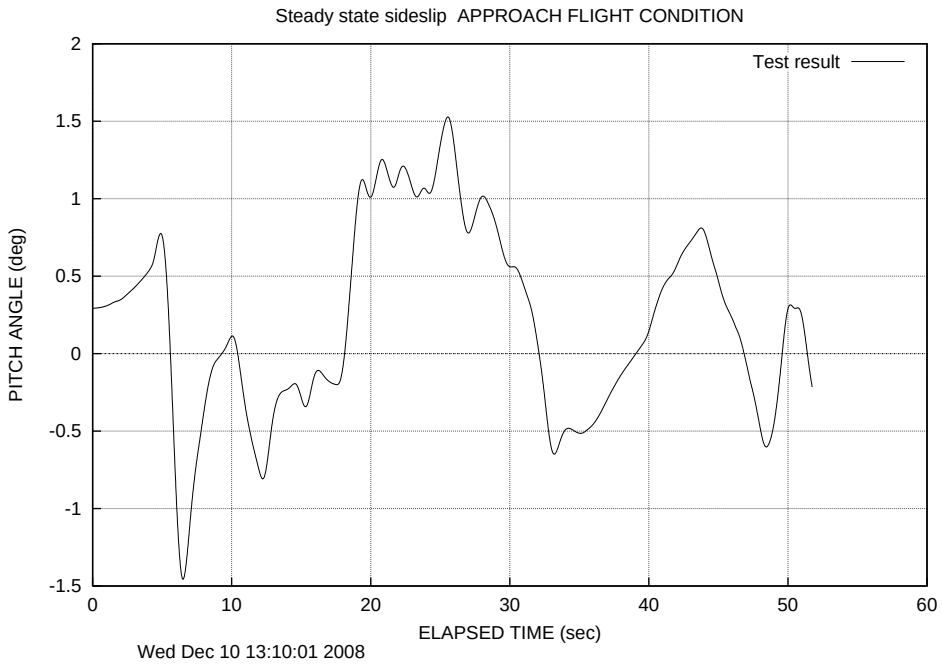

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ELEVATOR ANGLE (deg)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:09:58 2008

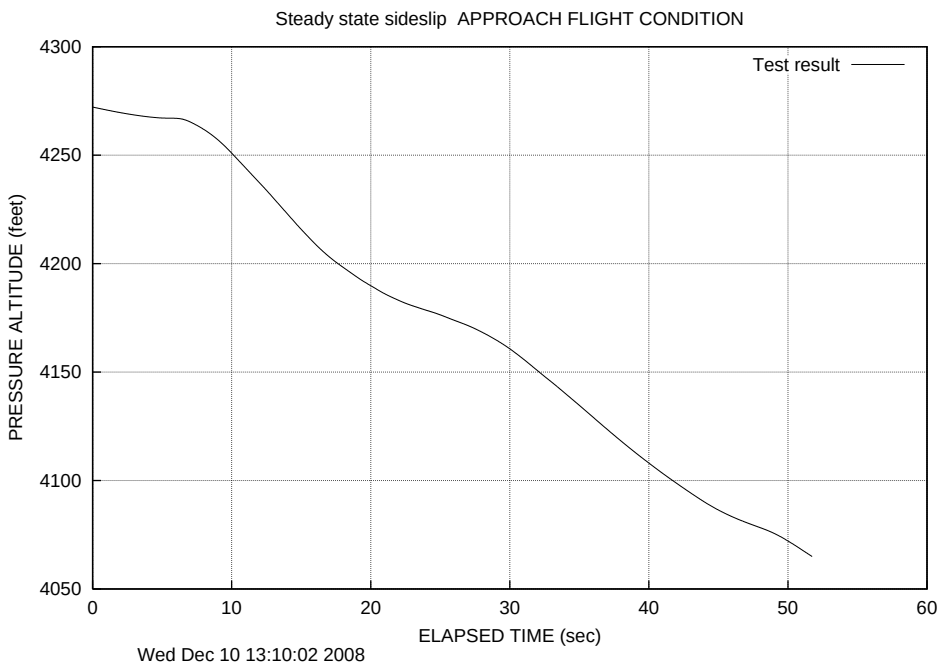

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ENGINE SPEED (rev/min)
2130
2125
2120
2115
2110
2105
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:09:58 2008

