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Flight Test Standard Practice Manual, FT-SOP-001

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REVISION DESCRIPTION

Revised By:	Description
Revsion A: Added several sections including TM room protocol, miscellaneous corrections, address ISRA comments [redacted] Date 11/7/2011 Aviation Safety Office	**Description** This document is a revision to GV-GER-1329 **Reason** Update to the latest processes and procedures **Residual Benefits** Standardization.

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1.0 PURPOSE

1.1 Scope

The mission of Flight Test is to provide data products to our customers at the highest standards of safety and efficiency. This requires a comprehensive set of processes spanning from requirements planning, through test article preparations, test conduct and reporting. The disciplined adherence to these processes along with those applicable processes outlined within the Gulfstream Corporate Policies and Flight Operations Manuals is the foundation for maintaining safety within flight test operations.

1.2 Intent

This manual is intended to provide the standard procedures to be used by Flight Test personnel to ensure the safe and efficient conduct of flight tests at Gulfstream. It is also intended that this manual be reviewed annually and updated as necessary to incorporate best practices and lessons learned. This document also defines the Gulfstream procedures accepted by the FAA as sufficient to establish an adequate level of safety for FAA flight test programs (Ref FAA MoU, Appendix A.10).

2.0 ORGANIZATION AND AUTHORITIES

2.1 Flight Test Organization

The Flight Test Organization is accountable to the Vice President of Engineering. Both the V.P. of Engineering and the V.P. of Flight Operations are accountable to the Senior V.P. of Programs, Engineering, and Test, who is in turn accountable to the President of Gulfstream. It is therefore the responsibility of these leadership roles to implement corporate aviation safety policy set by the President. Safety policy implementation with Flight Test is discussed throughout this document.

The Flight Test Organization is comprised of four areas responsible to the Director, Flight Test (ref Figure 1). Departmental Leaders for each area are responsible for ensuring:

- An adequately trained staff is maintained to support all flight test programs
- Inter-departmental processes are established, utilized and kept current to incorporate best practices and lessons learned
- Operations are conducted in accordance with Gulfstream standards established in this document

NOTE: Chief Engineering Position is shown on Flight Test Organizational Chart for reference only and is not a part of the Flight Test organization. The Chief Engineer is accountable to Program Manager and is responsible for all Engineering data. Flight Test provides a staff representative to each major program.

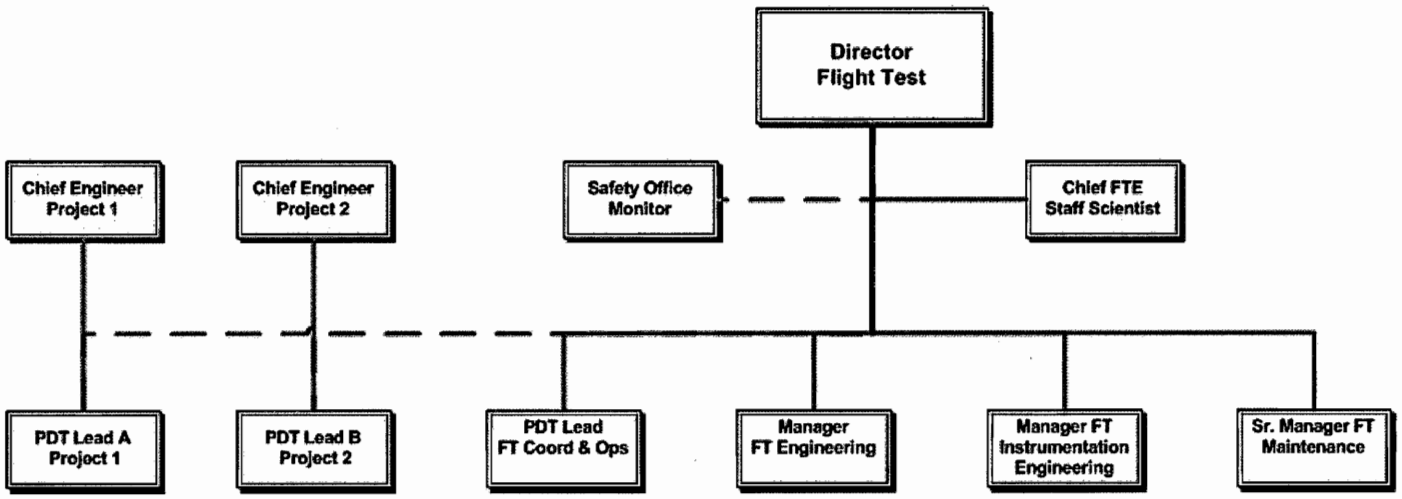


FIGURE 1 – FLIGHT TEST ORGANIZATION

2.2 Governing Authority

This manual governs the processes to be used by Flight Test Personnel. Additional information can be found in:

- Safety Management System – Flight Operations
- Safety Management System – Flight Test
- First Flight Readiness Reviews – Corporate Policy 14-15
- FTE Standard Operating Procedures (FT-SOP-003)
- FTIE Standard Operating Procedures (FT-SOP-004)
- FAA Order 4040.26A "Aircraft Certification Service Flight Safety Program"
- Repair Station Manual G02R813X
- FAA Partnership for Safety Plan III
- FAA Memorandum of Understanding, Risk Management (Rev A, 8/2/08)
- ODA Manual

3.0 ROLES AND RESPONSIBILITIES

Roles within Flight Test are varied and responsibility is assumed within the role description. For cases where a person fulfilling the role is absence from the office, that person will find a suitable delegate to perform the role in his absence. Email notification will go out to his direct reports and key colleagues of the stand-in responsible person, limit of authority, and length if time the delegation is planned for.

3.1 Chief Flight Test Engineer

The Chief FTE is a senior technical position reporting to the Director of Flight Test. This position provides mentoring of FTEs and technical expertise in all phases of flight testing. This includes representing Flight Test with outside agencies (i.e. Domestic and Foreign Certification Authorities), maintaining industry contacts and serving on technical committees. The Chief Flight Test Engineer also continually evaluates new technology and methods for opportunities to introduce continued improvements to the Flight Test process.

3.2 Flight Test Engineering (D343)

This department is responsible for a multi-disciplined staff of engineers and specialists responsible for the planning, test conduct, data processing, analysis and results reporting. Specific roles and responsibilities within this department are described in the following sections.

3.2.1 Flight Test Engineer (FTE)

The Flight Test Engineers are responsible for tests associated with flight sciences (aerodynamic performance, stability and control, loads and dynamics, acoustics) systems, powerplant and propulsion and avionics. Major responsibilities include:

- Establishing all test requirements and test plans
- Defining instrumentation requirements and submitting to FTIE.
- Establishing analysis methods and data reduction plans
- Performing risk assessments and test safety analyses
- Preparing detailed test cards, conducting mission briefings and real-time test support
- Issuing Flight Reports and maintaining test aircraft records
- Performing post test data reduction, analysis, and generating test results report

3.2.2 Data System Specialist

The Data System Specialists are responsible for providing necessary tools, software databases, applications and storage methods to enable processing, delivering and storing all types of acquired data. While the majority of data center efforts are on-site, capability for remote-site support is also required. Major responsibilities include:

- Database design and development for processing and storing data
- Data reduction / analysis tools
- Data format conversion tools
- Data transfer, storage, back-up and archiving
- Interface with vendors and other organizations external to Flight Test to fulfill their requirements for Flight Test information
- Troubleshooting data system hardware and software

3.3 Flight Test Instrumentation Engineering

These departments contain a multi-disciplined staff of engineers and specialists responsible for the definition, development, design, installation, and operation of instrumentation, data acquisition and specialized test equipment. Specific roles and responsibilities within this department are described in the following sections:

3.3.1 Instrumentation Operations Engineer (D345)

The Operations Engineers define instrumentation and data acquisition systems as well as other unique modifications to satisfy requirements defined by Flight Test Engineering. Major responsibilities for these engineers include:

- Selecting sensors and performing accuracy / response analysis
- Establishing calibration methods and procedures
- Developing data systems and providing large-scale or miniature quick-response data systems based on program scope
- Maintaining all data system components to ensure proper operation and airworthiness
- Maintaining instrumentation calibrations, measurement lists and configuration control per internal and regulatory requirements
- Providing electrical designs to support instrumentation, data acquisition and special test installations
- Providing preflight and post flight checks for flight test instrumentation and systems
- Supporting in-flight, ground test and remote operations as required

3.3.2 Instrumentation Mechanical Designer (D348)

Mechanical design personnel create engineering models, released thru approved work methods, for flight test installations. This function includes the following tasks:

- Provide designs that incorporate structural, aerodynamic or systems modifications to test aircraft for the installation of transducers, data system components, and specialized test equipment
- Release designs that have been approved by Stress and other cognizant Engineering groups to ensure airworthy and effective installations
- Provide support and technical guidance for part fabrication and installation of hardware on test aircraft.
- Resolve installation and fabrication problems due to design deficiencies or workmanship issues
- Disposition aircraft installation discrepancies and work with MRB and Stress Engineering to obtain repair resolution.

3.3.3 Instrumentation Technicians

Instrumentation Technicians perform the build-up, integration, installation and maintenance for instrumentation, data systems and special flight test systems. This includes:

- Off aircraft fabrication and assembly of mechanical and electrical components and assemblies
- Maintaining dedicated lab with proper equipment to calibrate a variety of sensor types
- On-aircraft installations, calibrations and on-going maintenance of the flight test instrumentation and special test installations.
- Preflight and post-fight checks for the flight test instrumentation and systems
- Support local and remote site test operations

3.4 Flight Test Coordination and Operations (D346)

This department is responsible for coordinating the flight test activities with internal flight test personnel and external Gulfstream personnel, suppliers and regulatory agencies. This includes responsibilities for establishing test program plans along with short-term and long-term aircraft schedules. A staff of test coordinators shall be maintained who are responsible for proper planning, coordination and integration of all activities required to support an aircraft's scheduled test operations.

3.4.1 Aircraft Coordinator

The Aircraft Coordinator is responsible for directing and coordinating the short-term and long-term activities for a given test aircraft. Major responsibilities include:

- Scheduling tests to be done, including preparation for off-site tests.
- Preparation and maintenance of the daily and weekly schedules
- Publication of the Daily Status Report.
- Maintaining and developing aircraft weight/balance sheets, configuration statements, and test area requirements.
- Establishing and maintaining aircraft configuration control.
- Notifying Flight Operations of pilot requirements.
- Sole responsibility for the generation and maintenance of the FTWA database (except for instrumentation FTWAs with are authored by FTIEs)
- Coordinating daily maintenance activity at the turnover meetings, relative to the upcoming tests to be performed

3.4.2 Flight Test Operational Support

Within the Flight Test Coordination and Operations group, the support function is responsible for maintaining surveillance of open work orders against each flight test airplane as discussed in Section 7. This includes:

- Managing the content of the flight test aircrafts' open work Excel file databases to support aircraft conformity assurance
- Providing technical support assistance (Solumina, Excel, Cognos), and logistics to support aircraft configuration and conformity
- Maintain FTWA, R&I, Flight Log, and other status tracking tools for the department

3.5 Flight Test Maintenance

This multi-department organization is responsible for the maintenance, modifications and repairs across a multi-aircraft-model test fleet. This includes:

- Scheduled and Unscheduled Maintenance
- Installation of production configuration changes
- Installation of prototype systems
- Installation of specialized flight test systems and equipment.

All maintenance operations shall be conducted in a manner that adheres to internal Gulfstream requirements and repair station manual. Maintenance operations shall be provided to support test program objectives, to include 24 hour / 7 day support. Internal programs shall be maintained for:

- Foreign Object Damage (FOD) Control (Ref CP 12-2)
- Tool Control (Ref CP 4-1, 4-6, 4-8)
- Employee Health & Safety (Ref CP-12)
- Maintenance Qualification Training to ensure appropriately qualified maintenance personnel are available to support operations on all shifts.

While the internal resources within the Flight Test Maintenance are contained within the following two departments, collaboration and coordination with certain Other Support Functions (Section 3.6) is required to properly maintain and operate the test fleet.

- Mechanics, Avionics / Electricians and Fabricators (D968)
- Material (D698) for the planning, inventory and control of non-stock purchased and fabricated parts

3.6 Other Support Functions

3.6.1 Product Development Team Leads

This position reports directly to the Chief Engineer for New Product Development Programs. This role provides direct reporting relationship to the Chief Engineer for all aspects of the Flight Test Program and is responsible to coordinate and prioritize all work between Flight Test and the NPD Engineering Organization.

3.6.2 Aviation Safety Office Monitor

The Aviation Safety Office (AVSO) is responsible to monitor compliance with established standard practices and Safety Management System (SMS) requirements. AVSO will periodically audit test cards, briefings, debriefings, installation work, and conformity inspections and ensure that safety requirements are complied with at all times. Additionally, the AVSO is to act as Ombudsman on safety issues between members of the Flight Test department and company Senior Management. Although Gulfstream has a clear non-retribution policy with regard to raising safety issues, if an individual feels that the concern raised is not being addressed by the supervisor chain of command, they are free to discuss the issue with the Safety Office who will conduct an investigation independent of the functional management organization.

3.6.3 Quality (D634)

The Flight Test Quality organization is responsible to ensure that all modifications and maintenance activities comply with documented requirements, as well as to complete daily inspections in preparation for and issuance of flight release of all Flight Test aircraft whether managed under the repair station or the manufacturer's authority based on program PSCP guidelines. These duties include:

- Initiating and verifying the accuracy of discrepancy tags (DR/DIs) in the discrepancy tracking database (currently Solumina for Production and Flight Test)
- Inspecting and accepting the completed work order operations/steps of engineering release work orders (blueprint changes approved from an ECR), re-work orders (needed corrections/fixes found from inspection or from flight crew), and Flight Test Work Authorizations (configuration control for changes made to flight test equipment, flight test instrumentation, flight test systems, and flight test components)
- Verifying R&I log and CMP card(s) accuracy

- Maintaining individual aircraft airworthiness records, including 8130 tags, certifications of conformance etc.

In addition, Quality Assurance is responsible for preparing and presenting the aircraft to the ODA Inspection Airworthiness Representatives (IARs) for the issuance of conformity or airworthiness certificates for aircraft assigned to Flight Test. The ODA IAR's are also members of the Quality organization.

3.6.4 Materials (D913)

The Materials organization provides support to Flight Test to manage stock material (aircraft production parts). This includes planning, logistics and control support for the flight test inventory of production spares, parts borrowed from Production, parts upgrades, maintaining current list of parts shortages, expediting shipping and receiving and maintaining inventory control.

3.6.5 Material Review Board

MRB is a group of engineering representatives empowered to review all reported airplane discrepancies (DRDIs) and develop authoritative resolution instructions.

3.6.6 Flight Operations (D926)

Flight Operations is responsible for providing all the test pilots for any Flight Test flight as well as any other necessary cockpit crew.

4.0 FLIGHT TEST PROCESS

Gulfstream flight testing is a multi-dimensional process illustrated at a top level in Figure 2. The process is a set of comprehensive procedures, reviews, data products, and cross checks which taken together, effectively manages the inherent risk associated with Flight Test operations. The process ensures that flight missions meet the following criteria:

1. Aircraft level test data is required to support Program, Engineering and Test Organizational objectives
2. The data required is optimized to support Engineering's development efforts and/or to show or find compliance with Regulations
3. Procedures and methods required to gather the data have been evaluated to include appropriate risk analysis and any appropriate mitigation steps determined
4. Test mission planning has been planned and organized in an appropriate build-up fashion
5. The mission has been crewed by trained, qualified individuals familiar with techniques and maneuvers being used as well as how to operate the airplanes flight and safety systems
6. Test aircraft are appropriately modified, maintained and configured to include any specialized safety equipment.
7. The test missions are executed in a disciplined manner with objective success and discontinuance criteria
8. Progressive results are understood, reported to the team, and considered as part of the evaluation process for follow-on missions.

The top level process diagram is illustrated in Figure 2 as a seven phase process starting at requirements definition and ending with data archival and project closure. Arrows indicate normal pathways of data and sequence flow. Each element of the process will be defined in the following sections of this document. Each of those sections contains a reference to the block number of the Flight Test Process in the section heading.

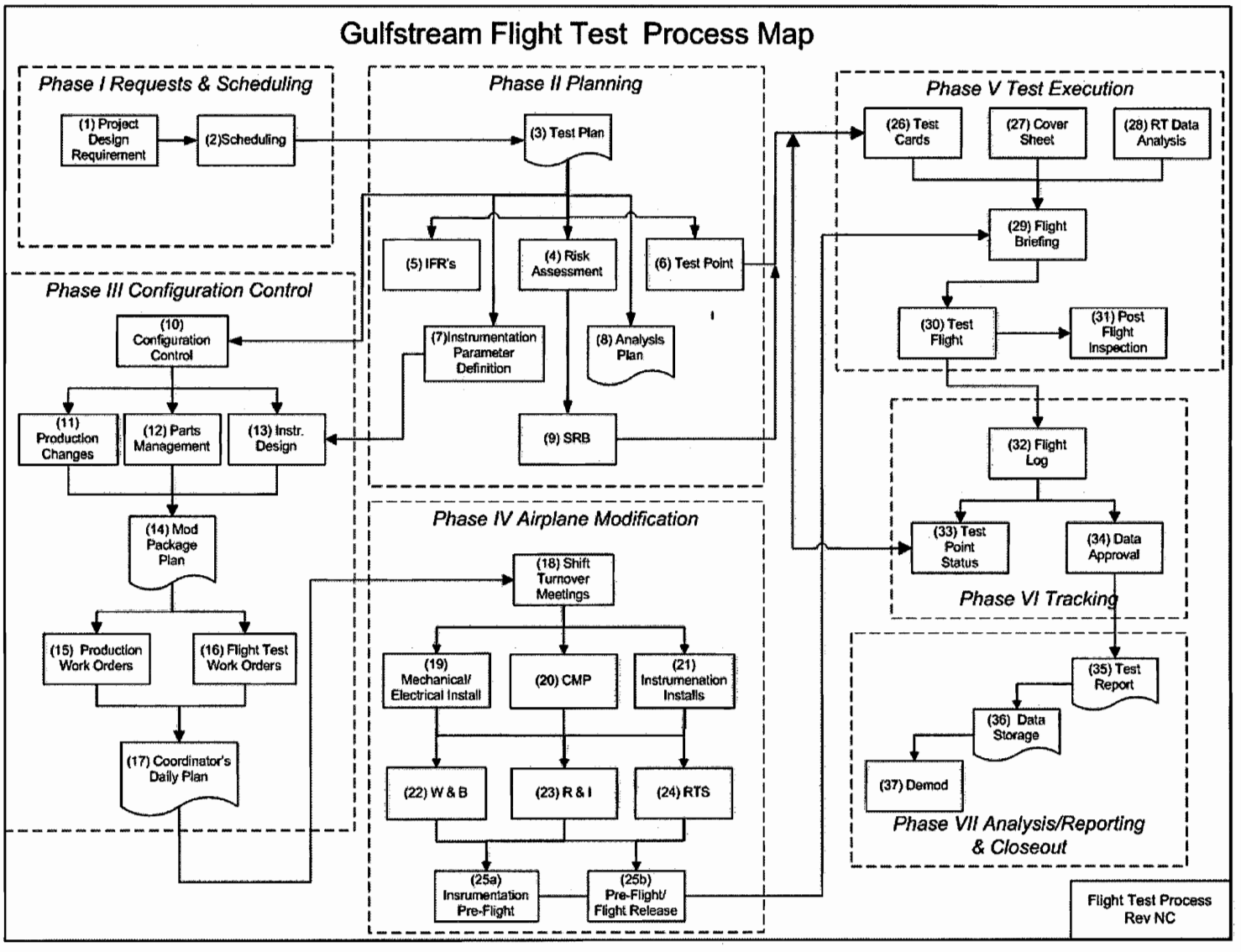


FIGURE 2 - FLIGHT TEST PROCESS OVERVIEW

5.0 PHASE 1: REQUESTS & SCHEDULING

All flight tests require authorization from appropriate engineering or program management. During or after the authorization process, schedules are prepared based on the scope of testing requested and an understanding of the requirements and lead-times to properly plan, prepare and configure the test aircraft, conduct the test and provide the results.

5.1 Authorization

For major product development programs, flight tests are authorized by the Program Office through a Program Directive. For other test programs, flight tests are authorized by appropriate Management personnel through the Request for Flight Test Services process outlined in Section 5.2.

5.2 Product Development Programs

For product development programs, the scope of the flight test program is determined based on an understanding of the configuration and the test requirements for development, company and certification tests. Comprehensive program schedules are established for the test aircraft thru coordination with Engineering and the Program Office.

Flight Test Engineering generates flight test plans documenting the test requirements and obtains the appropriate technical input and approval from the cognizant engineering personnel as outlined in Section 6.1.

Once the test program scope is established, then additional tests are authorized and scheduled using the Request for Flight Test Services Process outlined in Section 5.3.

5.3 Non-Product Development Programs

For test projects not authorized through a Program Directive, or tests that exceed the original scope during Product Development Programs, a Request for Flight Test Services form is written, approved and submitted to Flight Test. This form should contain the appropriate background to document the purpose of the test, along with other relevant information to define the test requirements to the extent tests can be conducted or support generation of a Flight Test Plan.

After receipt of an approved RFTS, an internal tracking number is assigned by Flight Test Operations and Coordination team and scheduled for a test aircraft. A log shall be maintained and kept current for all RFTS projects. The flow chart for the RFTS process is shown in Figure 3.

The RFTS form and instructions can by downloaded from the corporate intranet at:

[redacted]

A log shall be maintained and kept current for all RFTS projects. Current log can be found in the following

[redacted]

The flow chart for the processing of RFTS jobs is shown in Figure 3

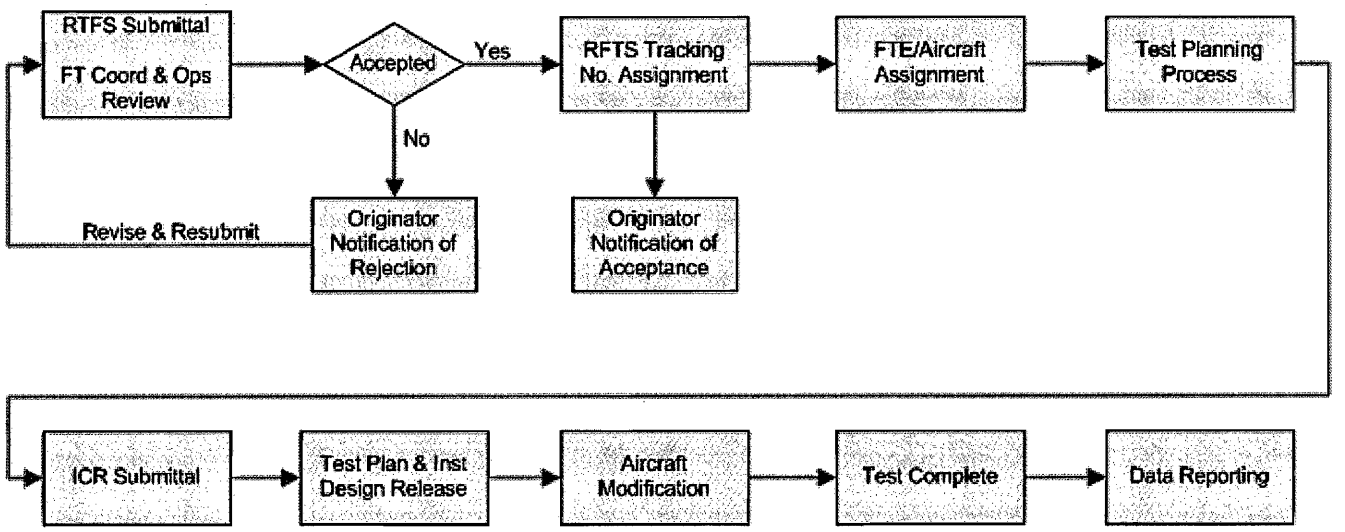


FIGURE 3– RFTS PROCESS FLOW

6.0 PHASE II: PLANNING

Planning phase activities are primarily performed by Flight Test Operations and Coordination personnel with contributions from other groups within and outside of Flight Test. Regardless of whether the requirement originates from RFTS or in support of a Product Development Program, the same structured planning process is required: requirements are analyzed, instrumentation & configuration are defined and aircraft test schedules are established. The output of this phase of the process may include an approved, released Test Plan in the case of large complex test program, or at a minimum an approved test point table, risk assessment, appropriate flight restrictions, parameter list, and data analysis plan if appropriate.

6.1 Test Plan (Figure 2 Ref 3)

Flight Test Plans are a primary deliverable of the Flight Test Engineering department and used to define the following elements of a test:

- Test Objective
- Company and/or Regulatory Requirements
- Test Conditions & Procedures
- Instrumentation Requirements
- Risk Assessment

To ensure that proper planning and coordination has been completed, test plans are approved thru Flight Test Engineering, Flight Operations and the appropriate cognizant Engineering group. An approved flight test plan is required before conducting test points during a test mission.

The title of the document should indicate the type of test plan (Development, Company or Certification) and shall be numbered sequentially through the Flight Test database system. The document number should indicate the model type (GVI-FT-XXX, GV-FT-XXX) where XXX is a sequential document number from the tracking database). Content of the test plan should follow the organization of the standard Test Plan template. Details of preparing a Flight Test Plan are contained in Flight Test Engineering FT-SOP-003 and a standard template format can be found in Appendix A.