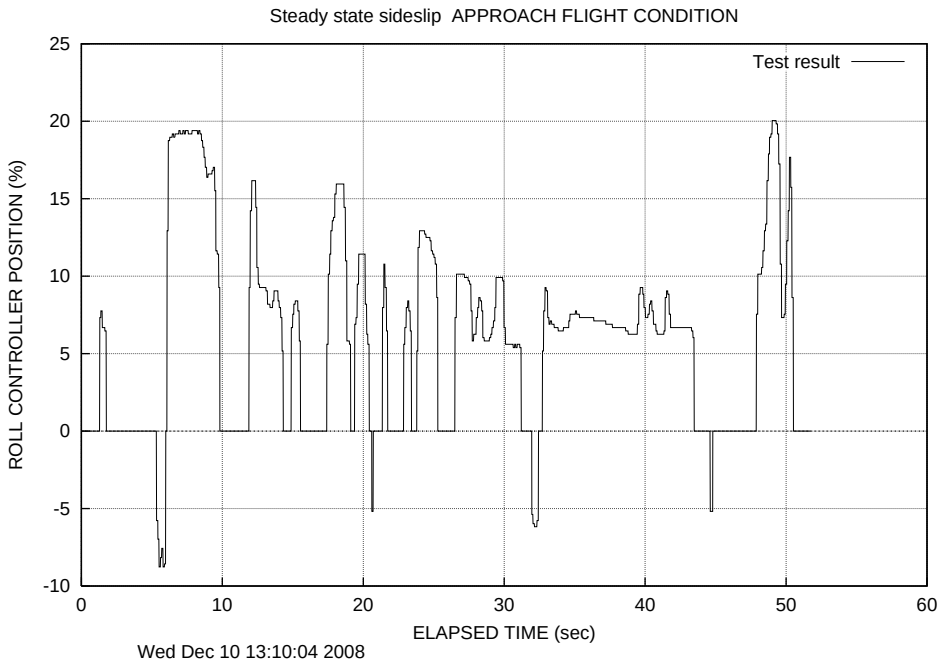

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
FUEL FLOW (Gallon/hour)
8.25
8.245
8.24
8.235
8.23
8.225
8.22
8.215
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:00 2008

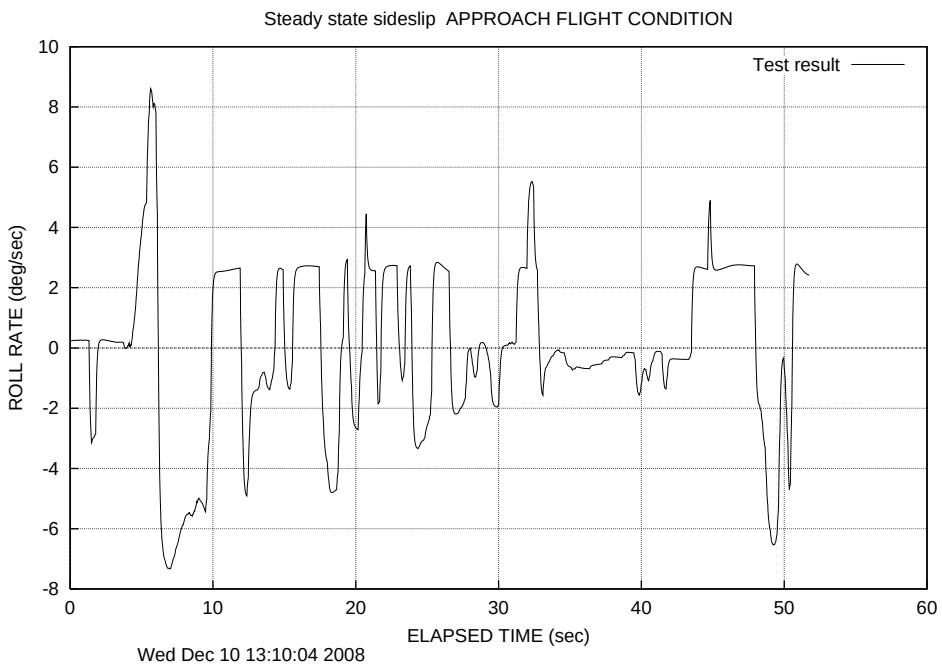

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
HEADING ANGLE (deg)
192
190
188
186
184
182
180
178
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:00 2008

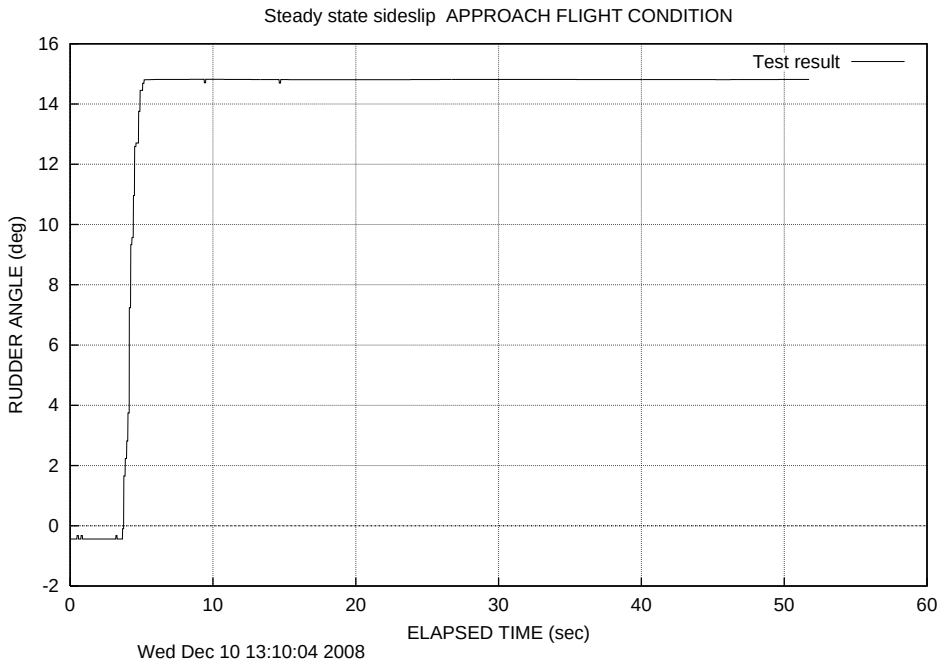

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
INDICATED AIRSPEED (knots)
76
75.5
75
74.5
74
73.5
73
72.5
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:00 2008