6.2 Interim Flight Restriction (Figure 2 Ref 4)

6.2.1 IFR Purpose

Interim Flight Restrictions are temporary limitations issued by the Engineering group that are over and above AFM flight restrictions that must be strictly followed to ensure safe operation of the airplane. These restrictions are most often associated with early stage flight testing of new development aircraft programs. IFRs can be generated as a result of the following types of issues:

(a) Known aircraft hardware and/or software problems.

(b) Incomplete laboratory or development testing.

(c) First flight envelope/Restricted flight envelope.

(d) Defined limitations for specific operations (usually outside standard aircraft limitations).

(e) Measure of conservatism (safety enhancement).

6.2.2 IFR Process

IFRs are normally created by Engineering, (e.g., Flight Sciences, Systems) and issued using a form similar to that located in Appendix A. The IFR contains the restriction, the basis for the restriction, the clearance action required to lift the restriction and the affected flight test aircraft. The IFR is approved by the originator, Flight Test Engineering, Flight Operations and the Program's Chief Engineer. Original signature copies are forwarded to Flight Test where a Log is maintained and the IFRs distributed to all personnel involved in executing test missions. They are included in the flight decks for each aircraft mission and briefed during the preflight. See IFR Flow Process in Figure 4 below.

IFRs remain in effect until formally cancelled. Cancellation is performed when all required action items for all affected aircraft are completed and additional cancellation concurrence signatures are added to the original. At the Type Certification milestone in a program, all IFRs should be closed or transferred into the AFM as a permanent item.

IFRs are included the test card package and briefed prior to flight. Compliance with IFRs is mandatory and specific wavers to exceed the IFRs for specific test purposes must be received from Chief Engineer via IOM or email and included in the Test Card package. For the GVI program, the IFRs are stored in the following network directory location:

[redacted]

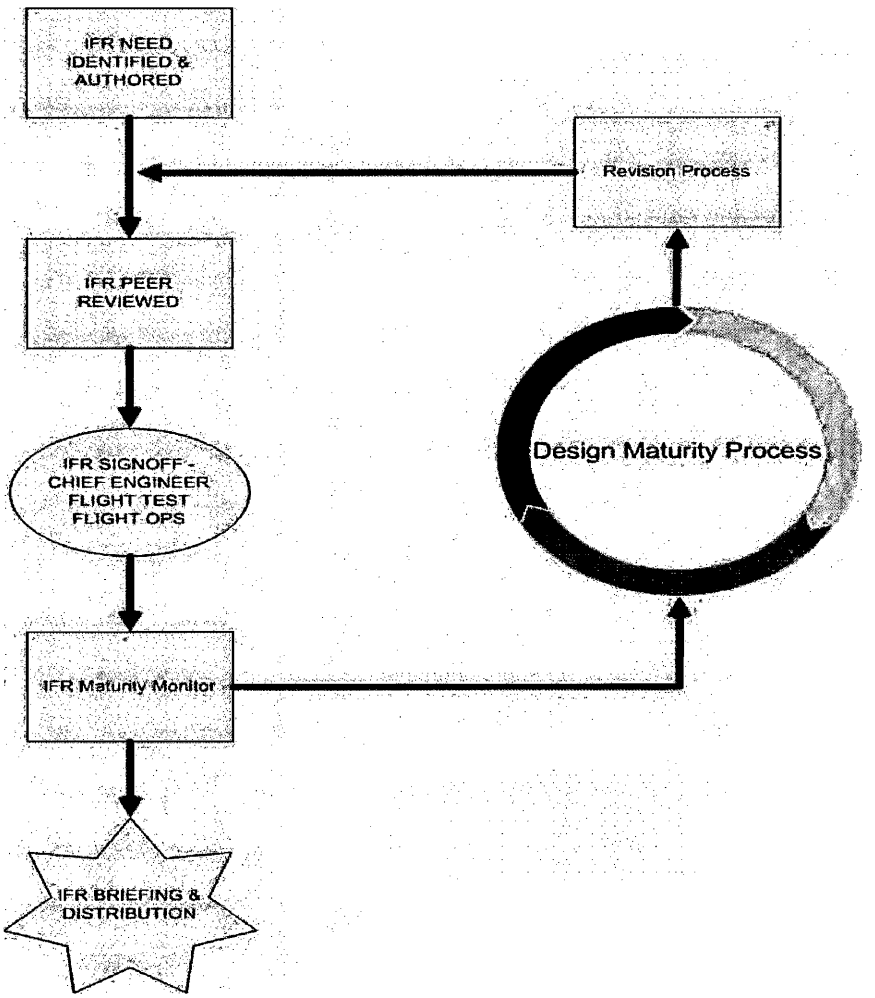


FIGURE 4– IFR FLOW PROCESS

[redacted]

6.3 Flight Test Risk Assessment/Risk Alleviation (Figure 2 Ref 5)

The Flight Test risk assessment is an essential element of insuring an acceptable level of risk is maintained during flight test operations. While the flight test risk assessment process outlined in this section mitigates risk for specific tests, to maintain the highest standards of safety involves a never-ending focus and disciplined adherence to the overall test process by everyone involved in the test program. It is the responsibility for all involved in the test program to identify and respond to safety-related issues at any time. These issues should be elevated to the appropriate management member and if necessary or preferred for priority or anonymity, the Gulfstream Aviation Safety Office (Ref Section 3.6.2)

The Flight Test risk assessment process starts with determining for each test point, the associated hazards along with the causes and effects. Guidance for hazard assessments and tests typically considered hazardous are provided Appendix A. In addition to internal Gulfstream expertise and experience, useful external sources such as FAA Order 4040.26A and the Flight Test Safety Committee should be consulted. Additionally, previous Gulfstream program Flight Test risk assessments are considered as a starting point and modified for differences in a new aircraft type and system level Fault Hazard Assessment (FHA) and System Safety Assessment (SSA) are good reference documents for analyzing Flight Test risk.

Per FAA Order 4040.26A, the following Hazard categories have been defined:

- **Catastrophic** – Loss of personnel and/or aircraft
- **Hazardous** – Major damage to aircraft and/or serious injury to personnel
- **Major** – Extreme crew workload conditions, damage to aircraft or minor personnel injury
- **Minor** – Excessive crew workload conditions

Probability categories are also defined within FAA Order 4040.26A from High to Improbable. There is no quantitative definition related to these categories, a subjective judgment will be made relative to the given test being analyzed. Once the hazard category and probability of occurrence is established, the overall risk classification is determined using Figure 5. These risk classifications are defined in FAA Order 4040.26A as follows:

- **AVOID** – represents risk that is unacceptable for flight testing and needs to be addressed by other means such as simulation. This is often the case for system failure response and is primarily driven by System Safety Assessments by Engineering
- **HIGH** – Test or activities which present a significant risk to personnel, equipment, or property, even after all precaution measures have been taken.
- **MEDIUM** – Test or activities which present a greater risk to personnel, equipment, or property than normal operations.
- **LOW** – Test or activities which present no greater risk to personnel, equipment, or property than normal operations. No Safety Review Board is required.

Generally speaking, Test Hazard Analysis is required (Ref. 6.3.1) along with Flight Test Safety Review Board (Ref. 6.7) will be required for all Medium and High risk tests. Limited exceptions to this requirement are covered in section 6.7.

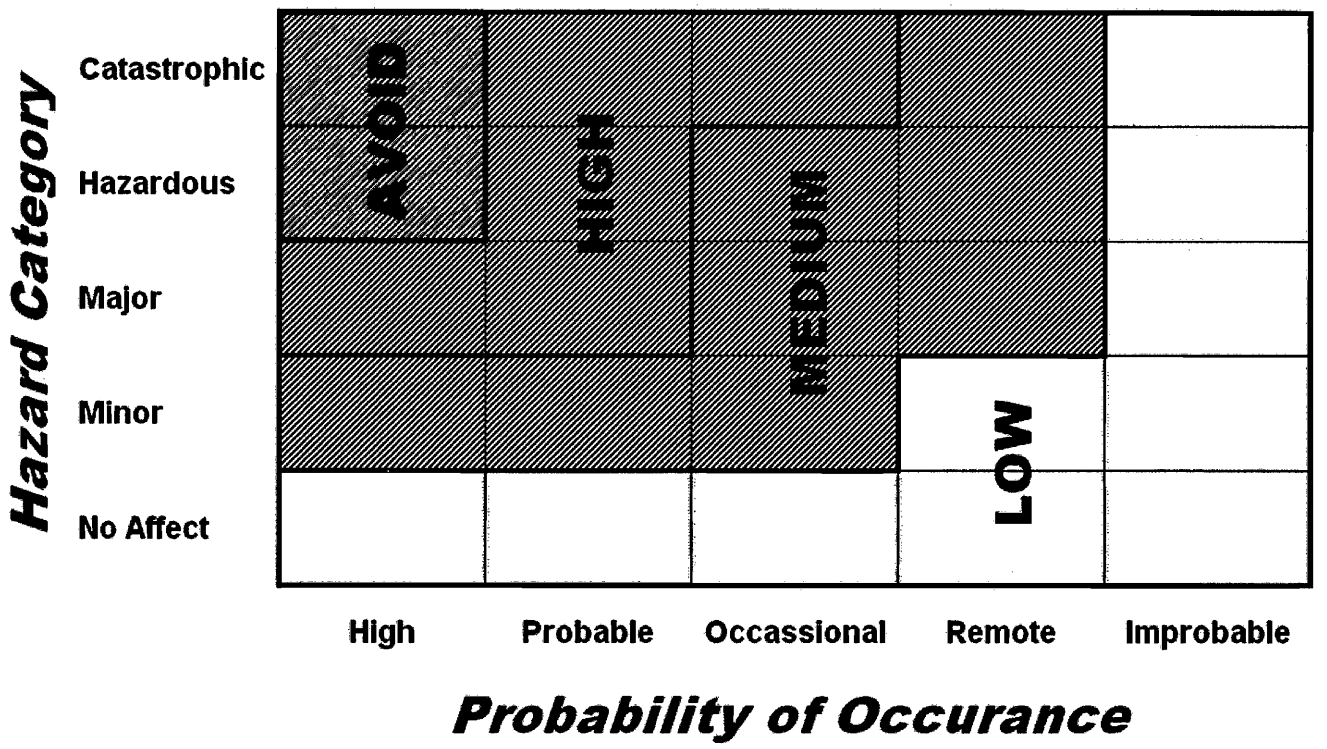


FIGURE 5– SUBJECTIVE RISK ASSESSMENT

6.3.1 Test Safety Hazard Analysis (TSHA)

For those tests that are not classified as low risk, a test safety hazard analysis is required. The cognizant FTE, in coordination with the test pilot, is responsible for developing the TSHA and informing the SRB chairman(s) of the requirement to convene a FT SRB.

The Test Safety Hazard Analysis (TSHA) utilizes the information from the Risk Assessment above and defines the necessary mitigation to achieve an acceptable level of risk. The TSHA is approved through the FTE and Flight Operations Organizations.

An example of a TSHA is included in Appendix A.

[redacted]

The following elements should be used in preparation of Test Safety Hazard Analysis:

Hazard – A short description of the envisioned dangerous condition

Cause – Key instigating factors leading to the envisioned dangerous condition

Effect – Resulting outcome if the hazard is encountered during the test

Preventative Actions / Minimizing Procedures – List all reasonable steps that can be taken to avoid the condition or reduce its probability of occurrence and establish appropriate constraints that will provide the most optimum conditions for recovery if the event does occur.

Corrective Techniques – Define pilot actions to perform to recover from the hazard

TSHA control and approval is as follows: TSHAs control numbers will be issued by Flight Test administrative personnel. The document will be prepared and signed by the cognizant FTE and reviewed and signed by the

Pilot (project pilot or pilot singed to fly the mission, the FTE conducting the test, and the Flight Test Manager or Director. Original signed copies will be stored in Flight Test records retention area, and PDF copies placed on the common network drive folder. The example shown below is GVI storage folder.

[redacted]

THSA revisions are sometimes required. Revision actions are usually initiated from SRB review. However, if a revision action is initiated from new information coming to light, the need for SRB reconvene will be governed by section 6.7.1. A new copy with the same control number will be prepared with new original signatures.

6.4 Test Point Table (Figure 2 Ref 6)

The Test Point Table contained in the Flight Test Plan defines the type of maneuver required, flight condition, airplane configuration, and process steps for how the maneuver is to be performed by the flight crew. Test points can be categorized into groups of similar types, assigned identification numbers, and input into tracking databases. Pre-requisite test points for a given test block will be identified as appropriate. For example, Field Performance testing will be preceded by aerodynamic stall testing, stall barrier development, brakes development etc. Test point tables are documented in the applicable Flight Test Plan. Test point, including conservative build up to higher risk maneuvers, are defined in the test point table. The initial test points will follow previous program precedence in terms of steps, flight conditions etc. Individual test points go through a review and approval as part of the Flight Test Plan review process.

The tool currently being used by Gulfstream Flight Test to manage test points on the GVI program is FTMS which runs inside of the Smarteam database application. This application is launched from the PLM dashboard.

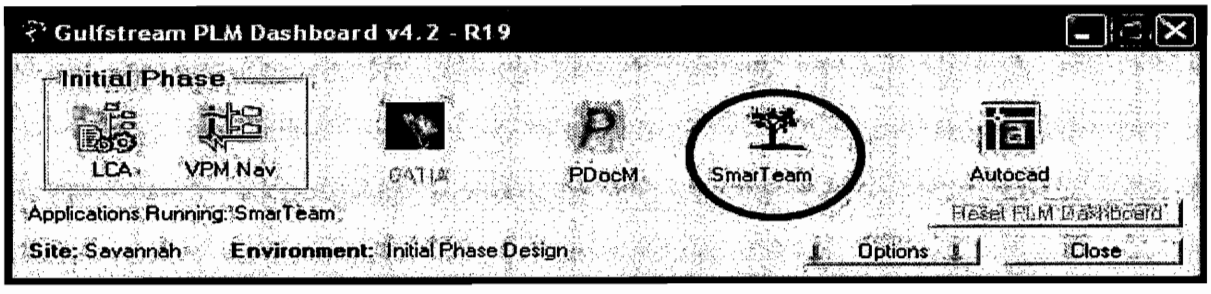


FIGURE 6– PLM DASHBOARD

An overview of how to utilize Smarteam to create and populate test point tables into a common project database is located in the following network directory:

[redacted]

6.5 Instrumentation Requirements Definition (Figure 2 Ref 7)

Instrumentation parameter lists are a key input from the Phase II Planning to the Phase III Configuration Control and must be defined and delivered sufficiently in advance to allow for design, procurement and installation activities to be completed. For major development programs requiring heavy design work, an initial list should be delivered to the FTIE group 12 to 18 months in advance of the first flight of the aircraft. The initial list shall define all analog measurements and identify all aircraft data busses that will require monitoring. The project PDT lead will be responsible for coordinating the definition of these requirements in partnership with FTEs and the design engineering organization. The communication of the requirements will be documented via Inter Office Memorandum (IOM). The contents of the table in the parameter list are

presented in Appendix B of the example Test Plan (Appendix A). The key information to convey is the measurement location, type, units, accuracy, ranges etc. Also if the parameter will be used for Safety Of Flight monitoring, this needs to be identified on the list.

Special instrumentation requirements that are not defined in the parameter list shall be provided by FTE and documented via IOM 12 to 18 months in advance of the first flight of the aircraft. These requirements include unique flight test installations to support the test program such as stall recovery parachutes, flutter exciters, differential GPS, etc.

6.5.1 Critical Flight Instrumentation Parameters

Specific instrumentation parameters that will be utilized for critical flight monitoring will be specifically identified in the Test Plan. These parameters will be reviewed by the SRB (Section 6.7) along with personnel assignments for monitoring via TM or on-board. These parameters fall into three categories:

Safety of Flight (SOF) parameter is one that is required to be monitored throughout the entire flight, regardless of the mission. The SOF parameter is used to alert the flight crew to a potential unsafe condition. If the ability to monitor a SOF parameter is lost, the testing will be required to be halted and the aircraft immediately returned to base. Loss of the ability to monitor a SOF parameter may also require specific limitations or procedures for the duration of the flight until the aircraft has landed. SOF parameters must identify aircraft effectivity, as all parameters may not be applicable to each test aircraft, i.e. Stall Recover Parachute system status. SOF parameters will be monitored either in TM or onboard the aircraft and will be reviewed by the SRB (Section 6.7)

Safety of Test (SOT) parameter is one that is required to be monitored throughout a specific test, to alert the flight crew to a potential unsafe condition. An example would be in-ground effect angle of attack calculated limit during field performance testing. Loss of a SOT parameter and any alternate measurement will require a Return to Base (RTB), or proceeding with alternate, pre-briefed tests not requiring the failed parameter.

Maneuver Quality parameter is required for either real-time or post-flight analysis and is essential to determining the success of a particular test point. An example would be electrical bus loading current measurements in electrical system testing. Loss of a Maneuver Quality parameter and any alternate measurement will require a Return to Base (RTB), or proceeding with alternate, pre-briefed tests not requiring the failed parameter.

6.5.2 Instrumentation Change Request Process

After the Instrumentation Parameter List is issued, changes will be managed through Instrumentation Change Request forms (ICR). This form is required by the FTIE group to manage incoming additional and changed requirements so they can be managed to support the proper airplane and test schedule. FTEs are responsible for the generation of all ICRs.

The format used for the GVI program is stored in the following network directory location:

[redacted]

6.6 Data Analysis Plan (Figure 2 Ref 8)

The data analysis plan is a document that is needed to establish a protocol of how lower level measurements are transformed into higher level data used for showing compliance or providing inputs to Engineering which are used to produce the final data. An example is GVI-FT-003 "Model GVI Data Analysis Methods". This document contains the agreed upon equations for processing air data (both production and reference systems), Stall Speeds, Minimum Control Speeds, Takeoff and Landing Performance Data, Thrust Reverser Effectiveness, Cruise Fuel Flow and Drag, Buffet Boundary, Engine Powerplant Performance, Flying Qualities, Component Cooling and Pneumatic Systems data. The document is produced by Flight Test and concurred with by Flight Sciences who is the primary customer of Flight Test data.

6.7 Safety Review Board (Figure 2 Ref 9)

The Flight Test Safety Review Board (FT SRB) is an inter-disciplinary group of Management, Engineering, and Flight Operations personnel responsible for reviewing tests classified as Medium or High and concurring that the subject tests can be conducted as planned with the prescribed mitigation and the resulting level of risk is acceptable.

The membership of the Flight Test Safety Review Board shall be defined as:

- Engineering Management Member
- VP Flight Operations*
- Director of Flight Test*
- Project Chief Engineer
- Chief Test Pilot
- Senior Level FTE
- Director, Engineering
- Project Pilot
- Others as required

* In the event a board member is not available co-chairs determine if a quorum exists for the Board to convene. A quorum shall consist of representatives of Management plus Engineering, Flight Operations and Flight Test.

It is the responsibility of the cognizant Flight Test Engineer to inform the Co-Chairs that an SRB is required, who should attend to support the board members review and ensure it is scheduled at an appropriate time preceding the test schedule (see section 6.7.1). It is acceptable for the cognizant FTE to review previously held SRB content and if it appears that existing THSA coverage exists for a given test point, make the proposal to the co chairs for applicability. The co-chairs will determine if SRB will be required based upon existing TSHA coverage. In order to ensure an effective meeting is held, the content and material for the review should be kept to a reasonable timeframe. Meetings of approximately 2 hours should ensure the ability for participants to support the meeting effectively.

At the FT SRB, the cognizant FTE should present the relevant information to support the board's determination if the risk level is acceptable. This should consist of the following information

- Test Background
- Test Aircraft Configuration
- Test Conditions & Procedures
- Safety of Flight Monitoring Abort Limits & Procedures
- Test Sequence (Build-up, Pre-Requisites)
- Data Analysis Requirements (Pre-requisite analysis, interim data reviews)
- Risk Levels
- TSHAs (Hazards, Probabilities, Mitigation)

In preparing for an SRB, a list of the types of questions that may arise or should be considered are included in Appendix A.

If during the course of an SRB, action items are generated (chits), recording the consensus of the issue and required follow-up action. All closure actions for the respective tests must be completed prior to testing to the

satisfaction of the SRB. Meeting minutes documenting material reviewed, closed actions, and approved TSHAs will be issued and retained for historical and future reference. SRB must be unanimous on the opinion to safely proceed.

After an SRB is completed, it is the responsibility of the test crew to elevate to the SRB Co-Chairs any issues encountered during the test program that would constitute additional risk that was not previously reviewed as part of the original SRB.

6.7.1 SRB Timing and Reconvene Process

Typically, the SRB should be scheduled a minimum of 2 to 3 weeks in advance of testing in order to allow adequate time to close any actions that may be identified. Closed SRB actions and associated approved TSHAs are considered sufficient provided no additional hazards or unexpected conditions are encountered during testing and the information reviewed during the SRB used to approve the tests remain consistent.

The SRB should be reconvened if:

A) Unexpected conditions are encountered that increase the hazards or probability

B) Changes are introduced to the test configuration, procedure, or crew

C) Start of testing is delayed significantly from the planned test start date (approximately 1 month)

D) If planned testing is repeated later in a program (approximately 3 months)

E) If testing is repeated on another program (ie, conducting TCAS encounters on a different software load)

For the purposes of conditions C through E where the SRB reconvene will review material already approved by the FT SRB, the SRB co-chairs shall determine the appropriate board participation.

NOTE UNDER NO CIRCUMSTANCE SHOULD SCHEDULE PRESSURES DICTATE THE ELIMINATION OR LIMITING THE FULL SCOPE OF THE RISK REVIEW PROCESS

6.8 Other Test Planning Activities

6.8.1 First Flight Readiness Review

First Flight Readiness Reviews (FFRRs) are required by corporate policy CP-14-15 to assure that all reasonable steps have been taken to establish airworthiness of a new aircraft type and that it is safe for its first flight and commencement of the flight test program. This formal review is required for at least the first 2 development vehicles of a new type, any test vehicle that has undergone a major modification or redesign, or any other reason deemed necessary by corporate management. Engineering and Program Management has primary responsibility for organizing these reviews.

6.8.2 Test Readiness Review

Test Readiness Reviews (TRRs) are internal Flight Test meetings held for major elements of a test program. TRRs are a team-wide review of the technical and operational aspects of a given test. The objective is to ensure satisfactory up-front planning and coordination are achieved to support the safe, accurate and efficient execution of a test will be achieved. These meetings are particularly useful for major offsite efforts where a high degree of logistic coordination is required with internal and external personnel plus establish a plan for transportation of people and equipment to the test site.

7.0 PHASE III: CONFIGURATION CONTROL (FIGURE 2 REF 10)

The airplane Configuration Control phase of the Flight Test Process is intended to ensure that the airplane test article is configured in an airworthy state, installed with the necessary components to be tested, and equipped with the required safety equipment. This requires configuration control for both production and flight test installations.

The initial phases of the Configuration Control block consist of Production Changes (11), Parts Management (12), and Instrumentation Design (13). These 3 blocks of activity feed the production of an aircraft Modification Plan (14) that is aligned with the master testing schedule (2). The Modification Plan consists of lists of Production (15) and Flight Test (16) work orders identifiers. This plan is the "master to do list" for a given scheduled modification period. Items are selected off of the this list and identified on the Coordinators' Daily Plan (17) to communicate on a shift by shift basis what is to be accomplished by various airplane's work crews.

7.1 Production Changes (Figure 2 Ref 11)

Production configuration evolves throughout a major Flight Test program due to a variety of reasons. Engineering Change Requests (ECRs) and discrepancies are generated to address items such as Engineering errors, part qualification failure, Flight Test identified non-compliances, flight squawks, product improvements, manufacturing identified errors, and supplier quality escape issues. The methods and tools utilized to manage change in the midst of a flight test program also evolve over time but the same basic requirements remain from program to program.

For the GVI program, Gulfstream instituted a new Manufacturing Execution System (MES) called Solumina. This is a database application that allows for structured planning of production fabrication, assembly, and installation work plans along with appropriate Quality buyoff and inspection operations. The system keeps track of every step performed to build a GVI, by whom, when it was performed, and discrepancies and resolutions encountered in the process of implementation. Each work order or discrepancy is assigned a unique tracking number for each airplane tail number. Discrepancies in Solumina are known as DRDIs (Discrepancy Record/Discrepancy Item).