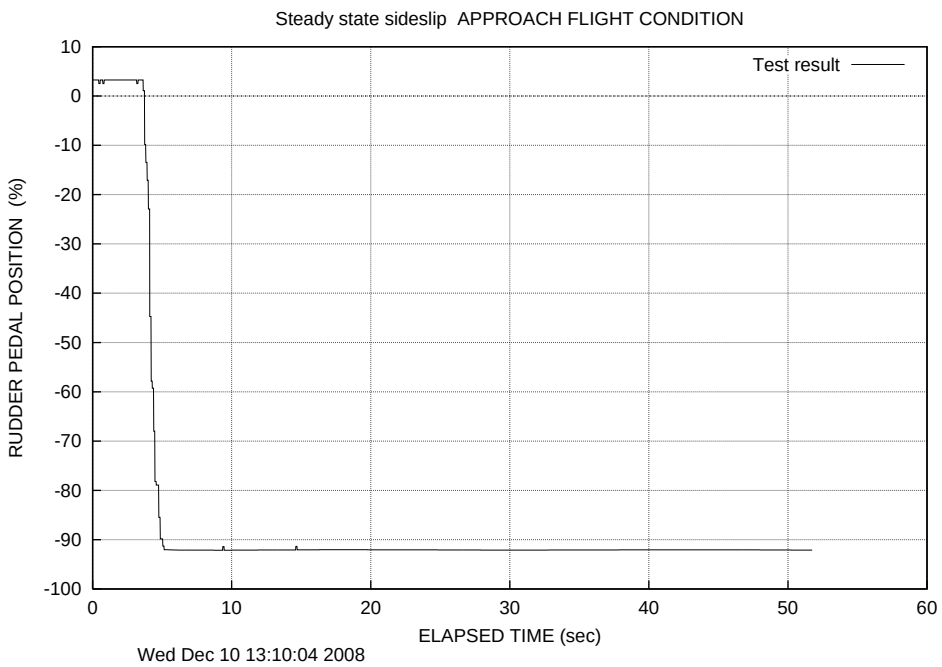

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PITCH ANGLE (deg)
2
1.5
1
0.5
0
-0.5
-1
-1.5
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:01 2008

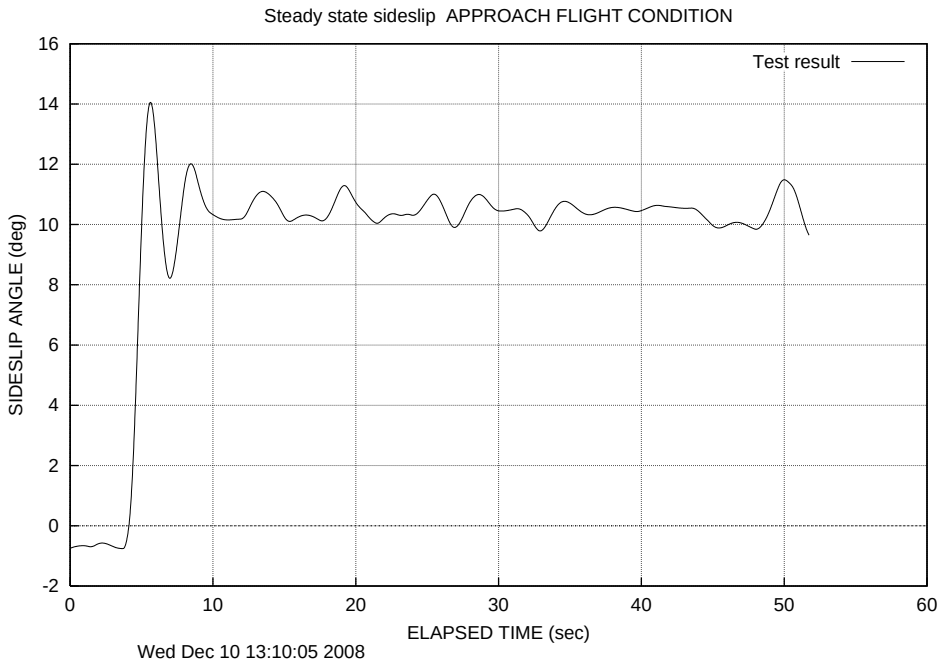

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
PRESSURE ALTITUDE (feet)
4300
4250
4200
4150
4100
4050
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:02 2008