ECRs are initiated by Engineering with a defined effectivity. If the Test Fleet is affected, the incorporation date is established by reference to the Flight Test schedule. ECRs are approved by "Configuration Review Board" consisting of representatives of Program Management, Engineering, Manufacturing, Quality, Materials, and Flight Test. ECRs define how and when each change should be cut into the production flow and what TIA test would be affected. Flight Test maintains surveillance of these changes using an automated twice daily Cognos reports. Cognos is a database reporting tool which queries the Solumina databases for added work orders affecting a given aircraft tail number. These reports can also be run on demand and are stored in the following network location:

[redacted]

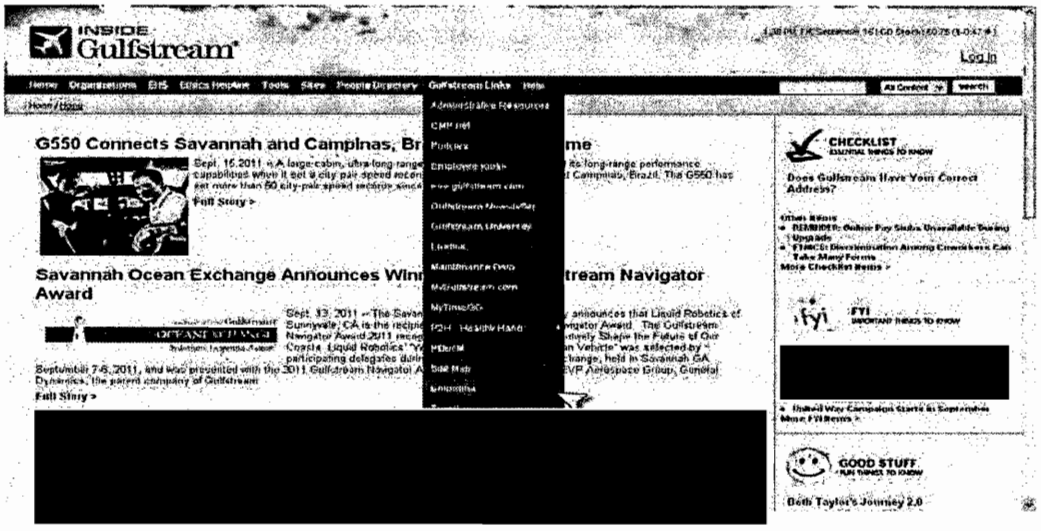


FIGURE 7– GULFSTREAM INTRANET TOP-LEVEL MENU SELECTION

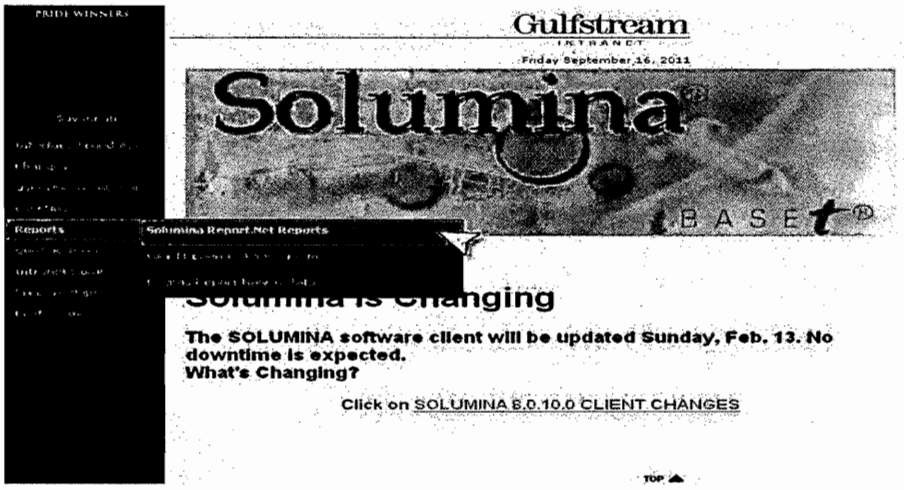


FIGURE 8 - GULFSTREAM INTRANET SOLUMINA LEVEL MENU SELECTION

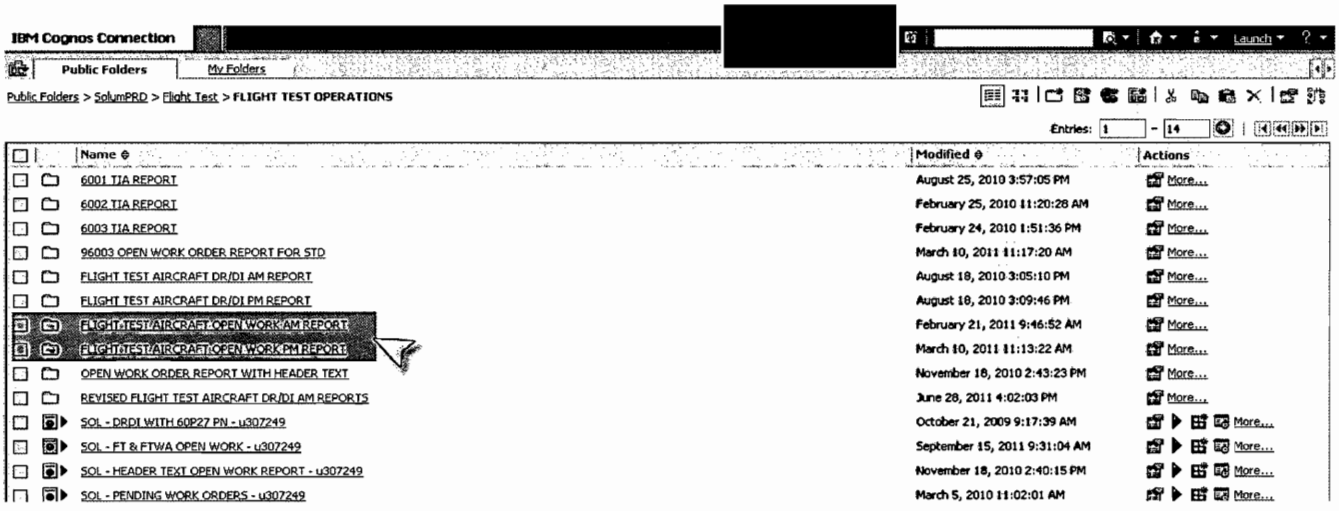


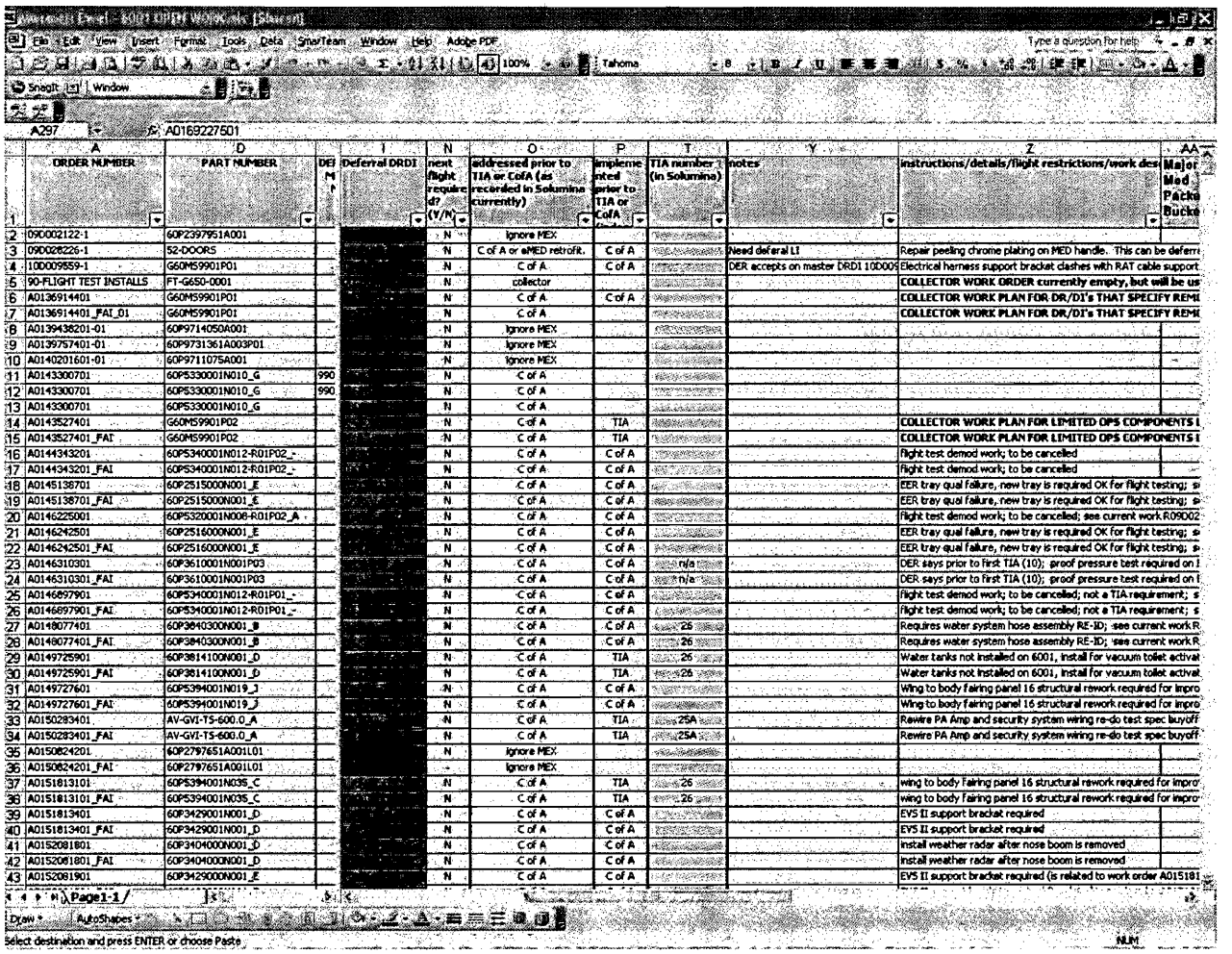
FIGURE 9 - COGNOS REPORT DIRECTORY SCREEN

From these Cognos reports, a manually produced and managed Excel spreadsheet is maintained which keeps a running list of open production work orders against each airplane tail number (see section 7.5). These reports are kept in the following locations for each GVI aircraft.(SN 6001 as an example).

[redacted]

Figure 10 presents a excerpt of the Open Work spreadsheet for SN 6001 as an example. The criterion for adding work orders to the Open Work spreadsheet is a fully authored and released order originating from the following sources of work order authors: DME (GVI Production Planning), and FTO (Flight Test Planning). Work orders with plant codes of MEX, PRD, and others are considered "backshop" sub-assembly issues that are not relevant to a particular tail number and if a tail number is indicated, it is assumed that the work order did not get bought off properly when the component was transferred to DME and installed on the aircraft.

Column "O" and T in the spreadsheet are particularly important as it provides a code of when the work order is to be implemented on the aircraft, and if the answer is TIA, then what TIA # is applicable. For example of the 1053 open work orders against 6001 as of Sept. 15,2011. 804 are declared "C of A" meaning that compliance is required prior to the issuance of the standard C of A. The remaining 249 work orders have a compliance requirement of TIA, prior to TIA, or at a specified maintenance interval requiring compliance to be scheduled during the Flight Test program before the noted TIA.



	A	D		I	N	O	P	T	Y	Z	AA
1	ORDER NUMBER	PART NUMBER	DEI M	Deferral DRDI	next flight required? (Y/N	addressed prior to TIA or CofA (as recorded in Solumina currently)	implemented prior to TIA or CofA	TIA number (in Solumina)	notes	instructions/details/flight restrictions/work desc	Major Mod Packa Bucke
2	090002122-1	60P2397951A001			N	Ignore MEX					
3	090028226-1	52-DOOR5			N	C of A or eMED retrofit.	C of A		Need deferal LI	Repair peeling chrome plating on MED handle. This can be deferr	
4	100009559-1	G60MS9901P01			N	C of A	C of A		DER accepts on master DRDI 10D005	Electrical harness support bracket clashes with RAT cable support	
5	90-FLIGHT TEST INSTALLS	FT-G650-0001			N	collector				COLLECTOR WORK ORDER currently empty, but will be us	
6	A0136914401	G60MS9901P01			N	C of A	C of A			COLLECTOR WORK PLAN FOR DR/DI's THAT SPECIFY REMI	
7	A0136914401_FAI_01	G60MS9901P01			N	C of A				COLLECTOR WORK PLAN FOR DR/DI's THAT SPECIFY REMI	
8	A0139438201-01	60P9714050A001			N	Ignore MEX					
9	A0139757401-01	60P9731361A003P01			N	Ignore MEX					
10	A0140201601-01	60P9711075A001			N	Ignore MEX					
11	A0143300701	60P5330001N010_G	990		N	C of A					
12	A0143300701	60P5330001N010_G	990		N	C of A					
13	A0143300701	60P5330001N010_G			N	C of A					
14	A0143527401	G60MS9901P02			N	C of A	TIA			COLLECTOR WORK PLAN FOR LIMITED OPS COMPONENTS L	
15	A0143527401_FAI	G60MS9901P02			N	C of A	TIA			COLLECTOR WORK PLAN FOR LIMITED OPS COMPONENTS L	
16	A0144343201	60P5340001N012-R01P02_-			N	C of A	C of A			flight test demod work; to be cancelled	
17	A0144343201_FAI	60P5340001N012-R01P02_-			N	C of A	C of A			flight test demod work; to be cancelled	
18	A0145138701	60P2515000N001_E			N	C of A	C of A			EER tray qual failure, new tray is required OK for flight testing; s	
19	A0145138701_FAI	60P2515000N001_E			N	C of A	C of A			EER tray qual failure, new tray is required OK for flight testing; s	
20	A0146225001	60P5320001N008-R01P02_A			N	C of A	C of A			flight test demod work; to be cancelled; see current work R09D02	
21	A0146242501	60P2516000N001_E			N	C of A	C of A			EER tray qual failure, new tray is required OK for flight testing; s	
22	A0146242501_FAI	60P2516000N001_E			N	C of A	C of A			EER tray qual failure, new tray is required OK for flight testing; s	
23	A0146310301	60P3610001N001P03			N	C of A	C of A	n/a		DER says prior to first TIA (10); proof pressure test required on I	
24	A0146310301_FAI	60P3610001N001P03			N	C of A	C of A	n/a		DER says prior to first TIA (10); proof pressure test required on I	
25	A0146897901	60P5340001N012-R01P01_-			N	C of A	C of A			flight test demod work; to be cancelled; not a TIA requirement; s	
26	A0146897901_FAI	60P5340001N012-R01P01_-			N	C of A	C of A			flight test demod work; to be cancelled; not a TIA requirement; s	
27	A0148077401	60P3840300N001_B			N	C of A	C of A	26		Requires water system hose assembly RE-ID; see current work R	
28	A0148077401_FAI	60P3840300N001_B			N	C of A	C of A	26		Requires water system hose assembly RE-ID; see current work R	
29	A0149725901	60P3814100N001_D			N	C of A	TIA	26		Water tanks not installed on 6001, install for vacuum toilet activat	
30	A0149725901_FAI	60P3814100N001_D			N	C of A	TIA	26		Water tanks not installed on 6001, install for vacuum toilet activat	
31	A0149727601	60P5394001N019_J			N	C of A	C of A			Wing to body fairing panel 16 structural rework required for impro	
32	A0149727601_FAI	60P5394001N019_J			N	C of A	C of A			Wing to body fairing panel 16 structural rework required for impro	
33	A0150283401	AV-GVI-TS-600.0_A			N	C of A	TIA	25A		Rewire PA Amp and security system wiring re-do test spec buyoff	
34	A0150283401_FAI	AV-GVI-TS-600.0_A			N	C of A	TIA	25A		Rewire PA Amp and security system wiring re-do test spec buyoff	
35	A0150824201	60P2797651A001L01			N	Ignore MEX					
36	A0150824201_FAI	60P2797651A001L01			-	Ignore MEX					
37	A0151813101	60P5394001N035_C			N	C of A	TIA	26		wing to body fairing panel 16 structural rework required for impro	
38	A0151813101_FAI	60P5394001N035_C			N	C of A	TIA	26		wing to body fairing panel 16 structural rework required for impro	
39	A0151813401	60P3429001N001_D			N	C of A	C of A			EV5 II support bracket required	
40	A0151813401_FAI	60P3429001N001_D			N	C of A	C of A			EV5 II support bracket required	
41	A0152081801	60P3404000N001_D			N	C of A	C of A			install weather radar after nose boom is removed	
42	A0152081801_FAI	60P3404000N001_D			N	C of A	C of A			install weather radar after nose boom is removed	
43	A0152081901	60P3429000N001_E			N	C of A	C of A			EV5 II support bracket required (is related to work order A015181	

FIGURE 10 - OPEN WORK SPREADSHEET ORDER SCREEN SHOT

7.2 Parts management (Figure 2 Ref 12)

Parts are received into the Flight Test "plant" using the same Material Inventory Control system that Production uses. Parts are delivered with Safety of Flight documentation in terms of a Certification of Conformity, an FAA Form 8130-9 tag or a Safety of Flight letter. A part without a SOF pedigree can only be installed on an aircraft if a "GROUND TEST ONLY" sticker is affixed to the component and the Solumina Work Order directing the installation of the sticker will also contain a "REMOVE BEFORE FLIGHT" operation requiring SOF paperwork documentation approval. This operation remains open until complied with which prevents Flight Release from being issued with an component that has not bee approved for flight. The inventory control system insures that the Aircraft components that are required to fulfill a given production work order are listed in the "Parts" tab of the work order as shown in Figure 13. The parts for a given work order are bundled into a tray and stored in the Flight Test material storage facility. In order to minimize the possibility of creating shortages in the system, Flight Test refrains from pulling on stocking work order parts until 7 days prior to the schedule installation start date. Planning for the needed parts is conducted in coordination with the Production Materials Group. A weekly planning meeting is held, whereby work orders schedule for incorporation several months in advance of the needed date, are reviewed part by part. If the delivery date for any part does not meet the installation need date, these parts are posted to a "shortage" list which receives a high degree of focused effort to expedite the part from the supplier or "canned" from an existing green aircraft and backfilled as required.

7.2.1 Shipping & Receiving Parts in Flight Test

Personnel responsible for maintaining/expediting parts for each shift have the responsibility to locate and deliver timely all parts to the plane captain or the designee assigned to each test aircraft. Personnel assigned to each shift will record in a shift-turnover the status of all parts. Personnel responsible for getting parts to flight test will contact the shift supervisor/foreman immediately when the status of a critical part has changed or is not expected to arrive on time. Names and numbers of Personnel in shipping and receiving will be posted in the Flight Test Operations so they can be contacted on any shift for emergency parts.

7.2.2 Stock Material

Stock material (defined by type design of the aircraft) is managed by the Materials organization. This includes the planning, acquisition (fabricated and purchased), shipping and receiving, stocking and inventory management for production material. This involves management of spares inventory, parts upgrades and parts obtained from production. For those parts obtained from production, close management is required to avoid exceeding exposing the part to greater than 30 flight hours. This is required to return a new part to production or ensure the financial consequences are addressed.

7.2.3 Conformed Material

Conformed Material are components that have received a conformity inspection and 8130-9 tag. These items are tracked in the stock control system so that they find their way to the correct airplane scheduled to perform the test involving that component. Engineering defines what components require conformity and place those items on a Request For Conformity. Generally speaking only newly defined components and assemblies get conformed, while TSO parts and components certified on previous Gulfstream installations do not. Before replacing any part or installing any new part on a test aircraft the Aircraft Coordinator and the Q.C. Inspector will check to see if a conformed part is required and verify that the 8130-9 Statement of Conformity tag is available A record of all conformed parts and serial numbers will be placed in the flight test operations work area, and maintained by a Q.C. Inspector.

7.2.4 Non-Stock Material

Non-Stock Material is anything not considered as stock. This material primarily consists of parts used for flight test instrumentation installations. This material also consists of specially configured "stock" parts that provide functionality needed for testing, which most often supports instrumentation system requirements or measurements. It is important to manage this material separately to mitigate unintended installations on aircraft outside of Flight Test Control. Some non-stock material related to sensors, and instrumentation wiring etc is planned, and acquired by Flight Test Instrumentation. The stocking and inventory control of non-stock material and non-stock parts will be the responsibility of the Flight Test Material Organization these non-stock items will be stored in a controlled area with limited access.

7.3 Instrumentation Design (Figure 2 Ref 13)

Designs for Flight Test unique or production modified components are developed using the same criteria as production components (safety factors, stress margins, edge distances etc) and are developed within the same design environments using CATIA for surface modeling and assemblies and released in Smarteam database application. Part numbering is governed by GER-7834 Gulfstream Part Numbering Requirements. Production parts which have been modified to accommodate instrumentation installations for the GVI program and that will remain installed and in service after the test program are assigned a number that begins with 60P and end with special identifiers. These designs are controlled by record E.O. models which limit installations to aircraft used for Flight Test only. Non-production GVI parts that are used to support the installation of instrumentation or special Flight Test installations are assigned a part number beginning with 60E. The design of these parts is described in Flight Test Instrumentation Engineering Standard Operating Procedures. 60P designs are performed using Catia v5 and approved through the same workflow approval process used for standard production parts. These workflows are managed in Smarteam data management

system. 60E designs utilize streamlined work flow approval procedures. Designs are then translated into Solumina work orders required to fabricate the components. These parts are routed to internal Gulfstream manufacturing resources or to outside 3rd party groups for fabrication. Once these parts are delivered they are stocked in the Flight Test Materials storage facility. 60E pars are removed from the aircraft before it receives its standard Certificate of Airworthiness (C of A).

7.4 Modification Package (Figure 2 Ref 14)

The modifications package is a strategic planning document that lists Solumina and FTWA work order numbers that will be incorporated into a given aircraft modification period. They are normally organized by TIA number and stored in the following location (example given is SN 6001):

[redacted]

This spreadsheet breaks down work orders into a greater detail by listing the number of operations for a given work order. This can vary from one operation to several hundred depending upon the complexity of the work order in question. As operations are completed over time, individual operations are checked off as complete and total completion percentage can be computed as a means to measure progress during a modification period. Figure 12 presents a typical tracking burn down chart that compares remaining deferred operations vs. date. The Modification package task list is transferred to the Coordinator's Daily Plan to identify the specific priorities on a per-shift basis.

	A	B	C	D	L	M	N	O
1			6001 Planned Aircraft Upgrade Program					
2	Coordinators Work Item	Install Description	Model # / Solumina WO #	Priority	Operations Total	Oper Closed	% Complete	Notes
706			Total Work Orders/Remaining Ops	COUNTA	57	7	7	Total Operations Remaining
707								
708			R11D016457-1					
709								
710								
711								
712		***Open Work Required for TIA 7/7B (FP, Brakes, TRs, NWS)***						
713		Install nose landing gear control manifold 60P3230030Z002. Work is completed on ai	A0152082101	1	12	12	100%	
714		INSTALL (2) 60P3244030Z002 HYD SHUTTLE VALVES PER 60P3244200N001 B EFF, 6	A0157863001	1	11	11	100%	
715		Replace LH outboard brake accumulator,valves with 60P3244190Z002 units; work in	A0160322901	2	7	7	100%	
716		REWORK - CABLE INSTL - EMERGENCY CONTROL (WORK ORDER SHOULD BE CANCI	A0166053901	2	6	0	0%	
717		REWORK - COMPONENT INSTL- VALVE, PARK BRAKE CONTROL 60P3248010Z002	A0166112001	2	11	0	0%	
718		Installs Universal CVR/FDR cockpit control unit in REER	A0169228301	2	5	0	0%	This is complete, buyoff only
719		Upgrade LH MLG Dressed Assembly to 60P3212010A007.	A0174324001	2	54	0	0%	Upgrade CWSIU and MRPSAs to Z003
720		Upgrade LH MLG Dressed Assembly to 60P3212011A007	A0174468801	2	54	0	0%	Upgrade CWSIU and MRPSAs to Z003
721		CRB 621974 Parking Brake Handle p/n roll to 60P3248023Z002 (currently Z001) effe	A0179684001	2	7	0	0%	
722		Brake red X's when hydraulic servicing the L reservoir during engine power assurance	R09D026913-3	2	1	1	100%	
723		REER circuit breaker panel overlay re-work required.	R10D010229-1	2	1	0	0%	Added TIA 7 due to TIA pre-req sheet top level install list
724		CRB 614053ABA WIRE MOVE ISSUE - Swap wires for LH Inbd and Outbd brake temp	R10D020644-1	2	3	3	100%	
725		CRB 613790 add HUD Personality moduel to EER	R10D031292-1	2	1	0	0%	Added TIA 7 due to TIA pre-req sheet top level install list
726		RED LINE ISSUES GVI-TS-3204, Rev G, section 4.3 requires to be compiled with	R10D031693-2	2	1	0	0%	
727		Install NLG Assembly Rebuilt GLG 0001 (-3 Motor, Z002 NPRSA, Harness upgrade)	11D013911	2	3	0	0%	
728		All 4 sets of brakes required to be removed to have milled down and thermocoples re	R11D016443-1	2	2	0	0%	
729		NWS tiller -4 Installation	TBD	2	TBD	TBD		
730		Upgrade TRAS on both TRUs	TBD	2	TBD	TBD		
731		**NOTE: 709 Previously deferred WO's still need to be reviewed for TIA 7 a**	TBD	2	TBD	TBD		
732								
733		***TIA 7***	Total Operations / Open Ops	SUM	179	34	19%	Total Operations % Complete
734			Total Work Orders/Remaining Ops	COUNTA	19	14	145	Total Operations Remaining
735								
736								
737		***Open Work Required for TIA 11 (FCS)***						
738		Install new fasteners in the canopy assembly per ECR-615715 AND ECR-615830	A0161915001	1	10	10	100%	
739		~~HARNESS INSTALLATION - LEER~~	~~A0173264401~~	~~1~~	0	0	#DIV/0!	172 operations deferred to C of A by 11D012329
740		~~HARNESS INSTALLATION - R EER~~	~~A0173264801~~	~~1~~	0	0	#DIV/0!	196 operations deferred to C of A by 11D012395
741		Uninstall wiring work around (60P3313129W, 60P3312130W and 60P3312131W) dis	R09D018336-1	2	3	3	100%	
742		Uninstall wiring work around (60P3313129W, 60P3312130W and 60P3312131W) dis	R09D018336-2	2	2	2	100%	
743		Logic for FDR system fail CAS message incorrect. Upgrade Planeview software 631	R09D019826-1	2	2	2	100%	In-work
744		Production test spec squawk: Internal baggage door CAS message inop. Requires H	R09D021548-1	2	2	2	100%	Ref 09D021548 Cannot comply, egress rope prevents closure
745		Production test spec squawk: MCDU/FMS synchronization inop. Requires Honeywell	R09D021549-1	2	2	2	100%	

V2 Audit | NLG Assembly | MFP 2 be | Prospective Schedule | Milestones | 6001 Planned Aircraft Upgrades

FIGURE 11 - MODIFICATION PACKAGE SPREADSHEET SCREEN SHOT

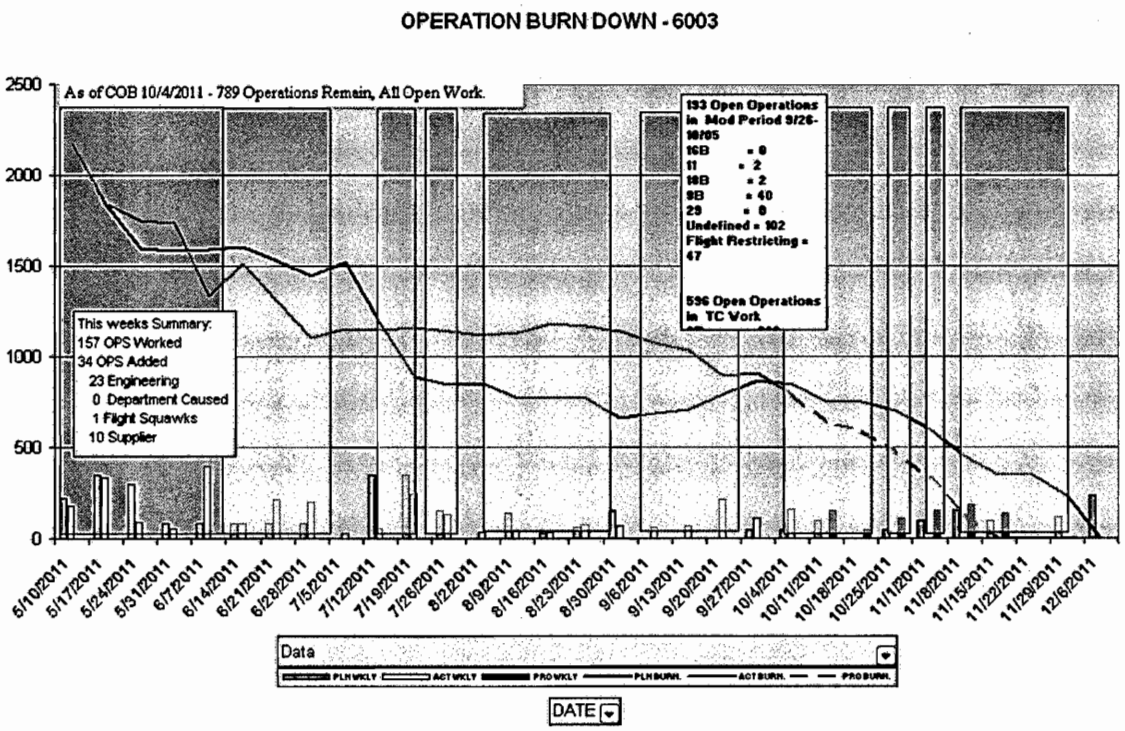


FIGURE 12 - DEFERRED WORK ORDER OPERATION BURN DOWN

7.5 Production Work Orders (Figure 2 Ref 15)

For the GVI program, Flight Test personnel maintain surveillance of all approved and pending changes affecting Flight Test aircraft. This data is stored in Excel spreadsheets located in the following network directory. Each airplane has its own file (the example shown is for GVI SN 6004).

[redacted]

Every work order in Solumina is reviewed and assigned a deferral state identifying an appropriate TIA #, inspection interval, flight number or planned modification period. If the work order does not contain deferral instructions, then it is assumed to be the next flight, or, a second DI is written to request clarification. Solumina DIs pass through specific maturity gates enroute to becoming a re-work order.

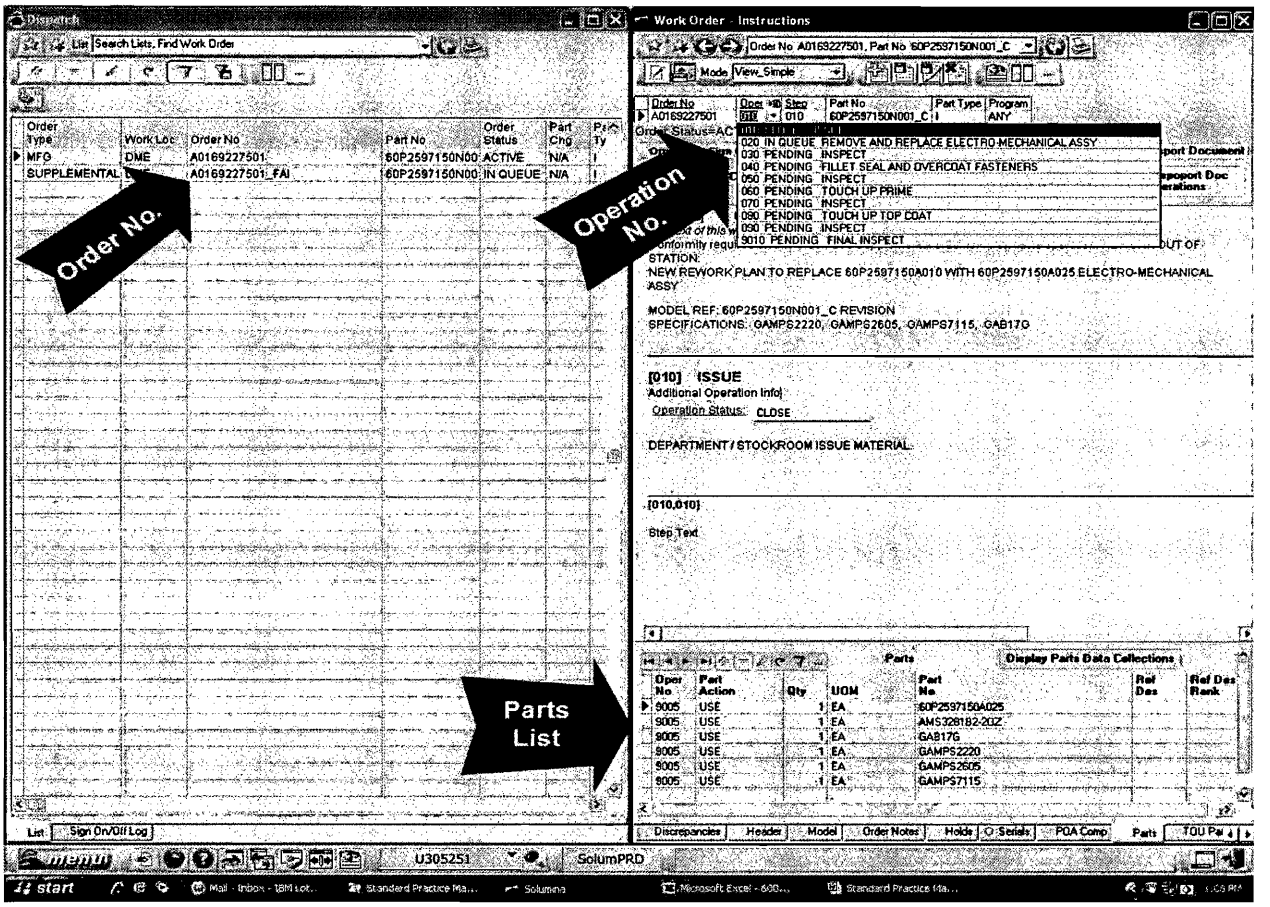


FIGURE 13 - SOUMINA WORK ORDER SCREEN SHOT

7.5.1 Configuration Change Effect Process

The FAA has a specific requirement to document that evolving Engineering Change Requests (ECRs) do not invalidate previously booked certification test results performed under Type Inspection Authorization (TIA). This process has evolved from specific form to database entry. Figure 14 shows a screen shot of the ECR database with Configuration Change Effect identified circled. This is labeled as "Impact to Configuration Testing YES or NO". After the start of TIA testing, every approved ECR must have this box checked as a condition of the ECR approval. The analysis behind this check is for the ECR design engineer sponsor reviewing completed TIA tests with the appropriate DER and Flight Test Engineer. If there is a case that would affect TIA results, the requirement is for the ECR sponsor to coordinate with the Chief Engineer, Program Manager, and Flight Test to get approval and have the affected TIA results scheduled for repeat. These details are entered in the "Notes" field of the database. The ECR database can produce a report that lists all approved ECRs along with the field result of the Impact to Certification Testing block.

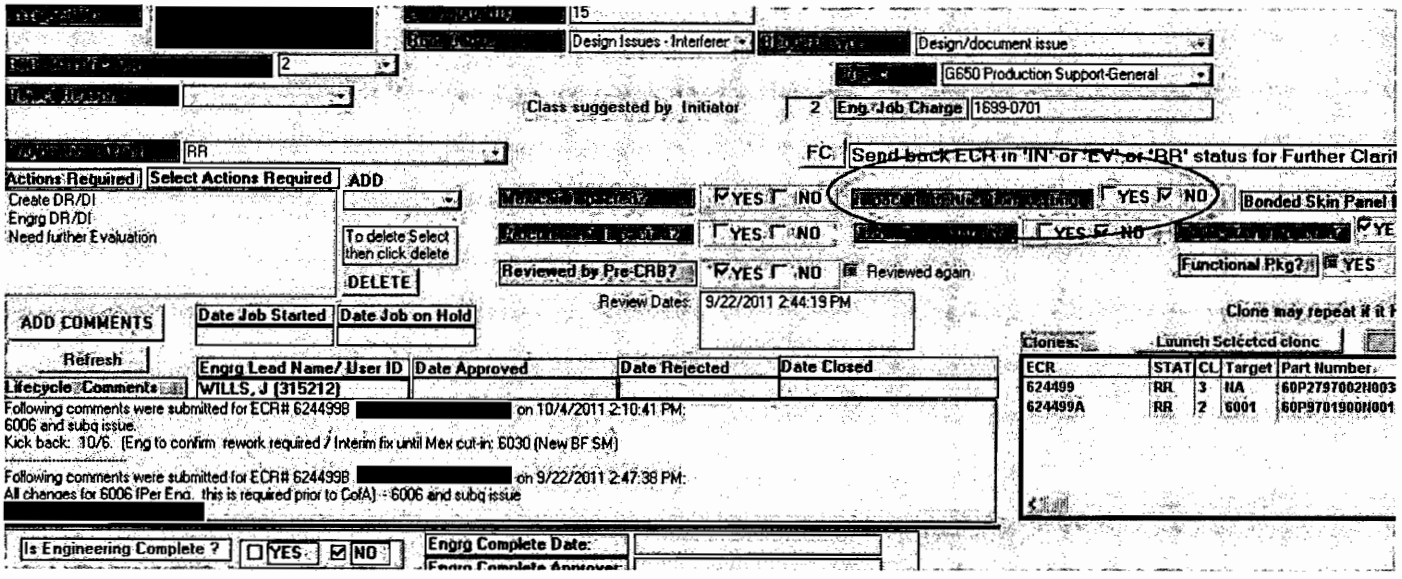


FIGURE 14 – ECR DATABASE SCREEN SHOT

7.6 Flight Test Work Order (FTWA) (Figure 2 Ref 16)

Flight Test Work Orders (FTWA's) are similar to Production Work Orders. In the case of GVI they are both authored in the same Solumina database, and for legacy programs are authored in Foxpro database program. The responsible party for FTWAs is the Aircraft Coordinator for the installation of aircraft components not covered by Production orders (such as software loads, supplier maintenance actions, inspection and maintenance intervals etc.), and the Aircraft Instrumentation Lead for the installation of Flight Test specific components such as racks, computer work stations, sensors and related wiring. Each FTWA has a Flight Number effectivity associated with it that specifies when the modification is to be performed. This effectivity is the equivalent of a TIA deferral statement in a production work order. Detailed instructions for the authoring of FTWAs can be found the Flight Test Instrumentation Standard Operating Procedure document A summary of each airplane's FTWAs is kept in an Excel spreadsheet in the following network directory:

[redacted]

7.6.1 Hardware/Software Control Procedures

The Flight Test program will use flight test specific Software Control Drawing (SWCD) to control the Line-Replaceable Unit (LRU) components containing upgradeable software for each of the test aircraft in the program. For the GVI program, Solumina production work orders and ECRs do not define software levels, therefore FTWAs are used to authorize software loads. The production SWCD (60PSWCD001) must first list the software as approved for installation and safe for flight before FTWAs are released for R&D flights. Prior to each Type Inspection Authorization (TIA) test flight and as part of the conformity process, specific test aircraft Software Control Drawings (60TSWCD00x Rev x) must be released and DER approved, to which conformity inspection will be performed to.

It is permissible to load software in advance of the Safety for Flight statement from the cognizant engineering group and release letter being issued (see section 7.6.1.2 step 3). However prior to closing that FTWA and issuing the flight release, these documents must be in place along with the 60PSWCD drawing revision. The following process documents step by step process approving upgrades to the Flight Test aircraft.

7.6.1.1 Supplier and Engineering Flight Release

1. The supplier of the updated hardware and/or software provides Gulfstream with SOF documentation in the form of a TCM. This documentation contains a test summary that provides assurance that the software is mature and tested to be safe for operation of Gulfstream flight test aircraft.; Along with this SOF TCM is a listing of the known issues with that version of hardware and/or software.
2. The updated hardware and or software component is installed in the GVI ITF where Gulfstream Engineering performs the required SOF ITPs and documents results.
3. Results of ITPs are reviewed to determine pass/fail of the test points required to achieve SOF for that hardware/software component. (3a) Any issues that are classified as must fix (severity 2 PR) will resul in a software update from the supplier, this starting the process over at step 1.
4. If Iron Bird (IB) testing is required, this will take place in the Gulfstream ADRL G650 Iron Bird test facility where the required SOF test procedures are performed. If IB testing is not required, the process goes to step 7, Engineering generation of SOF documentation for Flight Test.
5. The SOF required Iron Bird test procedures are performed on the identified hardware/software configuration with results documented.
6. Results of the IB tests are reviewed to determine pass/fail of the test points required to achieve SOF for that hardware/software update from the supplier, thus starting the process over at step 1.
7. Following successful completion of the IB testing and results review, Gulfstream Engineering generates and releases SOF documentation.
8. Engineering organizes a briefing with Flight Operations and Flight Test to review the results of the ITF and/or IB testing, known issues, any new issues, and the configuration changes required on the airplane for the required hardware and/or software update.

7.6.1.2 Flight Test Configuration Change

1. Flight Test and Flight Operations approves the configuration change for installation on the specified test aircraft.
2. Verification step to ensure that all of the SOF documentation has been provided to flight test to support the configuration change. (10a) If the SOF documentation is not yet available, the Lead FTE or Cognizant FTE for the target flight test airplane can approve or deny the installation on the airplane for ground test only.
3. Verification step to ensure 60PSWC document is released as this is the released engineering that approves the configuration and provides SOF assurance to support installation on the target aircraft. (11a) If the 60PSWC is not yet released, a DRDI tagged GROUND TEST ONLY, NOT FOR FLIGHT can be used with Lead/COG FTE approval for getting the software loaded on the airplane for early checkouts.
4. Flight Test is notified by Engineering that the 60PSWC has been released, this clearing the action for the FTWA to be issued to make the configuration change.
5. The Lead FTE or COG FTE directs the Aircraft coordinator to issue a FTWA to install the hardware and/or software components that have been addes to the 60PSWC as an approved configuration for the flight test aircraft.
6. The configuration change is performed on the airplane based on the direction in the FTWA. The Lead FTE or COG FTE is notified that this work has been accomplished on the airplane.
7. Return to service test specification are performed in accordance to the disposition in the FTWA to ensure the integrated systems in the airplane are operating as required following the configuration change.

8. If Gauntlet testing is not required, go to step 17. If Gauntlet testing is required to be performed on the aircraft, a series of abnormal and/or endurance tests are conducted by Flight Test and Flight Operations. (16a) If there are failures during the Gauntlet testing that require a must fix, a severity 1 PR is created.
9. This is a verification step after successful completion of Gauntlet or if Gauntlet is not required. This is in place to ensure the 60PSWC is released to provide SOF for the case where the DRDI "GROUND TEST ONLY, NOT FOR FLIGHT" was used to install the hardware and/or software update.
10. The Lead FTE or COG FTE is responsible for submitting the change to Engineering in the form of the SWC update request. This is used by Engineering to determine what Flight Test has changed on the target aircraft so an update can be made to the 60TSWC (aircraft unique) and released. (18a) Engineering uses the information from Flight Test to release the 60TSWC on a weekly basis or before a TIA conformity event. It the specific airplane 60TSWC that receives a FAA form 8110-3 (DERs) or 8100-9 (ODA ARs)

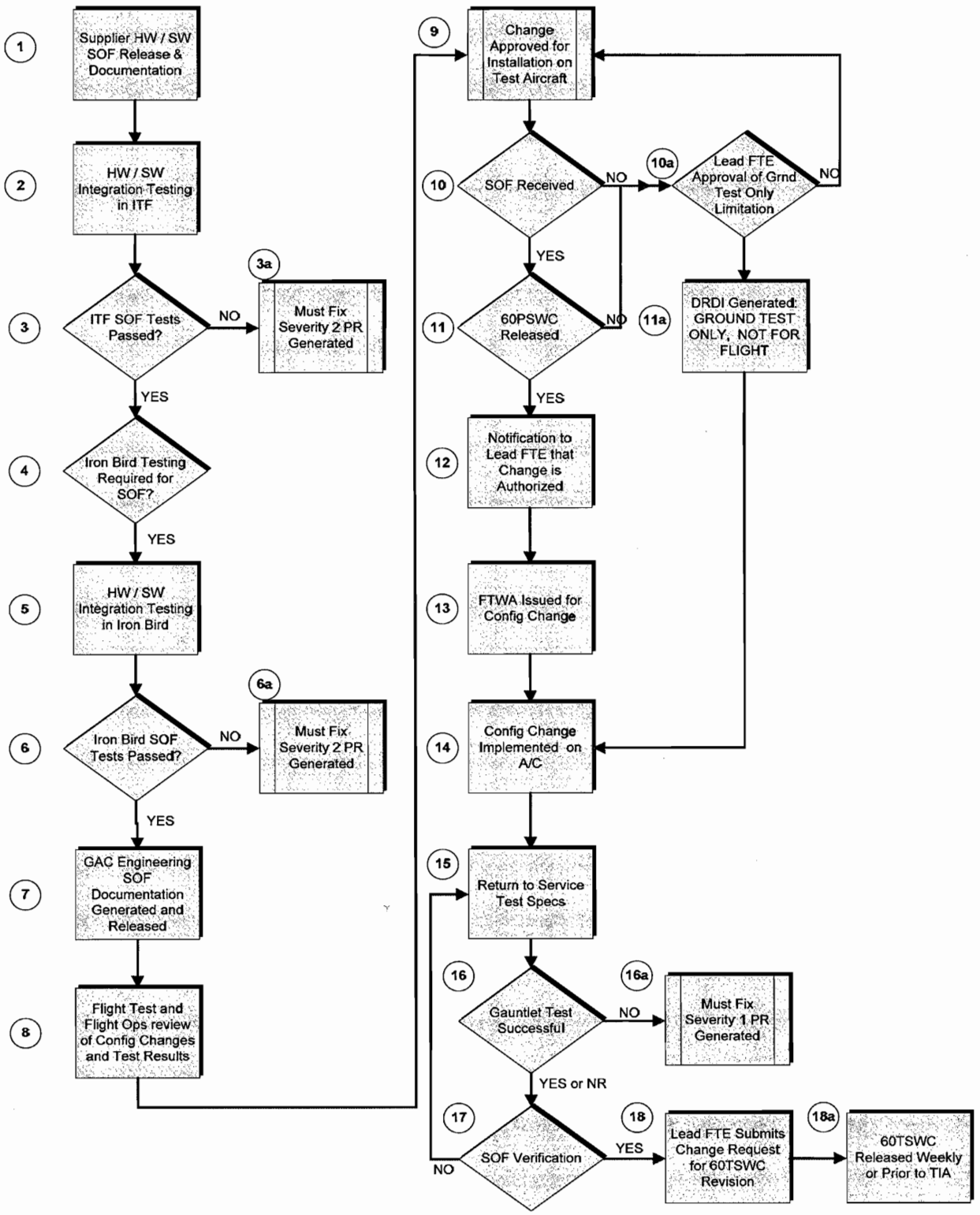


FIGURE 15 – HARDWARE / SOFTWARE CONTROL PROCESS

7.7 Coordinators Daily Plan (Figure 2 Ref 17)

The Aircraft Coordinators shall maintain a daily work plan for each assigned test aircraft (see example below). This should identify the Production Work Order, FTWAs and maintenance tasks to be performed in the upcoming shifts to support the test schedule. This list is to be reviewed at shift change meetings to clarify the tasks and priorities as work transitions from one shift to another. The Coordinator's Daily Plan spreadsheets are kept in the following network location:

[redacted]

ID	Task	Pre Fl	Gro	Part Stat	Work Stat	Reference	Comments	Work Date
1806	CMP September Due List	264	A, M		☐		24 Month MLG Corrosion, LDG Alternate Extension Ops Check, Hydraulic Manifold Filter Exchange; CMP code 323917, 321052, 321053, 291449, 291514	09/25/11
1849	Secure Rolls-Royce EMS Rack	264	I, M	—				09/27/11
[redacted]	AFT Equipment Area Missing Fasteners	264	M	—	☐	11D039511		09/27/11
1853	FQMS NVM download	264	A	—			Non Volatile Memory (NVM) download for Steve Bruce, requires 28 volt power	09/29/11
[redacted]	Defuel to 3,200 lbs	264	I	—			Keep boost pumps on during defueling and transport to hangar 10	09/28/11
1767	Harness Inspection Station 476	265	A, M	—	☐	11D028663-2	Inspection required every (3) days. DUE 9/25/11	09/25/11
1731	Leading Edge Rivet Inspection	265	M	—		10D027301	Every flight	TBD
1759	Flap "D" Track Inspection	265	M	—		11D008931-21	Every flight	TBD
1825	LH Wing TE Flap Track "A" Hat	265	M			11D039002-3	Daily inspection requirement of damaged area	TBD
1852	MLG SBA Spindle Bushing Blend	266	M	☐		11D041034-1	Engineering to disposition blending of bushing to allow for fly-on for a maximum of 10 flights	
1842	Replace Left MLG Post Side Brace Actuator Bushing	273	M	☐	☐	11D040471	Awaiting Bushing, PN C1M5303CA001, ordered 26 Sep. DOD 29 Sep 11	09/29/11
1730	Elevator backlash check	273	A, M	—		09D017940		TBD
1714	FQMS Degrade msg	999	A	☐		11D022972-4	Have parts for left side only. Complete work when parts for right side arrive	TBD
1698	HSTAB Actuator Tie-Rod Trigger Lock Inspection CMP 059246	350 hrs	M	—		11D009668; CMP code 059246	HSTAB Tie-Rod Trigger Lock Inspection Procedures. Due next mod period	TBD
1538	No Localizer Displayed in HUD	TIA 18E	A	—		11D011242-4	Comply with Engineering disposition, condition still exists. Engineering assistance requested	TBD

FIGURE 16 - COORDINATORS DAILY PLAN SCREEN SHOT

8.0 PHASE IV: AIRPLANE MODIFICATION

The Airplane Modification phase of the process implements the configuration changes to the test aircraft as defined in the test planning process. This requires close coordination amongst the flight test team and adherence to configuration management processes.

8.1 Shift Turnover Coordination Meetings (Figure 2 Ref 18)

Shift turnover meetings shall be held to coordinate maintenance and instrumentation work in progress that is transferring to the next shift to support the next days test activities. Attendance at the meeting shall include aircraft and shift leads from both maintenance and instrumentation and the coordinators facilitate the discussion on the Daily Plan (ref Para 7.7), aircraft status and work to be accomplished on the upcoming shift.

8.2 Airplane Mechanical/Electrical/CMP (Figure 2 Ref 19-20)

Airplane touch labor is divided into Maintenance Action (scheduled and unscheduled maintenance), and Modification Action (Configuration upgrades to support a test). Scheduled maintenance action is tracked by the Computer Maintenance Program (CMP) and performed per the requirements of the Airplane Maintenance Manual (AMM) for each tail number. Scheduled maintenance items have predefined and approved ± hour and/or cycle windows in which to perform the work. Any item exceeding the + tolerance of the window is defined as "overdue". The FT maintenance group monitors the status of the items and performs the work as required. Flight Release forms are signed after all outstanding overdue maintenance items are completed, unless the item is entered as a discrepancy in Solumina and receives Engineering disposition. Unscheduled maintenance items are entered as discrepancies and receive Engineering disposition to reaffirm the AMM action or modify it as necessary. The disposition defines the terms of deferability, if any. The maintenance status of the aircraft is communicated to flight crew during the pre-flight briefing and the crew must agree to accept the aircraft as presented or request that any particular deferred maintenance item be resolved prior to flight.