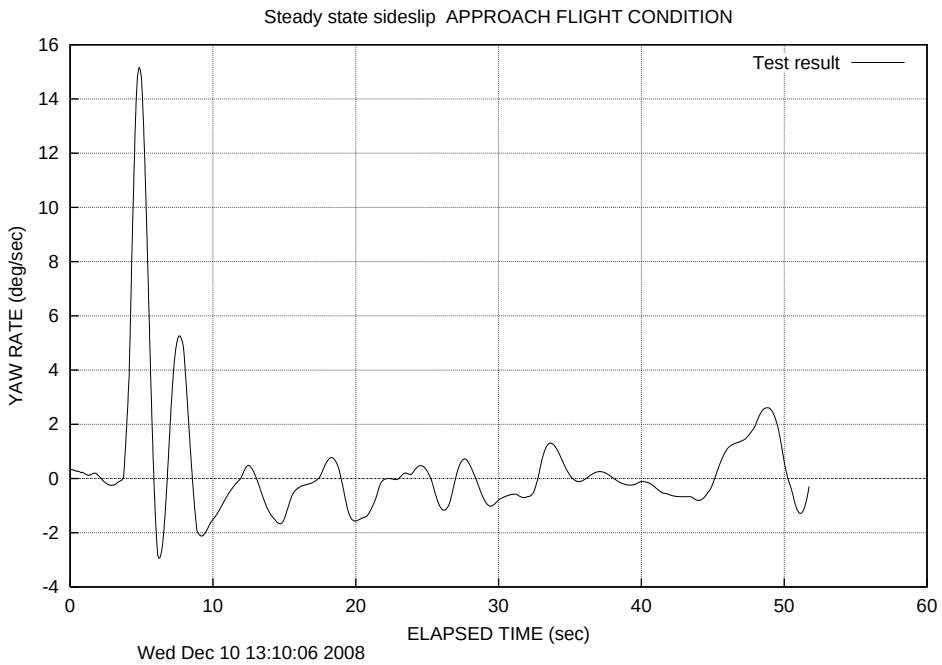

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL CONTROLLER POSITION (%)
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:04 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
ROLL RATE (deg/sec)
10
8
6
4
2
0
-2
-4
-6
-8
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:04 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER ANGLE (deg)
16
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:04 2008


Steady state sideslip APPROACH FLIGHT CONDITION
Test result
RUDDER PEDAL POSITION (%)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
10
20
30
40
50
60
ELAPSED TIME (sec)
Wed Dec 10 13:10:04 2008

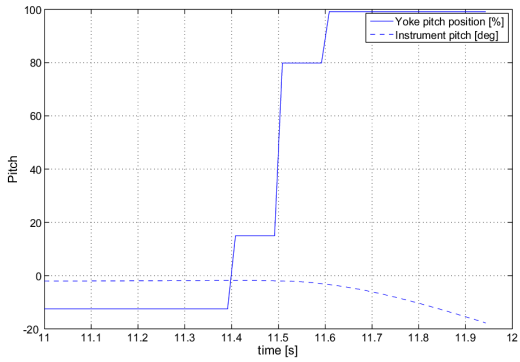

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
SIDESLIP ANGLE (deg)
ELAPSED TIME (sec)
Wed Dec 10 13:10:05 2008
16
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60

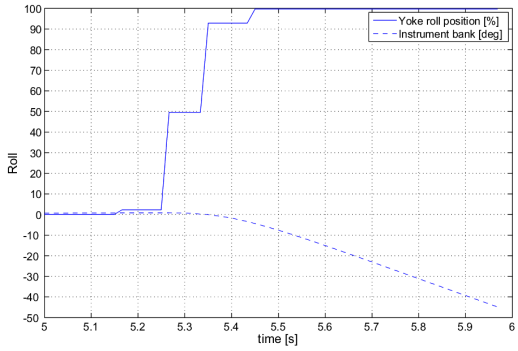

Steady state sideslip APPROACH FLIGHT CONDITION
Test result
YAW RATE (deg/sec)
ELAPSED TIME (sec)
Wed Dec 10 13:10:06 2008
16
14
12
10
8
6
4
2
0
-2
-4
0
10
20
30
40
50
60

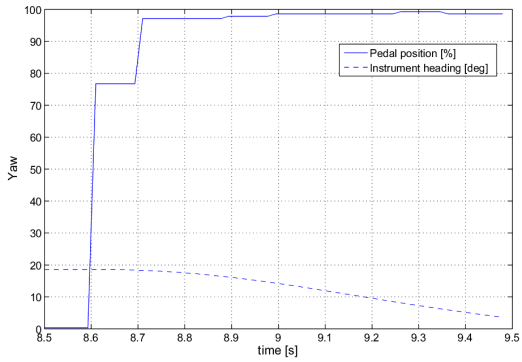
Source data	Section 3.20 of [1]
Comparison of results	The simulator test shows Correct Trend & Magnitude towards the Validation Reference Data result as described in Section 3.20 of [1].

6.25 Instrument response time (3b)

Test objective	To confirm that the cue correlation and responses of the instrument drive and visual drive are sufficient to be representative of perceived in the class of aeroplane.
Demonstration procedure	Subsequent signals are driven through the pitch, roll and yawn channels and the resultant effects on instruments and visual system are monitored to ensure that there are no unacceptable delays in the pilot-perceived cues of the simulation.
References	[3], [4]
Manual test procedures	
Evaluated parameters	(1) PITCH CONTROL POSITION PITCH ANGLE (FROM ATTITUDE INDICATOR) 'Y' DRIVE SIGNAL VISUAL SYSTEM IMAGE GENERATOR (2) ROLL CONTROL POSITION BANK ANGLE (FROM ATTITUDE INDICATOR) 'X' DRIVE SIGNAL VISUAL SYSTEM IMAGE GENERATOR (3) YAW CONTROL POSITION YAW ANGLE (SLIP INDICATOR) 'Z' DRIVE SIGNAL VISUAL SYSTEM IMAGE GENERATOR
Expected results	Response time of instruments and visual to a control input in pitch, roll or yaw is less than 300ms
Tolerances	300 milliseconds or less
Test result	


Yoke pitch position [%]
Instrument pitch [deg]
Pitch
time [s]


Yoke roll position [%]
Instrument bank [deg]
Roll
time [s]


Pedal position [%]
Instrument heading [deg]
Yaw
time [s]

Source data

Comparison of results

The instrument and visual response times to a control input in pitch, roll or yaw were determined from data that included airplane model calculations. The current software configuration does not allow for direct response time measurements on the instruments and the visual system. However, even with the model included, the results show that for all axes, the response time of the instruments and visual to a control input in pitch, roll or yaw is below 300ms and therefore complies to the requirements.

6.26 Visual ground segment (4a)

Test objective	To demonstrate that the visual system ground segment visible to the pilot at a height above the runway of 30 m (100ft) conforms to the class of aeroplane.
Demonstration procedure	Visibly determine that the visual ground segment is correct.
References	[2], [3], [4]
Flight condition.	Trimmed in the landing configuration at 30 m (100 ft) wheel height above threshold elevation whilst on glide slope at an RVR setting of 350 m (1200 ft)
Manual test procedures	Select a scene that has a fully marked and lighted runway. Collect data on the evaluated parameters as indicated below for that runway and the simulated airplane.
Evaluated parameters	PILOT DESIGN EYEPOINT COCKPIT CUTOFF ANGLE MAIN LANDING GEAR LOCATION (BOTTOM OF WHEEL) APPROACH SPEED TYPICAL WEIGHT OF AIRCRAFT ON LANDING PITCH ANGLE OF AIRPLANE AT SPECIFIED HEIGHT
Expected results	239m
Tolerances	±20% correct approach lights shall be visible in the visual segment.
Test result	

Comments	Approved by	Date

6.27 Visual Feature Recognition - Runway Definition (4b1)

Test objective	To demonstrate that the runway visual objects are visible at least 3km from the runway threshold. Visible objects include strobe lights, runway edge white lights and visual approach and guidance lights.
Demonstration procedure	Set the airplane at approach condition from the instructor station at least 3km from runway threshold. The distances at which different types of light may be discerned should not be less than those indicated in the specified test for those lights up to and including the first 30% of the visible runway.
References	[3]
Flight condition.	Trimmed in the approach configuration at at least 3km from runway threshold.
Visibility conditions.	Dusk, CAVOK.
Manual test procedures	Select a scene that has a fully marked and lighted runway. Collect data on the evaluated parameters as indicated below for that runway and the simulated airplane.
Evaluated parameters	RECOGNITION DISTANCES
Expected results	At least 3km
Tolerances	3km minimum from the runway threshold
Test result	More than 3km (at least 3NM)

Comments	Approved by	Date

6.28 Visual Feature Recognition - Runway Centerline Lights (4b2)

Test objective	To demonstrate that the runway centreline lights are visible from at least 3km from the runway threshold.
Demonstration procedure	Determine that the runway centreline lights are visible. Set the airplane to approach condition at least 3km from the runway threshold.
References	[3]
Flight condition.	Trimmed in the approach configuration at at least 3km from runway threshold.
Visibility conditions.	Dusk, CAVOK.
Manual test procedures	Select a scene that has a fully marked and lighted runway. Collect data on the evaluated parameters as indicated below for that runway and the simulated airplane.
Evaluated parameters	FEATURE RECOGNITION DISTANCE
Expected results	At least 3km
Tolerances	3km minimum from the runway threshold.
Test result	More than 3km (at least 3NM)

Comments	Approved by	Date

6.29 Visual Feature Recognition - Threshold and Touchdown Lights (4b3)

Test objective	To demonstrate that the threshold and touchdown lights are visible at least 3km from the runway threshold.
Demonstration procedure	Determine that the lights are visible at least 3km from the runway threshold. Set the airplane to approach condition at least 3km from the runway threshold.
References	[3]
Flight condition.	Trimmed in the approach configuration at at least 3km from runway threshold.
Visibility conditions.	Dusk, CAVOK.
Manual test procedures	Select a scene that has a fully marked and lighted runway. Collect data on the evaluated parameters as indicated below for that runway and the simulated airplane.
Evaluated parameters	FEATURE RECOGNITION DISTANCE
Expected results	At least 3km
Tolerances	3km minimum from the runway threshold.
Test result	More than 3km (at least 3NM)

Comments	Approved by	Date

6.30 Visual Scene Content (4c1)

Test objective	To demonstrate that the visual system contains the right runway, taxiway and lighting features.
Demonstration procedure	Visibly determine that the visual scene contains runways, taxiways and lighting.
References	[3]
Flight condition.	Set in ground and/or flight condition near airport to allow for overflying an feature recognition.
Visibility conditions.	Dusk, CAVOK.
Manual test procedures	Select a scene that has a fully marked and lighted runway. Collect data on the evaluated parameters as indicated below for that runway and the simulated airplane.
Evaluated parameters	SCENERY CONTENT
Expected results	Representative
Tolerances	Demonstration model
Test result	

Comments	Approved by	Date

7 Functions and subjective tests

7.1 Preparation for flight - Preflight

References [2], [3], [5].