Configuration changes are implemented as defined by the Aircraft Test Coordinator using an approved Solumina Work Order and/or Flight Test Work Authorization. It is the responsibility of maintenance personnel to ensure all work is installed in accordance with referenced drawings and proper documentation. It is important to confirm that conformed parts are installed on systems that are to be TIA tested. Maintenance personnel complying with the work instructions are to provide required information in the work order to support documenting completion, transitioning of open work to other personnel and supporting subsequent inspection activity and work order closing.

The following items are standard departmental procedures for working and closing FTWAs. Note that G650 FTWAs are paperless and stored in Solumina, while legacy aircraft FTWAs are managed in Foxpro Database and using official paper copies.

- The maintenance personnel performing the task shall initial, date and provide employee number legibly in the appropriate block after the work item has been completed. Before proceeding to the next task, maintenance personnel shall coordinate thru the Lead or Supervisor to obtain appropriate inspections by a Quality Control Inspector
- For those circumstances when maintenance personnel begin work on an item that has been started by another person, the individual beginning the work must be able to determine the status of the installation (verbal review or thru documentation) to ensure proper completion of the work item and final buy-off.
- Maintenance Leads shall keep abreast of all work performed on their assigned aircraft at all times.
- Every item of an issued FTWA shall be closed before the FTWA is removed from the Maintenance Lead's folder
- No person can remove the original FTWA from a folder without prior permission from the Maintenance Lead. Before the original FTWA is removed from the folder, a sheet of paper will be placed in the folder in the same sequence for the original, including the name of the person and date/time the original was removed. The Maintenance Lead can assign anyone to make a copy of a FTWA. After the working copies have been made the ORIGINAL MUST BE RETURNED TO THE PLANE CAPTAIN FOLDER and the sheet of paper w/info discarded.
- Person(s) assigned to configuration control may permanently remove Original FTWAs after they have been closed to update the FTWA database, and file the original closed FTWAs are stored in Flight Test records area and copies are scanned and maintain with the aircraft's records in the Q.C. area.

8.3 Instrumentation Installations (Figure 2 Ref 21)

Instrumentation configuration changes are also implemented as defined by the Aircraft Test Coordinator using approved Solumina (GVI) or Paper (Legacy aircraft) FTWAs. The FTIE is responsible for authoring the FTWA in accordance with the engineering requirements of the instrumentation drawing or model (60E drawing

numbers in the case of GVI). Flight Test Instrumentation Technicians will handle back shop build and applications of sensors and coordinate their calibration prior to installation (such as strain gages etc). These technicians will then oversee the installation of instrumented components onto the aircraft by aircraft mechanics. Wiring and data system hook up and checkout will also be performed by the instrumentation technicians under the guidance of FTIEs.

8.4 Weight and Balance (Figure 2 Ref 22)

Flight Test aircraft Weight and Balance is performed according to approved Weight and Balance manuals for individual airplane models which can be found on the company intranet site at the following link:

[redacted]

The FTE defines the requirement for a test mission's W&B and the aircraft coordinator performs the calculations to define the ballast configuration to achieve the requirements. These calculations are performed using the following W&B Forms which are approved and controlled at the start of an aircraft's test program:

- Form A Computed / Actual Empty Weight and Balance
- Form C Basic Weight and C.G. Log
- Form D Flight Loading Computation

In advance of ballasting to a required W&B condition, the FTE and Aircraft Coordinator shall coordinate the requirements with FTIE Mechanical Designers to ensure an approved floor plan model exists or will be released to provide engineering approval for the configuration. Depending on the nature of the requirements, this can require long-lead times for floor-loading analysis by Stress and identification and incorporation for any structural enhancements to achieve the extremes of the envelope.

In order to maintain accurate control of weight and CG, a test aircraft shall be weighed, in cooperation with the Engineering Mass Properties group, under the following conditions:

- When an aircraft is inducted into flight test for a test program requiring operations near or at the W&B limits
- After completing an extensive modification where W&B may have been appreciably changed
- After initial ballast loadings at the W&B limits
- After a prolonged period of time where multiple changes to W&B have been calculated
- Anytime there is uncertainty of loadings that may exceed a limit.

The W&B forms are to be stored along with each mission's test cards. For the GVI program, these are contained in the Flight Records folder on in the following network directory location:

[redacted]

8.5 Removal and Installation Log (Figure 2 Ref 23)

The Removal Installation Logs (R/I Logs) provide a record of all production parts that are removed and installed on flight test aircraft. R/I records are recorded on Form GA 0017 and governed by the Production Quality Assurance Manual. The R/I Log must be maintained as the work proceeds on a test aircraft. The R/I Log (manual record) is on file at the aircraft work station and is maintained by technicians, and all work is inspected by the Q.C. Inspector. Electronic summary files are kept in Excel format are kept in the following network directory location:

[redacted]

[redacted]

8.6 Return to Service Testing (Figure 2 Ref 24)

Return to service functional test requirements are determined by Engineering based on the extent of maintenance work performed. If instructions are not provided by the work order implementing the maintenance being performed, than Maintenance personnel will generate a discrepancy for Engineering to disposition with definition of required functional tests.

8.7 Instrumentation and Airplane Pre-Flight Inspection / Flight Release (Figure 2 Ref 25)

8.7.1 Data System Pre-Flight

Flight Test Instrumentation Engineers (FTIEs) are responsible for ensuring the aircraft's data system is prepared to record all necessary parameters to support scheduled testing. They will confirm the test numbers with the Aircraft Coordinators, and convey such information to the Techs as needed.

Flight Test Instrumentation Techs (Techs) will boot the data system, input information pertinent to the day's tests, and verify data system operation prior to the start of testing. Data system pre-flight checklist will be completed and provided to Q.C. personnel to support issuance of the Flight Release.

8.7.2 Aircraft Pre-Flight

Aircraft Preflight inspections are complied with by maintenance/Q.C. personnel for aircraft checks in accordance with the Production QA Manual. For test aircraft, these procedures may be tailored to address specific points of interest as defined by Engineering and documented in Quality Assurance traveler forms.

Subsequent to completing the maintenance preflight, Inspection approves the preflight and signs the Flight Release (Quality Instruction 9.1.4 and Form GA 0542). The form is filed with aircraft records retention. Signature of the Flight Release indicates that the airplane is declared airworthy per 14 CFR Part 43.7. See Quality Manual Section for 9.1.4.

9.0 PHASE V: TEST EXECUTION

The test execution phase of the process includes the preparation of test cards, conducting pre-flight briefings, performing the test mission, post-flight briefs, post-flight inspection and results reporting.

9.1 Test Cards (Figure 2 Ref 26)

Test Cards are prepared by the FTE in charge of that test phase testing in reference to the governing Flight Test Plan. Every test flight shall require a planned set of tests documented in a test card format that adheres to the standard defined in Appendix A. The format will include the following basic data:

- **BLOCK A:** Test Card Identification Block – includes SN, Flight No., Test Card No., Title, Test Point No. Configuration set up summary, and Notes
- **BLOCK B:** Procedure Block – includes Run No., step-by-step procedure for the pilot to perform the test, abort criteria, and test point acceptance criteria
- **BLOCK C:** Observation Notes, including time when procedures begin and end

In addition, the test card will include details of the specific configuration of the aircraft required for the test point in question. These details will be sufficient such that the test card can be executed without reference to other documentation. The test card will also include a brief description of the test point and, if required, the phases of the test. Finally, the test card will include space for UTC time referenced comments by the executing Flight Test Engineer, and certifying authorities as necessary.

The coversheet for the flight test cards is reviewed and signed by the FTE executing the test (signifying the cards conform to the requirements of the Flight Test Plan, applicable TSHAs, IFRs and AFM), the Pilot-in-Command (acknowledging procedures, techniques, configuration, and risk level classification), and Aircraft Coordinator (signifying that the aircraft configuration is appropriate for the test being performed). Test cards for all completed test missions are located in the following network directory location:

[redacted]

9.1.1 Ground Run / Flight Numbering System

In accordance with standard Flight Test practice, any test for which data are to be preserved will have a test number assigned to it. Test numbers will be designated as Flight or Ground as follows:

Flight Numbering enumerate the test flights, and are three-digit entities (padded with leading zeros if needed, e.g., "023") until such time as four digits are required.

Flight numbers designate test flights, indicating that the aircraft has left the ground at least once. A planned flight that does not result in a takeoff will become a Ground Test, and will be assigned a Ground Test number as described below.

The Flight number is incremented when both engines are shut down following a landing, unless the shutdown is a planned part of the test (e.g., on the ground prior to or after flight), or if engines are cycled to clear maintenance faults in a continuous run of data.

Ground Test Numbers: are expressed in a 'three-plus-two' format, the three-digit flight number and a two-digit ground run number separated by a lowercase character (e.g., "023g01"). The ground run number is padded with a leading zero if needed.

- The Flight number integral to the Ground Test number represents the upcoming Flight number for the aircraft.
- The two-digit ground run number increments for every Ground Test performed.
- The lowercase letter that separates the three-digit flight number and the two-digit ground run number is either "g" ('ground test') or "m" ('maintenance').
- "g" indicates a Ground Test whose information is to be preserved.
- "m" indicates that the data system was brought up for configuration or evaluation purposes, with no expectation that the data will be kept or Flight Notes taken down. The two-digit run number should be the same number as would have been used for an actual ground test.

(Note: In the event that a decision is subsequently made to preserve the maintenance data, the "m" will change to a "g" and the test will be recorded as an official Ground Test. Tests bearing the "m" designation will otherwise have no effect on the Ground Test numbering system and can be reused at will.)

Valid Ground Tests do not require that digital data be recorded. This can occur when tests are purely qualitative in nature, or when the FTE's observations and notes suffice to satisfy a given test's requirements. These test notes will be included in the Flight Records books, and thus require a suitable Ground Test number to identify them.

Ground Test numbers should be incremented as often as needed during testing. Some examples of when it might be desirable to increment the test number are

- Any time the data system is commanded to shut down, other than for data system trouble-shooting activities
- When the fundamental nature of the tests being performed changes, or a significant phase of testing is completed
- Whenever there is a significant break in testing that sensibly suggests a pause in data recording (an expected period of inactivity exceeding fifteen minutes, as a suggestion)

The Flight Notes should clearly indicate any time the Ground Test number changes. The FTE will inform the Aircraft Coordinator whenever he has used Ground Test numbers that will affect the published near-term schedule.

Responsibilities

Aircraft Coordinators (AC) are responsible for coordinating test numbers within the Flight Test organization. They will publish anticipated test numbers as part of the near-term schedule. ACs will communicate to the FTIEs if data system operation is not required for upcoming tests, with the default condition being that test data are to be recorded.

Flight Test Engineers (FTEs) conduct tests onboard the test vehicle, adhering (as practical) to the test numbers specified on the near-term schedule. If data system operation is not needed for a given test the FTE will make that clear to the Aircraft Coordinator prior to testing, otherwise it will be assumed that the data system will record data for preservation.

The FTE should verify test numbers with that aircraft's Coordinator at the start of testing. The FTE may increment Ground Test numbers as deemed appropriate during testing, and is responsible for noting these test number changes as part of their Flight Notes.

If the FTE's use of Ground Test numbers affects the published near-term schedule, the FTE must communicate the final Ground Test number used to the Aircraft Coordinators. If an interactive dialog with that aircraft's Coordinator is not achieved, an email must be sent to all Aircraft Coordinators to ensure that any stand-in Coordinator is informed.

9.2 Flight Card Deck

The flight card deck consists of a cover sheet, applicable IFRs, THSAs, Weight and Balance, plus the test cards.

9.2.1 Cover Sheets (Figure 2 Ref 27)

Every test card package will contain a cover sheet that summarizes the most relevant information pertaining to a given test flight. The cover sheet is organized into blocks, the content of which are summarized as follows:

- **BLOCK A :** Flight Reference sections lists registration and SN, Flight number, flight date, weight, CG, Fuel Load, and quick reference AFM speeds.
- **BLOCK B:** Configuration Summary lists the most relevant major items constituting the configuration of the airplane directly related to the test mission.
- **BLOCK C:** Limitation and Restrictions in addition to the AFM limitations sections (ie relevant IFRs)
- **BLOCK D:** Hazards/TSHAs lists governing hazards analysis and procedures and risk classification for the test mission
- **BLOCK E:** List emergency equipment present on the airplane
- **BLOCK F:** List purpose of the test
- **BLOCK G:** List crew, reference times, cycle counts and signatures for concurrence with the planned test

9.3 Real Time Data Analysis (Figure 4 Ref 28)

Real time support is provided to monitor data or perform analysis for the following purposes:

a) Determining Safety of Flight

b) Determining if the test point was conducted successfully

c) Determining if test result met expectations (ie., pass / fail)

Note that when monitoring parameters for items a & b above, it is often beneficial to have separate displays for pre-test configuration & set-up confirmation and the maneuver itself. This real time monitoring support can be provided either on-board or remotely via Telemetry. Which method should be utilized is dependent upon the minimum crew required to support the test and the risk level of the flight. While the pilot and the FTE are responsible for determining the preferred method, for high risk tests, the minimum crew and utilization of TM shall be reviewed at the Safety Review Board.

9.4 Test Flight Briefing (Figure 4 Ref 29)

Every flight test mission shall be preceded by a briefing (ref Appendix A for briefing guide). The briefing shall consist of two sections: The Engineering Brief which reviews the details of the test to be performed, and the Maintenance Brief which reviews the details of recent maintenance activities and any open flight squawks.

Engineering Brief: The Engineering brief can occur up to 24 hours in advance of the start of the test mission. The major elements of the pre-flight brief are as follows:

- Overview – information listed on the cover sheet
- Test Procedures – information listed on each test card
- TSHAs & IFRs
- Flight Test Personnel – crew participants and task assignments
- Chase Aircraft / Telemetry Support – Call signs, personnel , task assignments

At the end of the briefing the test card coversheet shall be signed by the briefing FTE and Aircraft Coordinator to concur the configuration of the aircraft is proper for the planned tests along with the Pilot –in-Command to approve the appropriate risk level is established for the mission.

In those cases where pre-flight briefings occur the day prior to the mission, the test crew will reconvene for a short briefing prior to the flight. This briefing will occur after the maintenance release to cover any applicable aircraft configuration items plus involve a quick review of the test cards covering the associated limits and TSHAs.

During the briefing, the test crew may agree to perform build-up maneuvers or add test points that are designed to provide more conclusive data results provided these enhance safety and efficiency of the mission without affecting the risk assessment for the tests or appreciably changing the test program scope. Only those tests briefed during the preflight briefing are authorized to be conducted on a test mission. Equally important is that the tests are to be conducted as briefed and within established limits.

If changes to the test point condition, test procedure, or success criteria become apparent that affect the test program scope or risk assessment, then approval from the originators of the test plan, or designees, is required, including determining if reconvening an SRB is required. However, in minor changes in procedure technique are agreed to, they can be redlined on the test card.

Maintenance Brief: The Maintenance brief shall occur just prior to the pilot signing of the SAV/GA Form 542 Flight Release. The Quality Inspector for a particular airplane will provide an update on all flight safety relevant open flight squawks and summarizes the maintenance actions performed since the last flight. The pilot then signs the Flight Release and is responsible for subsequent aircraft operations.

9.4.1 FTE Crew Qualifications

Each FTE that serves as part of the test crew is required to demonstrate proficiency in the use of all equipment necessary to support the execution of the test. These requirements include:

- Demonstration of proficiency in the use of instrumentation systems such as IADS, TIU, Video Monitoring etc Including the recovery of instrumentation from computer operational interruptions
- Initial and recurrent Flight Safety International emergency egress training (includes the use of smoke protection, fire extinguishers, evacuation, and water survival)
- Initial and recurrent training in the operation of all aircraft doors (MED, EED, Baggage)
- Initial and recurrent training in the operation of the smoke ventilation valve
- Operation of seat belts, oxygen bottles, egress electrical saw, crash axe
- Proficiency in the use radios communications protocol and the use of specialized test equipment such as trailing cone, FCS, hydraulic offload control panels
- Individual FTE's must take responsibility to ground themselves when he or she is aware of physical or mental deficiencies which may adversely affect their ability to complete FTE duties.
- FAA Class III Medical

FTE crew qualifications will be tracked internally to insure compliance and currency. Any exceptions for crew qualifications are to be approved by the Manager, Flight Test Engineering or his designee.

NOTE: for test crew that are not fully qualified (infrequent flyers, suppliers, etc.) a pre-flight briefing will be provided by the FTE or Pilot on cabin and flight test safety equipment, operation of doors, egress procedures and use of radio equipment.

9.4.2 Minimum Crew

Standard operations for test missions will be 2 pilots, a flight test engineer and other personnel (FTE, Engineering, Supplier) deemed essential to support the purpose of the flight. For hazardous testing, the minimum essential crew will be limited to 2 pilots plus support by TM unless the additional crew member is required due to:

- Having access to additional data available on board aircraft (ie. Video)
- Exposure to data dropouts and loss of signal world drive unnecessary repeats of the hazardous test
- TM coverage is not feasible due to line of sight limitations
- Duties required on-board cannot be done solely by the 2 pilots (gain changes or crew procedures not able to be conducted by the pilots or from the pilot seats)
- Crew resource management where additional onboard personnel provides enhanced safety
- On-board technical support enhances safety compared to support via TM (ie. does the onboard monitoring enable FTE to understand the data & understand the data & aircraft behavior quicker due to the situational awareness that goes with being to monitor data plus experience aircraft response first hand

9.5 Flight Test Execution (Figure 2 Ref 30)

During the test mission, the pilots retain the responsibility for ensuring the safe operation of the aircraft. The assigned test mission FTE on board the aircraft is responsible for directing the test activities during the mission. Any member of the flight crew has the right, at any time, to call for the mission to be terminated if, in their opinion, an event that was not planned and is not immediately explainable has occurred, or for any reason where one of the crewmembers feels uncomfortable about continuing.

Once a test mission has been launched, no member of the test crew may change or revise the planned test activities, unless the change is for flight safety reasons. No un-briefed maneuvers or tests not in the test cards will be conducted on any flight. Other requirements of test mission execution are:

- Personnel considered essential for the purpose of the mission are recommended by Flight Test with final authorization by the pilot in command
- Conducted in conditions governed by the Flight Operations Manual (weather minimums, daytime / nighttime, fuel minimums, etc).
- Conducted with the minimum crew required to perform the test within prescribed crew duty and crew rest limits (ref Chapter 4.15 Flight Operations Test Pilot Manual)
- Crewmembers will be qualified for the test to be performed. Pilots to be assigned by Flight Ops, FTEs will be selected by the FTE Manager or his designee
- In-flight duties to be established to fully optimize test crew resource management
- For tests classified as HIGH risk, the on-board test crew will review associated limits and abort procedures. This review is to include appropriate crew resource management and the assignment of responsibility to monitor limit parameters and abort calls.

9.5.1 Real Time Telemetry Room Protocol

Telemetry room equipment is available to support test missions as required and allows for more real-time monitoring of safety critical parameters. The use if the TM room and how it interacts with the crew is defined in this section. TM protocol to be followed both in the fixed in the TM room or in the TM mobile unit will be the same as those followed while conducting a test onboard the airplane.

While operating in the TM environment, all personnel in the telemetry monitoring room will conduct themselves in a professional business-like manner. In general, conversation should be held to the minimum required to successfully complete the test. Entry to the TM room will be limited to those with specific tasks necessary for the safe and successful conduct of the test. Those who wish to observe the flight may do so from the Observer Room. For all persons actively monitoring the flight in the TM room, cell phones, pagers, or other electronic devices must be OFF. Distractions during a test mission are a safety concern, and the cause of that distraction will be removed from the TM room.

- The Test Conductor (TC) is the person in charge of the TM room support crew and is the primary point of communication with the aircraft. All monitoring personnel communicate their observations to the TC who synthesizes all information and reports to the aircraft.
- The TC will communicate with the test aircraft by using the call-sign associated with the crew for that mission, typically "Gulf Test XX". The TM room will be identified with the call sign of "Gulf Test TM".
- In general, the TM room Test Conductor (TC) will be the only individual communicating directly with the Flight Crew on the airplane. Exceptions may be made at the discretion of the TC and Flight Crew. Discussions among the TC and FTEs/CEs shall be held between test maneuvers only. If a repeat of a maneuver is required by TM room personnel, the requesting FTE/CE will inform the TC why the repeat is necessary and, if agreed, the TC will relay the request to the Flight Crew, who will also evaluate the request. When deemed appropriate by the TC, lead FTE and flight crew, arrangements

may be made to allow one or more individuals other than the TC to contact the Flight Crew directly. This will eliminate any delay associated with the TC having to relay an abort command to the Flight Crew.

- To begin testing, the TC will identify the test card to be evaluated, and confirm the initial conditions and maneuver. Once the maneuver has been conducted and satisfies the data requirements, the TC or Flight Crew, as required by the maneuver, will state "Complete". Subsequent to a maneuver and prior to proceeding to the next flight condition, the TC will announce "Stand By" to the Flight Crew and the Flight Crew will acknowledge.
- After satisfactory data review, the TC will announce "Cleared to [Next Test Condition]".

  Note: [Next Test Condition] for example may be stated as: Test Card 15, Test Point A1, Mach 0.xx
- Once the Flight Crew, TC, FTEs and CEs agree that initial conditions are satisfied and required instrumentation is available, the maneuver will then be initiated by the TC with the callout "Ready for [Maneuver]".

  Note: [Maneuver] may be stated as: Test Card 15, Test Point A1, Mach 0.xx, etc.
- The Flight Crew will respond with "Beginning Maneuver".

  Note: If timing is critical, this callout may be followed by an audible countdown initiated by the Flight Crew.
- If the test maneuver progresses in an unsatisfactory manner due to reasons other than safety, it can be terminated by the Flight Crew, TC, or recommended to the TC by an FTE. The Flight Crew can call **"Knock It Off"** and state the reason once the airplane has recovered to a stable condition. Likewise, the TC can call **"Knock It Off"** and also state the reason. A decision will then be made as to whether the maneuver will be repeated, skipped or the flight terminated, depending on the reason for stopping the maneuver.
- Should an abort call originate from the TM room, either by the TC or other delegated personnel, the term **"ABORT, ABORT, ABORT"** will be used. All TM room workstations have an ABORT button that will transmit a pre-selected audio message to the aircraft to indicate an abort. This requires immediate action by the Flight Crew to recover the airplane to a safe condition. In the event a safety issue is identified first by the Flight Crew, the pilot will immediately begin recovery procedures and then announce **"Aborting Maneuver".** Once the airplane is in a safe and stable condition, the cause for the abort will be discussed and a decision made whether to continue testing or return to base.
- As always, the Flight Crew has primary responsibility for the safety of the airplane and their judgment in aborting a maneuver or terminating the flight for any reason will not be questioned. The TC also has the authority to terminate the flight if anomalies are detected. Discussions may be held post recovery or in the debrief as necessary.
- The potential exists for lost telemetry signal between the test aircraft and the TM room due to weather, distance, altitude limitations, or other factors. If TM loss occurs, the TC shall notify the test aircraft of lost TM signal. When the TM room is safety of flight critical to the mission, the maneuver will be aborted with a **"Knock It Off"** call, and the aircraft will not conduct further testing until TM has been regained. Attempts to move the aircraft closer to the TM facility, or turn the aircraft in such a way to improve TM signal strength will be attempted. The aircraft will standby while trouble shooting if the TM loss occurs. If the TM signal can not be regained, the mission will be aborted and the onboard FTE will provide as much safety of flight oversight as possible. If TM is not safety of flight critical to the mission, then the maneuver will be continued until completed, with the onboard FTE providing evaluation of the maneuver. Should TM not be regained and the TM room is not safety of flight critical to the mission, the onboard FTE shall conduct the remainder of the mission as TC. All efforts to regain TM integrity during the mission will be attempted; however, loss of TM should not jeopardize completion of missions where TM is not critical for safety of flight.

- The possibility also exists for lost communication between the test aircraft and the TM room due to weather, distance, altitude limitations, or other factors. If communication is lost, and is not able to be regained, the same process will be followed as for the lost TM signal. The aircraft will check communication with local ATC to verify communication is limited to TM. Lost comm with TM will not require the mission to be aborted unless TM has been identified as a Safety of Flight requirement.

9.6 Post – Flight Debrief (Figure 2 Ref 31)

The purpose of the test mission post-flight briefing is to ensure that all relevant information regarding the outcome of the test mission is communicated to the appropriate players. It is also the forum for any maintenance or engineering issues affecting the ability of the aircraft to conduct the next mission to be raised and assigned to the appropriate party for resolution.

The Aircraft Coordinator will schedule and communicate the time and location of the post-flight brief. This will be determined after reviewing with the test crew the time they need to properly prepare their notes. Attendees for the post flight shall include:

- Test Crew
- Aircraft Coordinator
- Aircraft Maintenance & Inspection Personnel
- Appropriate Cognizant Engineering Personnel

The post-flight debriefing will be led by the FTE and will address:

1) Flight Overview: flight times, status of completing all cards successfully
2) Maintenance Squawks and Engineering Issues (ref Section 9.6.1)
3) Test Results: Quantitative and qualitative observations from the test crew on what was or was not performed satisfactory
4) Lessons learned on the effectiveness of test point and risk mitigation procedures and if they need to be modified for follow-up flights

Note that when reviewing the test results, it is not necessary for the FTE to review chronologically the entire test flight. It's acceptable for the FTE to summarize a test card(s) was completed as briefed satisfactorily. At the conclusion of the post-flight, the aircraft coordinator will provide details for the next activity scheduled for the aircraft.

9.6.1 Maintenance Squawks vs Engineering Issues

The test crew is responsible for determining and reporting any discrepancies observed during a test mission as either a maintenance squawk or an engineering issue. This includes identifying any maintenance items that must be addressed prior to the next flight and determining the severity of any engineering issues.

Maintenance Squawks: Those discrepancies deemed to be maintenance related (ie., can be resolved by action defined either thru MRB actions or appropriate maintenance manuals). These will be recorded on GA 0982 Flight/Ground Discrepancies form and subsequently entered into Solumina. Flight Squawks are logged under the airplane tail number and special work order number assignment with the flight number imbedded (example: FTO-G650-6001-EXP-296, with the last three digits being the Flight Number).

Engineering issues: Those discrepancies that are not Maintenance Squawks will be reported to Engineering using the Problem Report (PR) process (ref GER-7786 Problem Reporting Process Description Document). It is the responsibility of the FTE to submit the PR into the database with the sufficient information and data to support the subsequent investigation, resolution, corrective action and verification activities. Since engineering will be accumulating PRs from other off-aircraft activities, before opening a new PR, it is a best

practice to coordinate with the Cognizant PDT lead to insure that the PR does not already exist in the system. The severity of a PR is classified into the following criteria:

Severity 1: Safety of Flight issue. The airplane is grounded until an acceptable mitigation action is performed, documented in Teamtrack, and the PR gets subsequently downgraded. Flight Release is not allowed with an open Severity 1 PR.

Severity 2: Initial certification issue. The discrepancy requires corrective action as soon as practical and must be resolved prior to TIA certification test. TIAs will not be issued by the FAA with open Severity 2 PRs active.

Severity 3: An issue that is neither Severity 1 or 2, but corrective action should be scheduled based on workload and schedule for implementation. These are typically future product improvements or potential customer satisfaction issue.

Severity 4: An issue that is neither Severity 1, 2 or 3 and corrective action and implementation can be delayed without any significant impacts to the program.

For the GVI program, a database application called TEAMTRACK or ELEMENTOOL (for Honeywell avionics issues only) is utilized (Figure 17 shows a screen shot of the Teamtrack user interface for a given PR item). The flow picture at the top represents the workflow of the issues and the fields below contain the entire history of the investigation of the issue. Cognizant Engineering groups are held accountable for the leading the investigation of PRs entered within a given design group. It is the FTE's responsibility to accurately enter the flight observations and reference data

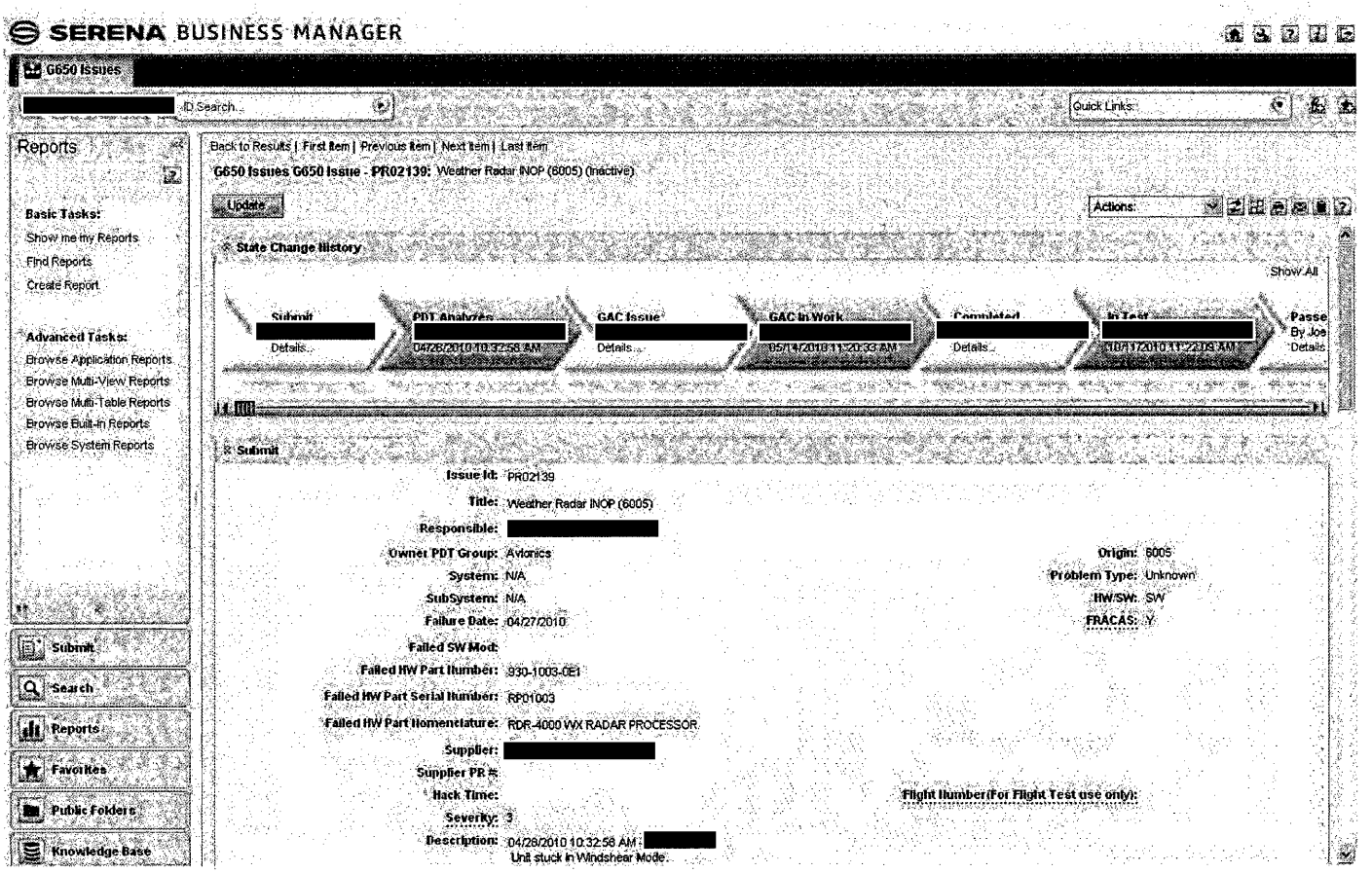


FIGURE 17 – ENGINEERING PR TEAMTRACK SCREENSHOT

9.6.2 Post-Flight Inspection

Post-flight inspection requirements are governed by the Production Quality Assurance Manual – Quality Instruction 9.1.4 and Form GA 0542. For the GVI, specific points of inspection are identified in Quality Assurance Traveler 60E5300968N005-GV. Post flight inspection will be completed and discrepancies entered into Solumina prior to post-flight maintenance action.

9.7 FTE Flight Reports

FTE flight reports are to be written and distributed by the FTE as soon as practical following a flight. Rapid communication of flight results to Engineering and key management and program personnel is a critical part of the flight test process and therefore the FTE should release the Flight Reports within 24 hours of completing the mission. Any incident that occurs during a test mission is required to be reported separately and before the next flight (see Para 9.7.1 below).

The FTE report is not intended to be a narrative description of the entire flight. Rather, the key elements of the FTE report shall include (see Appendix A for example):

- General Information: Flight Number, times, crew, W&B and mission objectives
- Summary addressing whether all planned tests were (or were not) successfully accomplished
- Specific observations relevant to mission, including any necessary data to assist definition or understanding of any issues
- Issues: Maintenance, Engineering, Instrumentation

9.7.1 Reporting of Accident and Incidents during Flight Test Execution

The reporting of an aircraft accident or incident is governed by the corporate policies listed in Figure 18. These documents define responsibilities for responding to accidents and reporting these events to the appropriate authorities (FAA and/or NTSB). Flight Operations, Technical Operations, and Legal are the primary organizations leading this response.

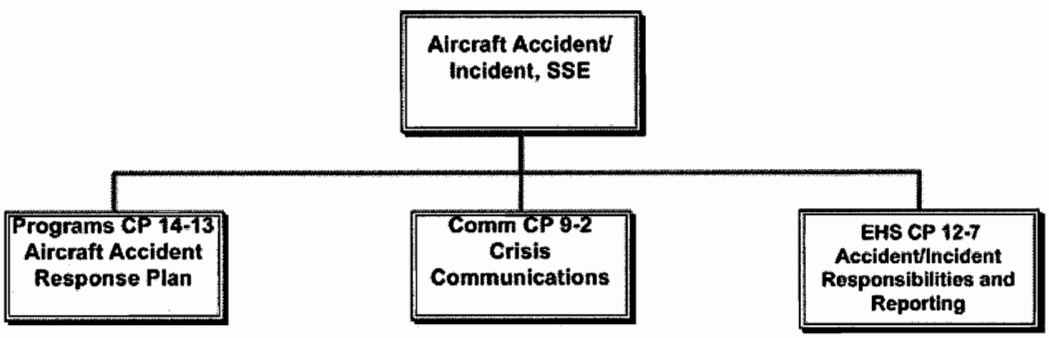


Figure 18 – Corporate Policies for Accident / Incident Response

In the event of an accident or major incident, the Flight Test organization will execute the following steps:

1. Immediately take all measures to respond to the accident or incident (call / coordinate / provide for crash, fire, medical response)
2. Provide initial contact as defined in CP14-13 plus ensure immediate contact is provided to senior management personnel: Sr. VP Programs, Engineering & Test, VP Flight Operations, VP Engineering, Chief Engineer, Program Manager, Director of Flight Test, and Director of Aviation Safety Office.

3. Secure the accident scene and equipment
4. Cooperate with Authorities, but maintain all communication and information confidential until cleared thru Gulfstream Programs Engineering & Test, Legal and Corporate Communication personnel.
5. Secure and sequester all data to include flight cards, notes, on-board and telemetered data, pictures, videos, local computer workstations, aircraft maintenance record.
6. Those personnel with first-hand account of the accident or incident shall provide a written report to their supervisor containing all relevant facts from their perspective with 24 hours
7. Data storage, access and distribution of all pertinent data shall be controlled by the Director of Flight Test
8. Comply with further instructions from Flight Operations lead responders in the implementation of the Aircraft Accident Response Plan

The reporting and investigation of Occupational Safety and Health Administration recordable injuries, product damage or near-miss incidents is outlined by CP 12-7. In the event of an occurrence, the responsible Flight Test Manager shall contact the Director of Flight Test with 24 hours.

9.7.2 Flight Test Issue Notification Report

Any incident or unexpected result occurring during a test mission will be reported by the Flight Test Engineer before the next flight. For this purpose, an "incident" is defined as any significant unexpected behavior, such as imminent loss of control (stall, roll-off or pitch up), PIO tendency and any difficulties during takeoff or landing operations. This notification shall include the following information and distribution (see Appendix A for example):

a. Test Crew
b. Test Description (test conditions, configuration, test procedure)
c. Appropriate level of detail pertaining to the incident
d. Any operational limitations until the incident is further understood
e. Email notification subject line shall specifically state "Flight Test Incident Notification: A/C xxxx, Flight xxx"
f. Distribution to the Sr. VP Programs, Engineering & Test, VP Flight Operations, Chief Test Pilot, VP Engineering, Chief Engineer, Program Manager, Director of Flight Test, Director of Aviation Safety Office, Manger of FTEs. Note that it will be the responsibility for the chief test pilot to update the FAA by contacting the Flight Test Branch Manager on the incident. Additionally Flight Ops, FT Management, and Chief Engineer will communicate results to appropriate FTEs, Test Pilots, and Engineering personnel.

These reports are currently located in the following network directory:

[redacted]

10.0 PHASE VI: TRACKING

10.1 Flight Records

The pertinent records for each mission shall be stored electronically on the Gulfstream network to allow for accessibility and retention (backup and archive). These records shall include:

- FTE's completed flight cards (including W&B, TSHAs and IFRs)
- FTE Flight Report
- Incident Report if applicable

- Data relevant to the mission that should be retained with the records above

These records shall be stored within 24 hours of completing a mission and purged of any "draft" material. For the GVI program, completed flight records are stored in the following network directory location:

[redacted]

10.2 Flight Logs (Figure 2 Ref 32)

A flight log shall be maintained by the FTE for each airplane and stored with the Flight Records. This log shall contain information for each flight such as:

- Date & Flight or Ground Test Numbers
- Type of Flight (company or certification)
- Event Times (ie, flight & block times)
- Cycle Events (full stop landings, touch & go's, go-arounds)
- Test Crew
- Weight & Balance Information
- Planned and completed tests
- Comments relative to the flight

[redacted]

10.3 Test Point Status (Figure 2 Ref 33)

The relevant data showing the status of activities within Flight Test shall be maintained by the respective departments. This data typically consists of:

- Planned versus Actual flights, flight hours and test points (for each aircraft and total program)
- Planned versus actual releases for key deliverables (mechanical models, material status, open aircraft work, test plans, test reports)

[redacted]

10.4 Data Approval (Figure 2 Ref 34)

The FTE is responsible for leading the effort to assess the data real-time or following a flight to determine if the test points were executed properly and resulting data are acceptable. This assessment shall be communicated in a timely manner to all appropriate personnel to insure near-term missions or longer-range planning can be adjusted as required.

11.0 PHASE VII: ANALYSIS, REPORTING, CLOSEOUT

11.1 Flight Data Release (Figure 2 Ref 36)

Flight Test Data is recorded from multiple streams input to HEIM solid state data recorders and output into a common time correlated UDP Ethernet data stream to an IADS data server for real-time use on-board the

aircraft (ref Figure 19). Following each flight, the data from the on-board recorders are downloaded onto network drive locations for use by Engineers authorized to access the data using the same IADS tools. There are multiple help and how-to files regarding data access, playback and processing via MATLAB scripts stored in the following.

11.2 Data Validation

Before beginning any analysis, drawing conclusions or making decisions based on recorded data, it must be verified that the data is valid. It is the responsibility of the engineer to evaluate the measured data to insure:

- Reasonableness of measurement (sign convention, units, neutral and extreme recordings)
- Alias, bias or shift has not been introduced
- Signal Integrity has not been compromised
- Frequency of sampling rates and filtering is appropriate

Issues on data validity are to be immediately addressed with the FTIE. If the measured data is confirmed invalid, the parameter is to be identified invalid and restricted from use.

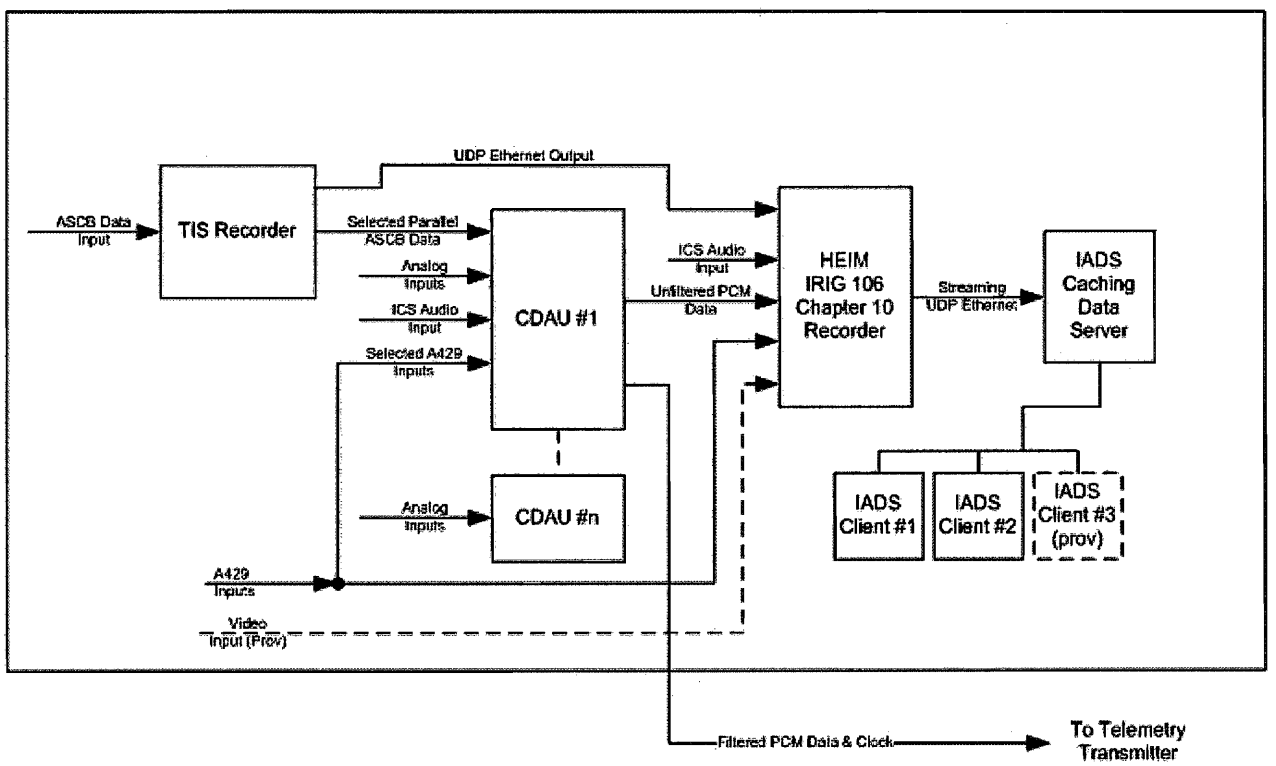


Figure 19 – GVI Data System Overview

11.3 Data Analysis

Flight Test Engineers shall provide measured data, calculated parameters or data that's been analyzed thru approved methods for external release and / or inclusion in the Flight Test Reports. For the GVI program,

there are multiple help and how-to files regarding data access, playback and processing via MATLAB scripts stored in the following.

[redacted]

11.4 Flight Test Report (Figure 2 Ref 35)

With certain exceptions pertaining to small test projects, closeout of a test will be via release of the Flight Test Report. These reports shall contain the necessary data and information to document the tests accomplished and substantiate the test results and conclusions (design and/or regulatory requirements). The standard test report format is presented in Appendix A.

To insure comprehensive coordination of the test results, Flight Test Reports shall be reviewed and signed by Flight Operations, Cognizant Engineering Representative with final approval by the Manager of Flight Test Engineering or his designee.

11.5 Data Storage, Management and Retention

The Flight Test Engineering Data System Specialist shall be responsible to coordinate the necessary network storage space requirements and access privileges with Gulfstream Information Technologies personnel. Aircraft recorded data will be copied onto the corporate network drive. Once this copy is created and verified, the aircraft media hard drives are re-cycled back into service. Short-term and long-term backup recovery for data downloaded onto the network drive will be coordinated and handled thru corporate network IT processes. Any data not stored on the network drive (ie., source tapes from video and/or special recorders) shall be retained by Flight Test for a period of approximately 10 years.

11.6 Airplane De-Modification (Figure 2 Ref 37)

The Aircraft Coordinator and FTIE shall coordinate with all affected organizations to determine the best method for restoration of the test aircraft to the approved configuration baseline. Affected organizations are the organizations whose system has been affected by a Fight Test installation. For example if a hydraulic sensor spliced into a pressure supply line is removed, FTIE will coordinate the Hydraulics group to design a permanent repair to remove the sensor and splice the line. Since this activity may involve repairs associated with the removal of flight test equipment, it is important to address this early in the process to insure the required engineering designs are completed and associated material is available.

The Aircraft Coordinator will ensure that all necessary FTWAs are issued to restore the test aircraft to the approved configuration and remove Flight Test specific equipment. Implementing the work, processing the FTWA and QC sign-off (including updating the configuration control database) will be complied with as described in Section 8 on Airplane Modifications. When the test aircraft has been restored to the approved configuration, copies of all inspection-stamped FTWAs will be provide to QC and the originals maintained in the project files of Flight Test Engineering..

APPENDIX A FLIGHT TEST FORMS

Appendix A.1 Request for Flight Test Services (RFTS) FORM

Flight Test					
Request for Flight Test Services					
(Submit via email to: [redacted])					
Requestor Name:		Dept:		Ext:	
COG Engineer:					
Project Engineer:					
Director Approval:					
Job Charge Number:		R/C Proj. Pri. Sec.			
Requested Test Date:		mm/dd/yy			
Test Background, Purpose, and Justification (Is this a RQAAT task?, Priority of task?, Indicate model; Indicate ground test, flight test or both; Indicate when the parts will be available, if required; and provide a suggested test methodology) (attach additional sheets if necessary):					
Associated Drawing Numbers and/or References:					
Information/Data Requested:					
Instrumentation Requirements (indicate required test aircraft configuration):					

FIGURE 20 - REQUEST FOR FLIGHT TEST SERVICES (RFTS) FORM EXAMPLE

Appendix A.2 Test Safety Hazard Analysis (THSA) FORM

Gulfstream

ID: TSHA-000144 Stall Demonstration with Functional/Proven Alpha Limiter
Risk: Medium Probability: Remote Hazard Level: Hazardous

Hazard: Departure from controlled flight

Cause: AOA Limiter fails to prevent aircraft from reaching aerodynamic stall
AOA overshoot due to turbulence
Dynamic pilot input to stall AOA

Effect: Aerodynamic Stall

Preventative Actions / Minimizing Procedures:

1. Testing shall not be conducted until the alpha limiter function has been proven via dedicated testing
2. Inspect leading edges and gap bands. Trim excess sealant if necessary.
3. FCS software version 5.24x or later is required.
4. Testing must be conducted in Day VMC, and with smooth air
5. Conduct testing in a buildup fashion.
6. Minimum essential crew.
7. Minimum altitude shall be 10000 MSL.
8. Do not exceed 1.00 NAOA.
9. If departure from controlled flight is experienced, immediately perform recovery procedures.

Corrective Techniques:
1. If AOA trend is likely to exceed NAOA=1.00, abort maneuver and reduce AOA.
2. If aerodynamic stall (pitchup, wing drop, or yaw) is encountered immediately apply forward column to reduce AOA.