Training task To conduct the training of normal checklist procedures up to ready for engine start.

Method Accomplish a functions check of all switches, indicators, systems, and equipment from the pilot's seat and at the instructor's stations and determine that the flight deck design and functions are identical to that of the class of aeroplane simulated.

1. The simulator should be started up and prepared using the prescribed procedures up to the point where it is declared ready for training.
2. All normal checks should be performed to prepare the simulator for a typical training detail.
3. Ensure the instructor station inputs are complete and that, initially, the environment is set for a standard atmosphere, maximum visibility, nil wind, nil magnetic wind, nil shear and nil turbulence.
4. Perform all preflight checks as detailed in the Pilot Operating Handbook and/or the Aircraft Flight Manual.

Findings		
Comments	Approved by	Date

7.2 Surface operations (pre-take-off) - Normal engine start

References [2], [3], [5].

Training task To conduct the training of engine starts using standard procedures.

Method

1. Establish the simulator at ISA and follow the pre-start and engine start check lists.
2. Monitor the RPM, EGT , fuel flow and sound cueing profiles until stable idle readings are achieved.

Findings		
Comments	Approved by	Date

7.3 Surface operations (pre-take-off) - Taxi - Thrust response, throttle friction

References [2], [3], [5].

Training task To conduct the training of engine handling procedures during taxis.

Method

1. Position the aeroplane on the ground at a suitable point on the airport like a General Aviation ramp (i.e. level terrain, away from known slopes). Ensure the aeroplane weight, centre of gravity are set to nominal values, surface friction to clean and dry and weather conditions are set to nil wind, nil magnetic wind, nil shear and nil turbulence.
2. Release the parking brake, allow time at idle power and check for movement, then slowly apply power until the aeroplane starts to move forward. Note appropriate engine parameters like RPM, EGT, fuel flow and any perceivable visual attitude changes at breakout.
3. Establish the aeroplane at normal taxi speed and note engine settings required to maintain speed.
4. Conduct several starts and stops, under different weight conditions, using normal procedures and techniques to determine feel to dynamic response of the aeroplane to thrust changes and also friction in throttle movement.
5. Apply toe brakes and move the throttle to access power against brake effects. Note sound and visual effects versus RPM.

Findings		
Comments	Approved by	Date

7.4 Surface operations (pre-take-off) - Taxi - Ground handling

References [2], [3], [5].

Training task To conduct the training of pilot techniques to be employed during manoeuvres on the ground.

Method

1. Establish the simulator at a nominal ramp cross weight and centre of gravity. Taxi the aeroplane from the ramp over various taxi routes to different runways. During the course of the evaluation vary the following parameters by setting the appropriate environment conditions: Surface roughness; Surface friction (contamination); Surface wind; Aeroplane weight and centre of gravity
2. Ground speed should be controlled using standard procedures, e.g. use throttle setting and toe brakes as appropriate.
3. The nose wheel steering characteristics should be verified by performing normals tasks such as turning onto a runway and maintaining the centreline.
4. Aeroplane free response to surface wind effects should be monitored by observing ground speed, crosswind component, gross weight, centre of gravity, nose wheel steering on or off, and noting the heading change over a given period of time.
5. The speed decay during turns at idle thrust should be noted and behaviour on straightening from a full deflection turn.
6. Perform representative manoeuvres such as 180 degree turn on runway, with particular reference to item 5. above, to check the turning circle radius.

Findings		
Comments	Approved by	Date

7.5 Surface operations (pre-take-off) - Taxi - Brake operation

References [2], [3], [5].

Training task To conduct the training of the correct pilot techniques to be employed while braking the aeroplane during taxi.

Method

1. Establish the simulator at a nominal ramp cross weight and centre of gravity with standard ISA conditions and nil wind. Position the aeroplane on the taxiway with parking brake set.
2. Apply and release toe brakes and parking brake in various combinations.
3. Release all brakes and establish the aeroplane at nominal taxi speed. Apply varying amounts of brake, both symmetric and asymmetric, to access the aeroplane response to brake application. Standard procedures should be employed e.g. allow the aeroplane to accelerate to 20 or 30 kts, as appropriate, in a straight line then apply brakes to reduce speed to 10 kts.
4. Perform normal operating tasks such as bring the aeroplane to a smooth stop, accurately.
5. Repeat the above step for the limiting values of gross weights, centre of gravity and surface conditions.

Findings		
Comments	Approved by	Date

7.6 Take-off - Normal

References [2], [3], [5].