[redacted]

Cog Engineer: [redacted] Test Conductor/Coordinator: [redacted]
Pilot: Manager:

FIGURE 21 - TEST SAFETY HAZARD ANALYSIS EXAMPLE

Appendix A.3 Interim Flight Restriction (IFR) Form

This tracking number is assgined and managaged by orginating organization

DATE: 2/07/11 LOG: GVI-IFR-FCS-001 A

INTERIM FLIGHT RESTRICTION

TITLE: FLYING INTO KNOWN LIGHTNING CONDITIONS IS PROHIBITED

DISCIPLINE: FCS P/FT ENG:

RESTRICTION:

Flight into known lightning conditions is prohibited until FECU and MCE's have passed lightning testing.
Rev A: [redacted] MCE's added due to Aircraft Level Lightning tests indicated exposure levels greater than those tested during the MCE qualification test program. HSCU and FCC deleted from this IFR based on installation of V2 units on all a/c

Limit proximity to 20 miles

BASIS FOR RESTRICTION

FECU- Awaiting V2 unit on 6003
MCE - Aircraft Level Lightning tests indicated increased, and untested exposure levels

CLEARANCE ACTION:
Rev A

- A/c 6003 to receive V2 FECU

– All a/c to be retrofitted with lightning compliant MCE's (V2.2)
- All affected wiring harnesses in the fuselage shall receive overbraid - ECR 622090

A/C EFFECTED: 6001:_X__ 6002:__X___ 6003:__X___ 6004:__X_ SUBS:__X__

REVISION: A

SIGNATURES:

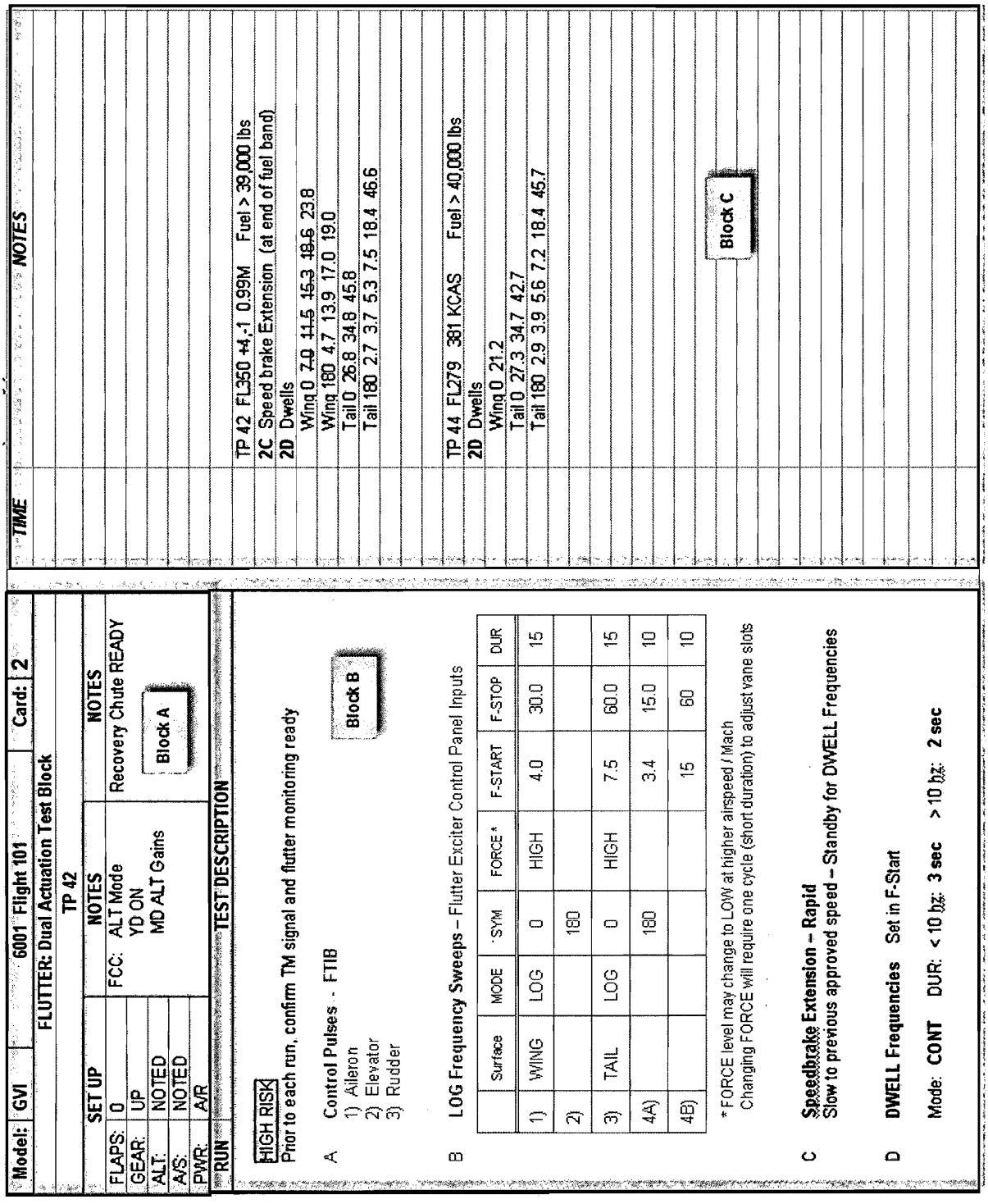
[redacted]

_ORIGINATOR
_CHIEF ENGINEER
_FLIGHT TEST
_FLIGHT OPS

FIGURE 22 - INTERIM FLIGHT RESTRICTION EXAMPLE

[redacted]

Appendix A.4 Flight Test Cards



Model: GVI	6001 Flight 101	Card: 2

FLUTTER: Dual Actuation Test Block

TP 42

SET UP		NOTES
FLAPS:	0	FCC: ALT Mode YD ON MD ALT Gains
GEAR:	UP	
ALT:	NOTED	
A/S:	NOTED	
PWR:	A/R	

NOTES: Recovery Chute READY

Block A

RUN

TEST DESCRIPTION

HIGH RISK

Prior to each run, confirm TM signal and flutter monitoring ready

A **Control Pulses** - FTIB
1) Aileron
2) Elevator
3) Rudder

Block B

B **LOG Frequency Sweeps** – Flutter Exciter Control Panel Inputs

	Surface	MODE	SYM	FORCE *	F-START	F-STOP	DUR
1)	WING	LOG	0	HIGH	4.0	30.0	15
2)			180				
3)	TAIL	LOG	0	HIGH	7.5	60.0	15
4A)			180		3.4	15.0	10
4B)					15	60	10

* FORCE level may change to LOW at higher airspeed / Mach
Changing FORCE will require one cycle (short duration) to adjust vane slots

C **Speedbrake Extension – Rapid**
Slow to previous approved speed – Standby for DWELL Frequencies

D **DWELL Frequencies** Set in F-Start

Mode: **CONT** DUR: **< 10 hz: 3 sec** **> 10 hz: 2 sec**

TIME	NOTES
	TP 42 FL350 +4,-1 0.99M Fuel > 39,000 lbs
	2C Speed brake Extension (at end of fuel band)
	2D Dwells
	Wing 0 ~~7.0~~ ~~11.5~~ ~~15.3~~ ~~18.6~~ 23.8
	Wing 180 4.7 13.9 17.0 19.0
	Tail 0 26.8 34.8 45.8
	Tail 180 2.7 3.7 5.3 7.5 18.4 46.6
	TP 44 FL279 381 KCAS Fuel > 40,000 lbs
	2D Dwells
	Wing 0 21.2
	Tail 0 27.3 34.7 42.7
	Tail 180 2.9 3.9 5.6 7.2 18.4 45.7

Block C

FIGURE 23 - FLIGHT TEST CARDS EXAMPLE

Gulfstream
A GENERAL DYNAMICS COMPANY

FLIGHT TEST CARDS

Reg No: N650GA	Serial No: 6001	Flight No: 271	Date: 8 OCT 11

ZERO FUEL WEIGHT		TAKEOFF GROSS WEIGHT		FLAPS		~~FLEX~~ [Rated]	1.56
ZERO FUEL C.G.		TAKEOFF C.G.		V1 / VR		VSE	
FUEL LOAD - LEFT		TOTAL FUEL		V2		VREF	
RIGHT				FIELD		TO TRIM	

Block A

[redacted]

AIRCRAFT CONFIGURATION / TEST SUPPORT

[redacted]

LIMITATIONS / RESTRICTIONS

[redacted]

Block C

HAZARDS/TSHA's

1. 107 Offset Landings
2. 124 Rudder Jammed Landing
3. 125 Degraded FCS Actuation
4. 126 Alternate Mode Testing
5. 047 Single Engine / Single Hyd
6. 136 Attitude Recovery System

Block D

Flight RISK: HIGH

EMERGENCY EQUIPMENT

1. Fire Extinguishers (3) and Fire Axe
2. First Aid Kit
3. Crew Parachutes (available if required)
4. Emergency Egress Do[redacted]partment
5. FTE Walk-Around Oxy[redacted]oggles
6. Battery-powered Saw ([redacted]ea Insulation provisions (cut and taped in place)

Block E

PURPOSE OF TEST: **Company** **FWD CG**

1. Flight Controls Company Testing – 5.242
   - -Failure Mode X-wind Landings (Rudder Jam & Alternate - MLW
   - -Rudder Jam (Takeoff Jam) Landing – No Crosswind - MLW
   - -Offset Landing (Normal, Alternate & EB Mode) - MLW
   - -PIO Evaluations – Normal, Alternate & EB Mode - HVY

Block F

CREW:

[redacted]

		Go Around's	
		Full Stop	
ENG START	/	Touch & Go's	
ENG SHUT DOWN	/	Total Landings	
CHOCKS IN		LANDING	
TAXI		TAKEOFF	
BLOCK TIME		TOTAL FLIGHT	

Block G

Pilot In Command Risk Acceptance ☐		FTE Configuration Acceptance ☐
Aircraft Configuration Release ☐		

FIGURE 24 - FLIGHT TEST CARD COVER SHEET EXAMPLE

Appendix A.5 Example Incident Report

Flight Test Issue Notification — Date: 19 AUG 2011

Model:	GVI	Serial:	6001	Flight:	263	Flight Date:	28 SEP 2011

Crew:
TM Support [redacted]
Loading: ZFGW: 59,740 lbs ZFCG: 34.2

Issue Summary:

While holding altitude and heading during AFCS testing of Plane View 6.4 with AFCS Quick Turn Patch 2, a roll oscillation occurred at approximately 5 hz. The oscillation was initially perceived by the pilots as turbulence, but as it got worse it was identified as a roll oscillation. The pilots disconnected the AP and the oscillation immediately stopped. The aircraft was at FL290 and 340 KCAS when the oscillation occurred. Elementool PR 508 was created to track the correction and closure of this issue.

Initial review of the data showed that the oscillation was being driven by the AP. The AP was exciting a structural mode. The oscillation was most clearly seen in the roll rate signal. The maximum roll rate amplitude was 1.5 deg/sec. The roll angle amplitude was only 0.1 deg. The event only lasted 5.5 seconds, but was still diverging at AP disconnect.

A similar event occurred on 6003 flight 70 on 31 JAN 2011 at FL 410 Mach 0.9. The oscillation was also around 5 hz and was exciting a structural mode. Notch filters were added to the AFCS at the structural mode frequencies. Review of the notch filter implementation shows that the notch filter was not properly implemented in the AFCS. A new build of AFCS has been delivered with the corrected notch filters. The notch filter implementation will be verified by analysis as well as demonstrated on the ITF.

FIGURE 25 - INCIDENT REPORT EXAMPLE

Appendix A.6 Flight Test Plan Template

Refer to the Engineering Documentation Standards Templates intranet page [redacted] for the complete Flight Test PalnTemplate.

Gulfstream

DOCUMENT NO:	XXX-FT-XXX	FAA PROJECT NO:	N/A
CURRENT REVISION:	As Noted	INITIAL DATE:	XXX, ##, 20##
GAC CAGE CODE:	59734	MODEL:	N/A
VENDOR REFERENCE:	N/A	ATA NO:	N/A
CERTIFICATION DATA TOP ASSEMBLY NO (if applicable):			

General Flight Test Plan Template

[redacted]

DEPARTMENT:	343	TECHNICAL APPROVAL:	
SECTION:	Flight Test Engineering	TECHNICAL APPROVAL:	
PREPARED BY:		FLIGHT OPERATIONS	
CHECKED BY:		MANAGER APPROVAL:	

FIGURE 26 - GENERAL FLIGHT TEST PLAN TEMPLATE EXAMPLE

Gulfstream General FT Plan Template

REVISION APPROVAL

REV	REVISED BY	APPROVED BY	SIGNATURES	DATE

Gulfstream General FT Plan Template

REVISION HISTORY

REV	PARA	DESCRIPTION OF CHANGE
-	-	Initial Release, No Change (NC)
A	##	Changed " "to " ".
B	##	Changed " "to " ".

Gulfstream General FT Plan Template

TABLE OF CONTENTS

1.0 INTRODUCTION

This section provides background information and reasons for the test requirement, include information regarding the type and scope of test to be conducted.

If graphics are included in this document, use the following format:

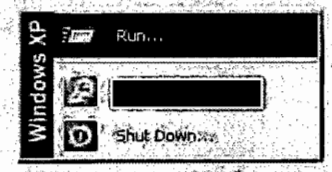


FIGURE 1 – EXAMPLE GRAPHIC WITH TITLE PLACED BELOW

1.1 Test Objective

This section summarizes the objectives of the testing. Include a brief description of the testing required. Identify the aircraft type or specific serial number to be used. Provide information regarding unique test equipment, personnel requirements, and test location. Personnel requirements include stating the number and type of Gulfstream personnel (DERs), supplier personnel (vendors), and regulatory (FAA) personnel necessary.

2.0 APPLICABLE REGULATIONS AND/OR DOCUMENTATION

This section provides the pertinent regulatory, specification, and other resource material which supports or specifies the test requirements. List all specific paragraphs from Federal Aviation Regulations (FAR)/ Joint Aviation Regulations (JAR), Advisory Circular (AC) Material, Issue Papers, Military Specifications, or other necessary material to which compliance is being demonstrated. If the test plan supports company research and development, list the engineering department goals or troubleshooting criteria. For compliance test plans, cross-reference applicable FAR/JAR's listed in the certification plan (CP) or project specific CP (PSCP) as appropriate. The information in Table 1 must match that found in the compliance checklist that identifies a means of compliance by flight or ground test.

TABLE 1 – EXAMPLE REGULATION INFORMATION

Regulation Paragraph Number 14 CFR Part 25 / CS (As Required)	Amendment	Regulation Paragraph Title
103 (a), (b), (c), (d)		Stall Speed Determination
[regulation paragraph number]		[regulation paragraph title]

3.0 CONFIGURATION

This section provides pictures, graphics, or drawings of the modification or the test aircraft. Provide a general list of modifications or differences from the baseline aircraft model.

3.1 System Description

This section describes the details of the system being tested. Include references to supporting figures, part numbers, and serial numbers if appropriate. In the case of compliance requirements, refer to the Certification plan for items that require conformity inspection.

3.2 Test Article Configuration

This section describes the general configuration of the test article. Identify components relevant to the test outcome, including ballast requirements and any special flight test equipment installed. Reference Configuration Control items (Flight Test Work Authorization (FTWA), etc.) in the applicable section of the Flight Test Standard Operating Procedure, as required. Provide configuration information for systems with known non-conformance to production standards. Include an adequate review of these systems to assure non-conformances do not affect the outcome of the proposed test.

4.0 INSTRUMENTATION

This section describes the instrumentation system used to measure test parameters. Avoid including the instrumentation parameter list in the body of the plan, especially if the list of parameters is lengthy. Instead, include the list in Appendix A: Instrumentation Parameter List, or refer to the Instrumentation report as appropriate. If necessary, include diagrams of the measurement locations as required in order to orient the reader. If known, reference at least the top level instrumentation drawing.

5.0 TEST PROCEDURES

This section provides information about the testing arranged according to the information provided in the Regulation Paragraph Title column of Table 1 in Section 2.0, Applicable Regulations or Documentation, or as discussed in the text of that section.

For example, if 14 CFR 25.103 is listed in the Table 1, then the following subsections are required:

5.1 Stall Speed Determination

5.1.1 Test Procedure

5.1.2 Test Analysis Methodology

5.1.3 Success Criteria

5.1 Regulation Paragraph Title

The title of this section is derived from the Regulation Paragraph Title listed in Table 1. At a minimum, there will be one subsection for each Regulation Paragraph Title listed in Table 1.

This section describes test requirement details and state compliance requirements. Refer to test points in Appendix B. The Test point table should include a test point number based on ATA code, weight/center of gravity, flap, gear spoiler positions, trim airspeed and altitude, power settings, and any other unique test requirements. A brief test procedure should also be included in the test point table.

5.1.1 Test Procedure

This section describes the detailed, step-by-step test procedures required to complete the test. These procedures should not only reference other documents for procedural guidance. The procedures included here provide the direct input to the flight test card.

5.1.2 Test Analysis Methodology

This section describes the data reduction routines, equations, or data plots that transform the flight test data into the final form for evaluation. Refer to the Flight Test data reduction plan if appropriate. Describe, in general terms, the data to be included in the test report.

5.1.3 Success Criteria

This section describes clearly the criteria used to determine test pass or fail or to characterize some aspect of the system operation. Use regulatory language as much as practical when defining success criteria for compliance test plans.

6.0 RISK ASSESSMENT

This section identifies the proposed tests with Low/Medium/High risk assessments and addresses the need for a safety review board. Refer to the applicable section of the Flight Test Standard Operating Procedure manual for details. Include applicable TSHA forms in Appendix C: Test Safety Hazard Analysis. The TSHA should include information such as crew experience requirements, minimum crew requirements, special equipment requirements (for example, helmets, parachutes, spin chute, etc.), safety chase aircraft, safety of flight data, telemetry requirements, flight limitations, build up procedures, etc.

7.0 REFERENCES

This section provides a list of all reference documents using the following format:

Document Number, Document Title, Document Release Date

Otherwise, refer to the Chicago Manual of Style or call Engineering Process Control for guidance in structuring your list of references. Two examples of the Chicago Manual of Style methodology for documenting resources follow:

- Book: Last Name, First Name, *Title*. Edition. Location: Publisher, Year.
- Online Book: Last Name, First Name, *Title*. Edition Location: Publisher, Year. URL (accessed Month Day, Year).

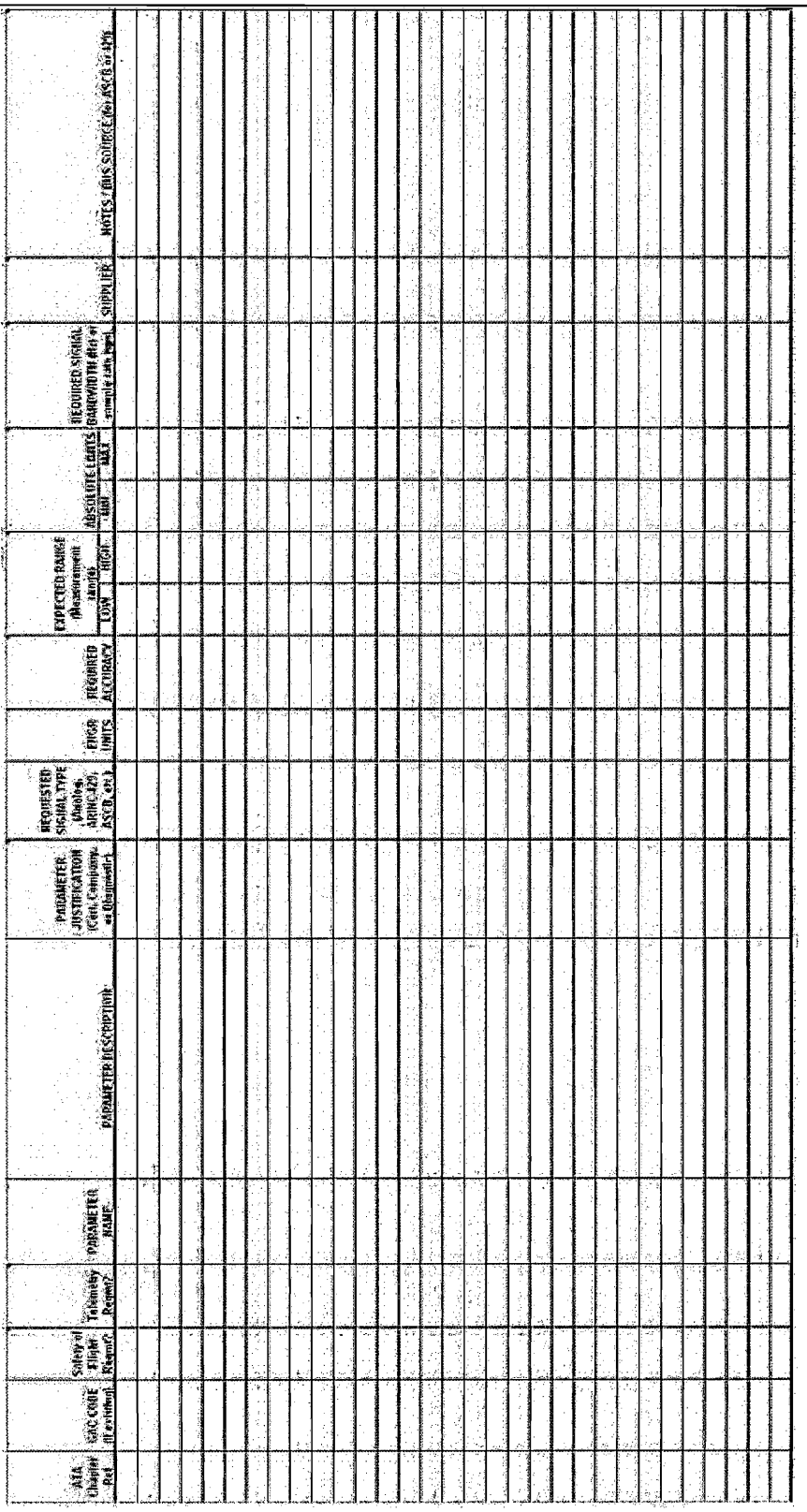


FIGURE 27 - GENERAL FLIGHT TEST PLAN TEMPLATE INSTRUMENTATION PARAMETERS LIST

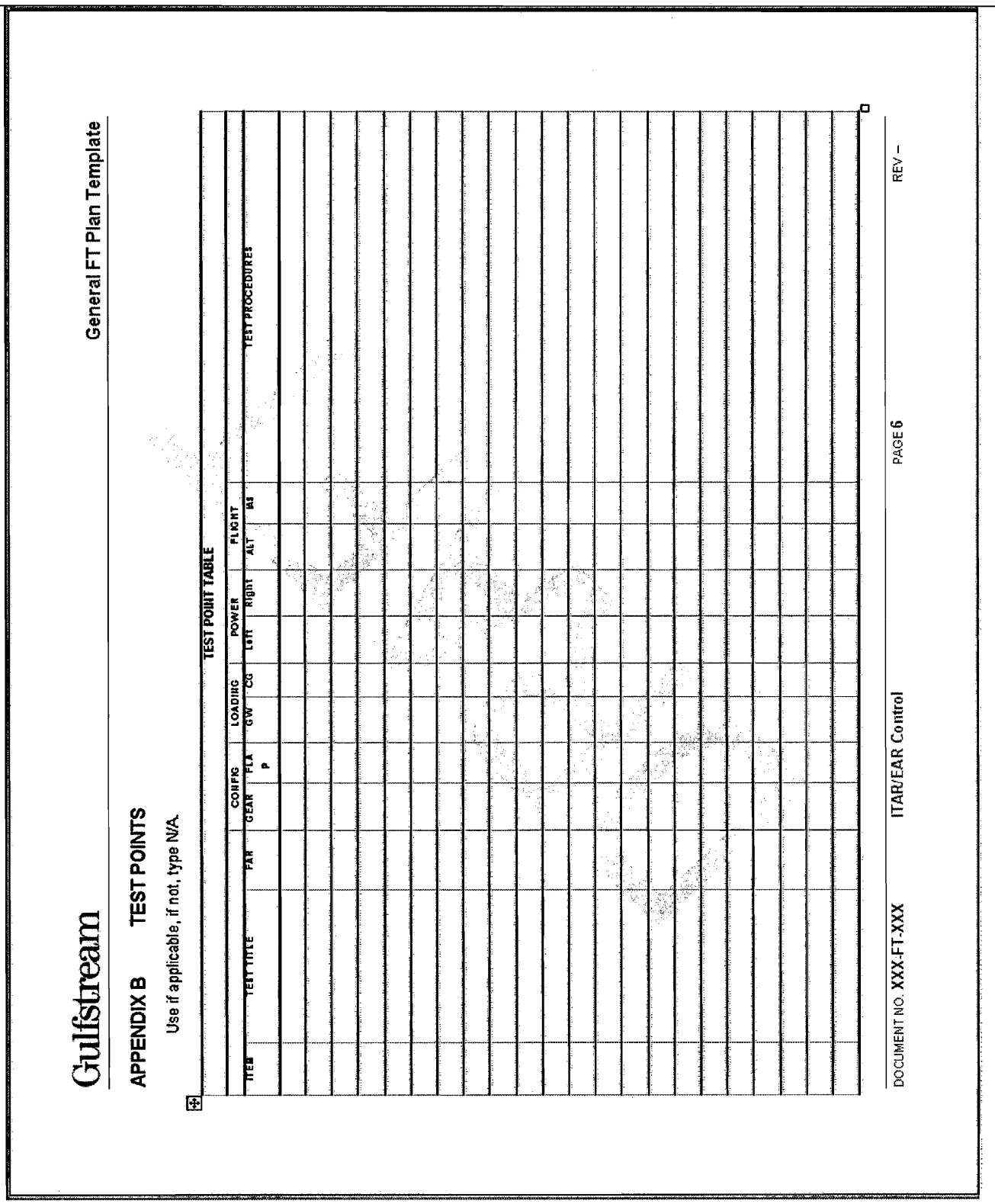
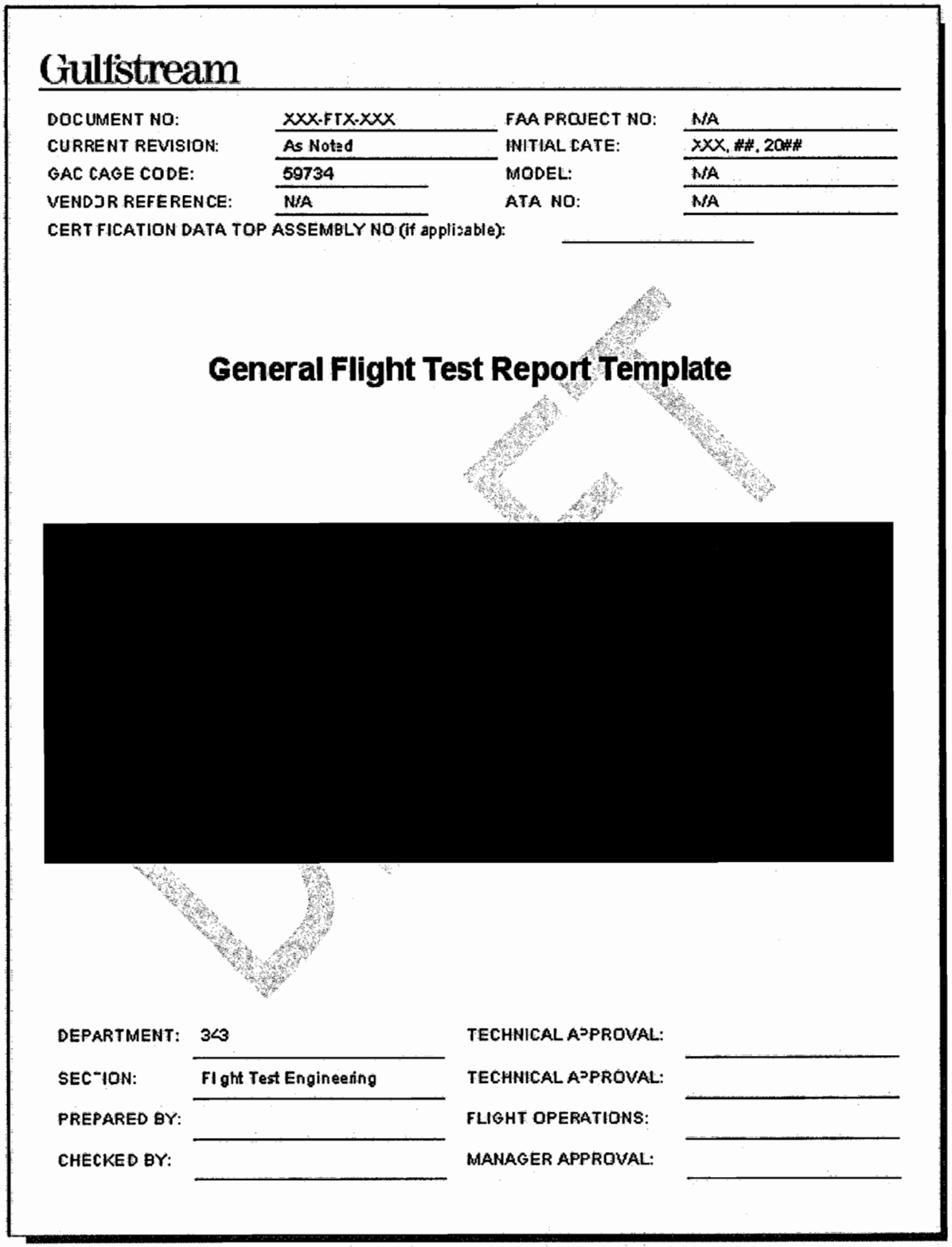


FIGURE 28 - GENERAL FLIGHT TEST PLAN TEMPLATE TEST POINT TABLE EXAMPE

Appendix A.7 Flight Test Report Template

Refer to the Engineering Documentation Standards Templates intranet page [redacted] for the complete Flight Test Report Template.