Training task To conduct training in the correct techniques for normal take-off procedures.

Method

1. Establish the simulator at a nominal ramp cross weight and centre of gravity with standard ISA conditions, nil wind and dry runway friction coefficient.
2. Follow the pre-take-off and taking runway checklists.
3. The engine parameters should be observed as the throttle setting is advanced
4. As the power is increased sound cueing should be noted and the longitudinal acceleration characteristics should be assessed.
5. The runway tracking using nose wheel and/or rudder steering should be assessed by using the controls to acquire and track the centreline of the runway.
6. After the rotation and once the initial pitch attitude has been achieved, normal sequencing of the wing flap devices should be assessed for changes in aeroplane attitude and performance.

Findings		
Comments	Approved by	Date

7.7 Climb - Normal

References [2], [3], [5].

Training task To conduct training in realistic climb performance conditions.

Method

1. Establish the simulator at a suitable take-off weight and centre of gravity with standard ISA conditions and nil wind.
2. Tune a suitable DME, set the stopwatch and note the fuel weight.
3. Perform the take-off and after take-off checks flying a standard climb profile.
4. Record time, distance, fuel and pitch at 2000 ft intervals up to the service ceiling.
5. Repeat at different temperature and pressure conditions.

Findings		
Comments	Approved by	Date

7.8 Cruise - Performance characteristics (speed vs. power)

References [2], [3], [5].

Training task To conduct training in realistic cruise performance conditions.

Method

1. Set the simulator at a suitable cruise weight and centre of gravity and at standard ISA conditions.
2. From the Instructor Operating Station, initialise the simulator at a suitable cruise and airspeed.
3. Release flight freeze and allow the simulator to fly for at 30 to 60 seconds to ensure stable engine airspeed and altitude parameters.
4. Record engine parameters and pitch attitude.
5. Repeat the above steps for a range of weights, centre of gravity and environment conditions i.e. temperature and pressure.

Findings		
Comments	Approved by	Date

7.9 Manoeuvres - High angle of attack, approach to stalls, stall warning, buffet and g-break

References [2], [3], [5].

Training task To conduct the training of the handling qualities of the class of aeroplane at high altitude and indicated airspeed. Additionally, experience of the overspeed warning will be demonstrated and training in the techniques and procedures required to recover from inadvertent excursion beyond the high speed limit.

Method

1. Establish the simulator at an aft centre of gravity and typical top of climb heavy weight. From the Instructor Operating Station, initialise the simulator at a suitable cruise level and airspeed.
2. Perform normal navigational turns and also turns pulling to the airframe limit of 2.5g.
3. Accelerate the simulator in a descent and until the never exceed speed is achieved.
4. Deliberate overspeed to the never exceed speed and check the onset of the overspeed warning.
5. During the descent monitor pitch sensitivity and roll sensitivity.
6. Repeat the above steps for a take-off, approach and landing configurations.

Findings		
Comments	Approved by	Date

7.10 Manoeuvres - Turns

References [2], [3], [5].

Training task To conduct training in the correct techniques and reference parameters for normal and steep turns.

Method

1. Establish the simulator at a mid weight and centre of gravity configuration.
2. Set a nominal manoeuvring speed and altitude. Establish the simulator in a 30 degree bank and note the ease with which the attitude can be achieved and maintained. Note the pitch attitude, power requirements and roll controller, pitch controller and rudder pedal forces applied and the control surface positions.

Findings		
Comments	Approved by	Date

7.11 Descent - Normal

References [2], [3], [5].

Training task To conduct training in realistic descent performance conditions.

Method

1. Establish the simulator at a suitable end of cruise weight and centre of gravity. The environment may be set to ISA conditions with nil wind.
2. Tune a suitable DME, set the stopwatch and note the fuel weight.
3. Perform the descent checks and fly a standard descent profile.
4. Record time, distance and fuel at 2000 ft intervals down to 1000 ft.

Findings		
Comments	Approved by	Date

7.12 Descent - Maximum rate performance

References [2], [3], [5].

Training task To conduct training in maximum rate/emergency descent techniques and procedures.

Method

1. Establish the simulator at a suitable mid cruise weight and centre of gravity. The environment may be set to ISA conditions with nil wind. Reposition to the optimum cruise flight level and airspeed for the weight.
2. Tune a suitable DME, set the stopwatch and note the fuel weight.
3. Perform the descent checks and fly the maximum rate descent profile.
4. Note sound cues associated with the configuration.

Findings		
Comments	Approved by	Date

7.13 Instrument approaches and landings - Precision

References [2], [3], [5].

Training task To conduct training in the procedures and techniques required for precision approaches.

Method

1. Establish the simulator at a nominal weight and centre of gravity for landing and position the aircraft by means of the Instructor Operating Station on an ILS approach. Perform the approach checks as detailed in the Pilot Operating Handbook and/or the Aircraft Flight Manual.
2. Select the correct ILS frequency and perform a manual ILS approach and landing without the use of the flight director in suitable weather condition for a CAT I type of approach.
3. When positioned at the outer marker, freeze the simulation and check the baro and radio altimeter indications, the ILS DME, the ILS QDM, the latitude/longitude, the distance to threshold and the aeroplane position relative to the approach path indicators and visual representation of the runway. Continue the approach to the Minimum Decision Altitude (MDA) or to the Decision Height (DH) and repeat the assessment.
4. At the MDA/DH review the visual effects in terms of the cloudbase set and the visual ground segment available. The pre-set weather options available on the Instructor Operating Station should be reviewed for settings against ICAO limits.
5. Review the runway threshold latitude and longitude, altitude and runway centreline magnetic heading (QDM).
6. Once on the runway, ILS transmitters should be reviewed for correct position of origin by moving from one end of the runway to the other observing the ILS indications.
7. Repeat the above steps for a manual approach and landing with the use of the flight director. Also, for both configurations, with and without the use of the flight director, introduce deliberate errors such as high/low, left/right and fast/slow before initiating a go-around.

Findings		
Comments	Approved by	Date

7.14 Instrument approaches and landings - Non-precision

References [2], [3], [5].

Training task To conduct training in the procedures and techniques required for non-precision approaches.

Method

1. Establish the simulator at a nominal weight and centre of gravity for landing and position the aircraft by means of the Instructor Operating Station at the beacon outbound for the approach. Perform the approach checks as detailed in the Pilot Operating Handbook and/or the Aircraft Flight Manual.
2. Perform at least three non-precision approaches in suitable weather conditions:
   (a) NDB
   (b) VOR,VOR/DME
   (c) ILS LOC, ILS LOC/BC

Findings		
Comments	Approved by	Date

7.15 Visual system - Correlation with aeroplane and associated equipment

References [2], [3], [5].

Training task

Method

1. Visual system compatibility with aerodynamic programming. Qualitative tests to verify the validity of throughput and visual attitude versus FNPT attitude.
2. Visual cues to assess sink rate and depth perception during landings. Visual cueing sufficient to support changes in approach path by using runway perspective. Changes in visual cues during take-off and approach should not distract the pilot

Findings		
Comments	Approved by	Date

7.16 Instructor controls

References [2], [3], [5].

Training task

Method Verification of the instructor controls of:

1. Environmental effects, e.g. cloud base, cloud effects, cloud density, visibility in kilometres/statute miles and RVR in metres/feet.
2. Airport/aerodrome selection.
3. Airport/aerodrome lighting including variable intensity where appropriate.
4. Performing the training tasks.

Findings		
Comments	Approved by	Date

7.17 Missed approach

References [2], [3], [5].

Training task To conduct training in the procedures and techniques required for a missed approach without the autopilot engaged.

Method

1. Establish the simulator on a suitable approach at the maximum landing weight and aft centre of gravity with weather conditions below the minima required for the approach.
2. At the appropriate decision point initiate a go-around and complete the missed approach procedure as published.

Findings		
Comments	Approved by	Date

7.18 Surface operations (post landing) - Landing roll and taxi

References [2], [3], [5].

Training task To conduct training in the procedures and techniques required during the normal landing roll out.

Method

1. Establish the simulator on final approach for landing with maximum landing weight and nominal centre of gravity with weather conditions below the minima required for the approach.
2. Asses the operation of the toe braking system under runway conditions that should be varied to cover all surface friction effects and wind conditions that should be varied from calm to moderate.

Findings		
Comments	Approved by	Date

7.19 Any flight phase - Aeroplane and powerplant systems operation

References [2], [3], [5].

Training task To conduct relevant checks that the aeroplane and powerplant systems observed function correctly for indications, performance and response.

Method During any flight phase, check and observe that the following systems function correctly for indications, performance and response:

1. Communications. I.e function of VHF/HF communications from all stations on different frequencies, intercom and operation under battery only power.
2. Electrical systems. I.e. electrical failures under generator on or under battery only power operation.
3. Fuel and oil, hydraulic and vacuum systems.
4. Power plant system. I.e. engine idle readings and RPM limit readings in different atmospheric conditions; restart in flight.
5. Navigation systems. I.e. check VORs, DME, ILS, ADF on different locations and frequencies for correct identification and indication.
6. Stall warning.

Findings		
Comments	Approved by	Date

7.20 Any flight phase - Airborne procedures

References [2], [3], [5].

Training task To conduct training in airborne procedures

Method

1. Establish the simulator on a suitable approach at the nominal landing weight and nominal centre of gravity. The environment may be set to ISA conditions with nil wind.
2. Simulate a holding imposed by air traffic control procedure.

Findings		
Comments	Approved by	Date

7.21 Any flight phase - Engine shutdown and parking

References [2], [3], [5].

Training task To conduct relevant checks that the powerplant and the parking brake system observed function correctly.

Method During the taxi after landing phase, check and observe that the following systems function correctly:

1. Engine and systems operation. I.e. engine shutdown.
2. Parking brake operation

Findings		
Comments	Approved by	Date

7.22 Sound system

References [2], [3], [5].

Training task To conduct training with significant aeroplane noises to the pilot during normal operations.

Method The following check should be performed during a normal flight profile:

1. Monitor the presence of significant aeroplane noises to the pilot such as engine noise to a comparable level of that found in the the class of aeroplane.

Findings		
Comments	Approved by	Date