[redacted]



Gulfstream

DOCUMENT NO:	XXX-FTX-XXX	FAA PROJECT NO:	NA
CURRENT REVISION:	As Noted	INITIAL DATE:	XXX, ##, 20##
GAC CAGE CODE:	59734	MODEL:	NA
VENDOR REFERENCE:	N/A	ATA NO:	NA

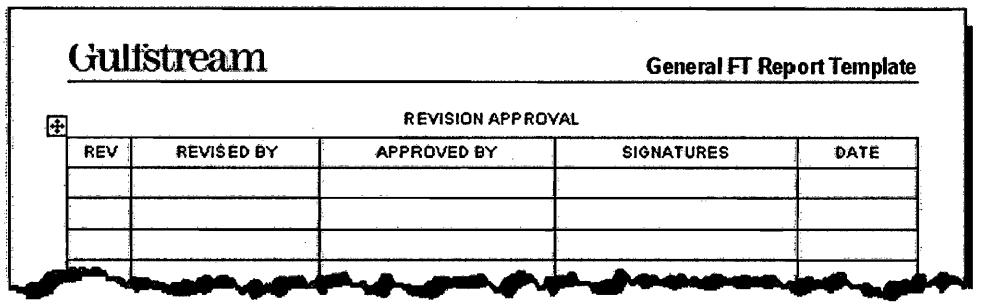
CERTIFICATION DATA TOP ASSEMBLY NO (if applicable):

General Flight Test Report Template

[redacted]

DEPARTMENT:	343	TECHNICAL APPROVAL:	
SECTION:	Flight Test Engineering	TECHNICAL APPROVAL:	
PREPARED BY:		FLIGHT OPERATIONS:	
CHECKED BY:		MANAGER APPROVAL:	

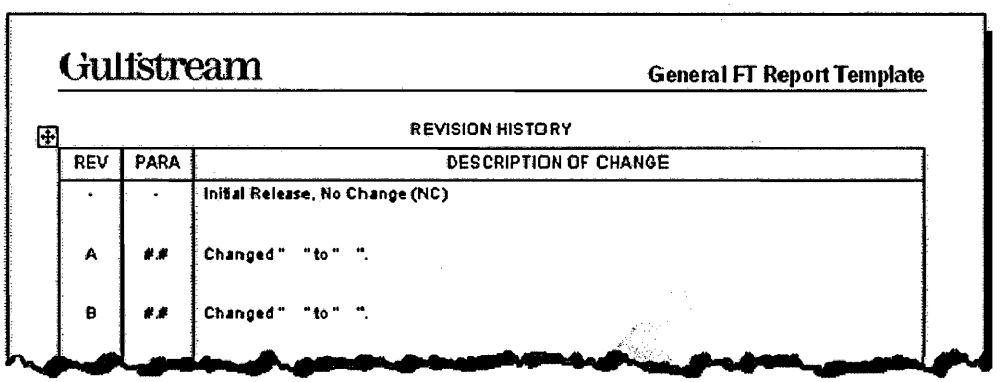
FIGURE 29 - GENERAL FLIGHT TEST REPORT TEMPLATE EXAMPLE



Gulfstream — General FT Report Template

REVISION APPROVAL

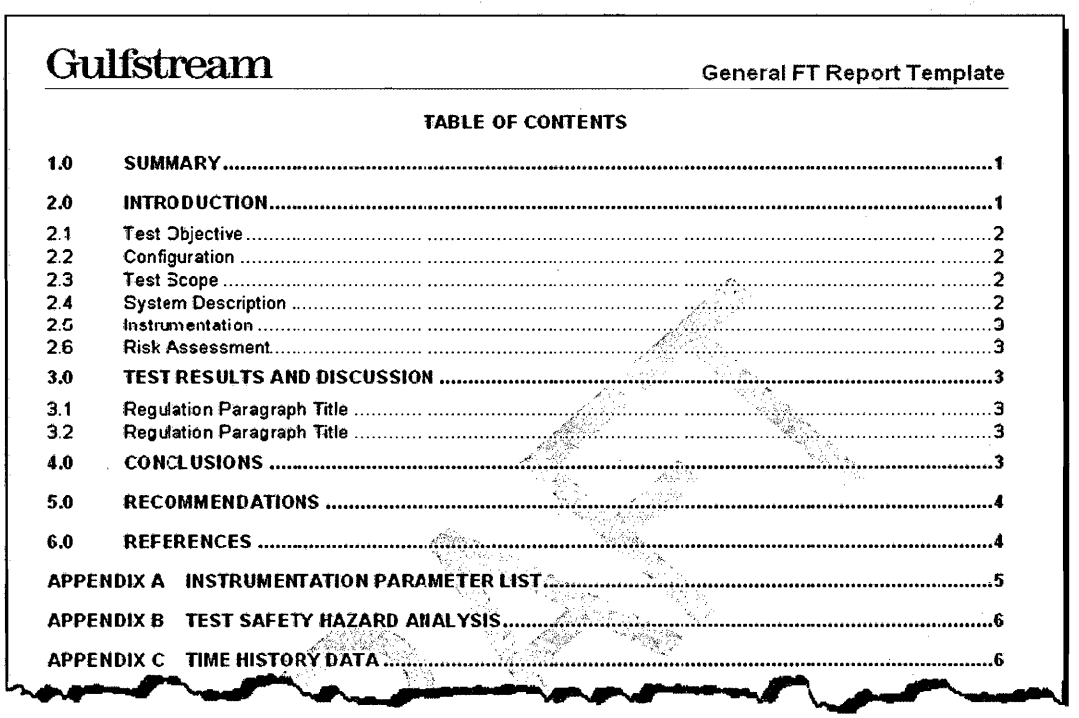
REV	REVISED BY	APPROVED BY	SIGNATURES	DATE



Gulfstream — General FT Report Template

REVISION HISTORY

REV	PARA	DESCRIPTION OF CHANGE
-	-	Initial Release, No Change (NC)
A	#.#	Changed " "to " ".
B	#.#	Changed " "to " ".



Gulfstream — General FT Report Template

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Gulfstream — General FT Report Template

1.0 SUMMARY

This section provides a brief, executive summary of the test results, but should be detailed enough to provide the reader with enough information to determine if further reading is necessary. The information in this summary includes a brief description of the purpose of the test (for example, compliance, functional check, research and development, etc.) the type or subject of the test, the significant results, conclusions, and major recommendations.

If graphics are included in this document, use the following format:

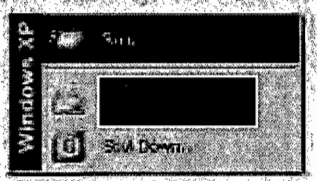


FIGURE 1 – EXAMPLE GRAPHIC WITH TITLE PLACED BELOW

2.0 INTRODUCTION

Start this section with a clear statement of the purpose and type or subject of the testing mentioned in the summary section. All background material should be discussed in this section. The information should provide the framework and appropriate context for the test results reported. Background information is useful to help the reader understand why the tests were convened (for example, in-service problem, research and development, support certification, etc.).

If necessary, you may insert the applicable portion of the table from the test plan document as shown in Table 1.

TABLE 1 – EXAMPLE APPLICABLE REGULATION INFORMATION

Regulation Paragraph Number 14 CFR Part 25 / CS (As Required)	Amendment	Regulation Paragraph Title
103 (a), (b), (c), (d)		Stall Speed Determination
[regulation paragraph number]		[regulation paragraph title]

2.1 Test Objective

State the detailed objective of the tests, including the applicable Federal Aviation Regulation(s) (FAR) or a paraphrasing of the applicable FAR(s). This section provides the specific criteria necessary to achieve the testing purpose. The test plan should be referenced here along with a restatement of the pass/fail criteria for the testing.

For example, if the test purpose is to support an FAA type certificate (TC) or supplemental type certificate (STC) project, then the objective is to show compliance with the applicable regulations. If the project is research and development oriented, refer to the applicable engineering documents for specific criteria or characteristics of testing. Refer to appropriate guidance material or to project specific Issue Papers.

2.1 Test Objective

State the detailed objective of the tests, including the applicable Federal Aviation Regulation(s) (FAR) or a paraphrasing of the applicable FAR(s). This section provides the specific criteria necessary to achieve the testing purpose. The test plan should be referenced here along with a restatement of the pass/fail criteria for the testing.

For example, if the test purpose is to support an FAA type certificate (TC) or supplemental type certificate (STC) project, then the objective is to show compliance with the applicable regulations. If the project is research and development oriented, refer to the applicable engineering documents for specific criteria or characteristics of testing. Refer to appropriate guidance material or to project specific Issue Papers, special conditions, or equivalent safety findings for unique or novel criteria requirements. This section informs the reader about exactly what is intended to be achieved by this test.

2.2 Configuration

This section should be the same as in the test plan. Items to note here are any deviations from the intended configuration, reasons for the change, and what impact (if any) there is to the testing conducted.

2.3 Test Scope

Provide brief information about test aircraft, number of flights, test crew, etc. Refer to flight log table. State clearly whether all testing was completed, if any tests were not completed, or if there were any added tests. Details of added or deleted tests or test points should be provided in Test Results and Discussion section.

TABLE 2 - SUMMARY FLIGHT TEST INFORMATION

A/C No.	Date	Flight No.	ZFGW	ZFCG	TOGW	TOCG	Crew
XXXX	DDMMYY	XXX	XXXXX lbs	%	XXXXX lbs	%	Name, role Name, role Name, role

2.4 System Description

Same as test plan. Note any deviations to the plan and impact to the testing.

2.5 Instrumentation

Same as test plan. Instrumentation list is included in Appendix A.

Note any deviations to the plan and impact to the testing.

2.6 Risk Assessment

If applicable, this section discusses the results of the Safety Review Board (SRB). Include statements which classified proposed tests with Low/Medium/High probability and consequence scales. Include applicable SRB meeting minutes and copies of the final, signed-off TSHA forms in Appendix B: Test Safety Hazard Analysis.

3.0 TEST RESULTS AND DISCUSSION

This section provides additional information about the testing methodology arranged according to the Regulation Paragraph Title as listed in the regulatory material listed in the associated plan document in Section 2.0, Applicable Regulations or Documentation.

3.1 Regulation Paragraph Title

The test results for each test procedure conducted during the test program must be discussed in this section. This should include a description of how the test was done and any deviations from the planned test procedure. Provide discussion of any test points added during the testing, or test points determined to be not required. Include all test points in the discussion, even if they did not meet the requirements, especially if certifying authorities participated in the testing. Indicate with a brief statement which points were not acceptable and why.

The test results can be presented in a variety of formats, based on the type of test conducted. The report writer will determine the best method, generally, a summary table with test point number, flight conditions, and figure number for reference time history data located in the Appendix C, Time History Data. Appropriate cross plots or other data should be included here as required to support the results. Note whether the test objectives were met or not.

3.2 Regulation Paragraph Title

Repeat as necessary.

4.0 CONCLUSIONS

Use this section to state conclusions based on data discussed in the test results and discussion section.

5.0 RECOMMENDATIONS

This section is optional.

If the test results are satisfactory, then the recommendation should be to submit the data to engineering or to the FAA as appropriate. For example:

> It is recommended that this report be submitted to [Gulfstream Engineering or the FAA] as documentation that the [x modifications/enhancements] to the [type] aircraft, S/N XXXXXX, has demonstrated compliance with the applicable requirements of 14 CFR [XX], as defined in Table X, Regulation Information, in XXX-FT-XXX, the associated flight test plan.

This section is also used to document any procedural process changes identified during the testing process.

6.0 REFERENCES

This section provides a list of all reference documents using the following format:

Document Number, Document Title, Document Release Date

Otherwise, refer to the Chicago Manual of Style or call Engineering Process Control for guidance in structuring your list of references. Two examples of the Chicago Manual of Style methodology for documenting resources follow:

- Book: Last Name, First Name, *Title*. Edition. Location: Publisher, Year.
- Online Book: Last Name, First Name, *Title*. Edition Location: Publisher, Year. URL (accessed Month Day, Year).

Gulfstream General FT Report Template

APPENDIX A INSTRUMENTATION PARAMETER LIST

The following parameters were recorded and form part of the data in this test report:

IADS Short Name/ GAC Code	IADS Parameter Name	IADS Long Name/ Description	Source	Units
[From Instrumentation Parameter List]	[From Instrumentation Parameter List]	[From Instrumentation Parameter List]	429, ASCB, Derived, Analog, etc	[From Instrumentation Parameter List]

Gulfstream General FT Report Template

APPENDIX B TEST SAFETY HAZARD ANALYSIS

Include Safety Review Board Meeting Minutes and final, signed TSHA form(s) here if applicable, and if not, type N/A

APPENDIX C TIME HISTORY DATA

Include time history data for flights.

Note: You may have multiple time history data appendices, depending on the number of tests reported in the report.

Appendix A.8 Hazard Classification Guide

Risk Rating Assessment Guidance: The following criteria should be considered in assigning risk rating to test conditions:

1. Envelope expansion (higher risk) vs operations within a stable, proven region of the flight envelope (lower risk)
2. Altitude and airspeed in relation to established flight envelope limits or terrain and/or airplane recover equipment (higher)
3. Test technique and workload (higher workload could increase risk)
4. Gross weight and CG, in relation to envelope limits (operations near limits increase risk)
5. Environment (weather, ATC, Airport conditions and obstacles, lighting etc) (low visibility, obstacles increase risk)
6. Airplane internal environment (smoke, temperature, pressurization etc.) (abnormal or emergency procedures testing increase risk)
7. Design maturity –for example first attempts to define aerodynamic stall limit would be considered high risk, while subsequent approaches to a programmed alpha limiter or push would be considered a lower risk level and not required stall recovery parachute
8. Test condition sequence
9. Adverse system or software effects
10. Specific aircraft limitations
11. Consequence of failure in technique, system, or structure
12. Intentional multiple failure conditions (for example, single engine flight in EBHA FCS mode of operation)
13. Simulator, lab result, historical experiences, predictive studies
14. Crew proficiency, currency, familiarity, with the type of the test being performed and aircraft type

Risk Alleviation Guidance: Risk alleviation procedures are actions to minimize, understand, or respond to risk. They should be actions the flight test crew has control over or events that the test crew can confirm have occurred (ie lab testing, simulator evaluations, etc.). The following criteria should be considered in defining risk alleviation procedures::

1. Is the test condition in its present form really needed? Does the FAA need to repeat a test point or can it be done once, for concurrent credit? Can the test point be delegated?
2. Length of time since configuration validating or conformity
3. Review test techniques and specify steps to reduce the risk
4. Design the test for a conservative build up of maneuvers
5. Review the test environment and specify steps to reduce the risk (temperatures, winds, visibility are some examples)
6. Provide predications and expectations to prepare participants. Update performance predictions with flight test data when possible
7. Run test in simulator, lab, etc.
8. Provide special training and consultation

9. Specific training and equipment requirements (helmets, goggles, masks, oxygen, escape provisions, parachutes, fire extinguishing systems, escape saw and axes)
10. Use of chase plane observations to provide visual feedback
11. Use of photo/video coverage
12. Use of telemetry to monitor the tests in real time
13. Install hardware to protect structure and personnel
14. Limit personnel onboard to the absolute minimum required to safely conduct the test (do not arbitrarily set a limit on the number of personnel, take the right number to safely conduct the test)
15. For build up tests, utilize the right personnel to evaluate the data and plan for subsequent tests. Allow for adequate time to evaluate the build up test points
16. Schedule flight crews based on crew qualifications and recent experience relative to the required tests being conducted
17. On certain potentially hazardous ground tests (e.g. high energy RTOs), experienced ground crews should be briefed during the preflight briefing and be immediately available to support the tests if necessary (e.g. cooling fans, fire trucks, aircraft jacks, etc.). The ground crews should be advised as to who is in charge, regarding their participation.
18. Review weight and balance computations. Weigh the loaded aircraft if necessary. This is particularly important on critical handling qualities tests at the extremes of the weight/CG envelope and WAT limited performance tests
19. Minimize the number of actual engine cuts during runway performance testing if spool-down thrust can be properly accounted for by analysis and related systems failures can be accurately simulated
20. All test personnel should be briefed on egress procedures
21. For high altitude flights, all crewmembers must be briefed on oxygen use/location
22. For over water flights, all crewmembers must be briefed on water survival equipment use/location
23. Test personnel involved with cold/hot weather testing should be briefed on appropriate survival skills, and be properly equipped to endure the anticipated environment

SRB Example Questions

The following questions are examples of the types of questions to be addressed at a Safety Review Board meeting:

- Have the project pilot, safety representatives, maintenance and support personnel participated in the planning process and provided inputs? (yes = lower risk)
- Does the test plan reflect inputs and considerations of all aspects of the test including supporting activities and special support items? ? (yes = lower risk)
- Have the test sorties been planned logically and progressively so that the least hazardous conditions are experienced and evaluated early in the program before the more hazardous ones? ? (yes = lower risk)
- Does the test require special instrumentation? If so, has a Failure Modes Effects Analysis (FMEA) been prepared and a safety analysis of the installation performed or scheduled? ? (yes/no = higher risk)
- Have all anticipated hazards and precautions taken in response to them been documented? (yes = lower risk)
- What hazards remain after the precautions? Do these constitute any undue risk? (yes = higher risk)

- Has the possibility of multiple failures of systems during the test been recognized and addressed? (yes = lower risk) What actions would be required of the flight crew in response to multiple malfunctions? Are there any combinations of emergencies that could be catastrophic? (yes = higher risk)
- Is the program build-up for the hazardous tests satisfactory? (yes = lower risk)
- Are pilots trained for tests? (yes = lower risk)
- Who will make the go and/or no-go decisions for the tests?
- What limitations are imposed on the test by the airplane (structure, design), engineering (of the test airplane, test item or test equipment) or by the technical data?
- Has the number of crew members been kept to the minimum consistent with mission accomplishment? (yes = lower risk)
- Will any aspect of the test present an undue hazard to ground personnel or property? (yes = higher risk)
- Will the currently approved flight envelope be exceeded? (yes = higher risk) Has the envelope expansion been approved?
- Will safety- or photo-chase airplanes be required? (yes = higher risk)Has the chase pilot been included in test planning? (yes = lower risk) Have the chase pilot's duties been clearly identified? (yes = lower risk)
- Will radar tracking, telemetry, ground-based photography, or other ground-based support be required? (yes = lower risk)
- Will operational suitability of critical components be proven before the airplane is tested in a regime where such components may be subjected to extreme demands? (yes = lower risk)
- Have all ground crews (including test engineers, firefighters, crash rescue teams, and maintenance personnel) been appropriately trained? (yes = lower risk)
- Are there provisions to handle unexpected safety deficiencies? (yes = lower risk) Are there procedures in-place to immediately notify management and safety personnel of safety related events that occur during testing? (yes = lower risk)

Appendix A.9 Flight Test Briefing and De-Briefing Guide

The Gulfstream test mission briefing guide follows the requirements of FAA Order 4040.26A but moderated according to the order of material presented in the Test Card format

Test Card Cover Sheet

1. Flight Number
2. Purpose of the Test / Risk Classification
3. Zero Fuel Gross Weight/CG
4. Fuel Load
5. Takeoff Gross Weight/CG
6. Takeoff Flap and Reference Speeds
7. Emergency and Backup Communication Frequencies
8. Aircraft Configuration
9. Limitations / Restrictions
10. Hazard/TSHAs summary
11. Emergency equipment installation
12. Crew Members and Duties
13. Test Area Locations / Altitudes
14. Weather
15. Fuel Reserve Requirements
16. Primary / Alternate Landing Sites
17. Expected Landing Time
18. Emergency Response Plan (Coast Guard telephone numbers and frequencies)

Weight and Balance

19. Detailed review of Weight & Balance

THSAs

20. Medium and High Risk TSHAs discussed individually, including Preventative and Corrective Techniques

Individual Test Cards (in order of expected execution)

21. Test card number , Title, and Risk Classification
22. Test point set up / configuration requirements
23. Run number and test procedure steps (build up points will be assigned specific Run numbers (Note, Run numbers are a composite of the Test card number + a sequential letter ie/ 2A, 2B, 2C...)
24. Test Monitoring and Success Criteria

Instrumentation Status

25. Complete Preflight

Maintenance Status

26. Relevant Maintenance Actions
27. Open Squawks
28. Complete Preflight

QC Status

29. Complete Maintenance and Instrumentation Preflight Release

Appendix A.10 FAA MOU Flight Test Safety & Risk Assessment

Memo of Understanding

Flight Test Safety and Risk Assessment
between
FAA Atlanta Aircraft Certification Office and Gulfstream Aerospace Corporation

I. INTRODUCTION

This Memorandum of Understanding (MOU) between the Federal Aviation Administration Atlanta Certification Office (AACO) and Gulfstream Aerospace Corporation (GAC) is intended to establish a jointly agreed upon flight test risk assessment program for the FAA Type Certification and Supplemental Type Certification programs conducted by GAC or associated Completion and Service Centers. The MOU will serve as a guideline to insure an acceptable level of risk is established and maintained for all flight test activities involving FAA managed certification programs.

II. OBJECTIVE

This MOU coordinates GAC's Flight Test Risk Assessment/Risk Alleviation process and the FAA Risk Assessment Program as required by FAA Order 4040.26A to establish an Accepted Risk Assessment Process for evaluating and minimizing hazard levels in FAA certification testing.

III. REFERENCES

1. FAA Order 4040.26A Aircraft Certification Service Flight Safety Program
2. FAA Atlanta Aircraft Certification Office, Standard Operating Procedures, -No: A-23-115 Rev B Flight Test Risk Management and Risk Assessment Process
3. Gulfstream Aerospace Corporation Flight Test Standard Practices Manual (GV-GER-1329) Section 5 Risk Assessment/Risk Alleviation
4. Gulfstream Aerospace Corporation Flight Operations Manual – Revision 4 dated 11/1/97

IV. TEST PLANNING

GAC is responsible for planning the test program and providing documentation to the FAA that outlines the means of compliance with Federal Regulations. Future documentation will also include an assessment of the risk involved in the Certification flight test program (see procedures below). This documentation will be coordinated with the FAA Program Manager (PM) and the AACO is responsible for providing their approval with the proposed means of compliance. In addition, the AACO will provide concurrence with the GAC Risk Assessment prior to issuance of the TIA. The FAA must be given an adequate time for review and approval. Two to four weeks is considered adequate time for review and approval. Changes to the Certification Flight Test program after release of the TIA must be subjected to the Risk Assessment/Risk Alleviation procedures specified by GAC standard practices and submitted to the AACO for concurrence.

V. TEST CONDUCT

The Flight Test Techniques used during FAA Certification Programs will be those procedures refined and successfully utilized during the GAC development testing or prior Certification programs. If such procedures differ from published FAA guidance material differences must be resolved by preparation of an Issue Paper and coordinated with FAA Transport Airplane Division. For HIGH risk test points and those unique situations where a test point is being conducted for the first time with FAA Flight Test personnel for Certification credit, the pilot flying will be coordinated between FAA and GAC test crews to insure the highest level of safety is maintained.

Testing conducted during an FAA test flight will be limited to the test points and procedures reviewed during the preflight briefing and documented on the Flight Test Cards. Exceptions to this can be considered if the deviations are minor, have an insignificant impact on the planned flight and are approved by the GAC Pilot in Command. The preflight briefings will also include a review of applicable Test Safety Hazard Analysis (TSHAs) that have been generated for any MEDIUM or HIGH risk testing. These documents provide procedures for risk mitigation and are the basis for establishing an acceptable level of risk.

All flight testing shall include necessary environmental precautions appropriate to the planned test and test location (e.g., over water, arctic, desert, etc.). All tests identified as MEDIUM or HIGH risk shall be completed no less than one hour prior to sunset to allow adequate time for search and rescue efforts.

VI. RISK LEVEL

FAA may not participate in testing rated by GAC as HIGH risk without written authorization from the Manager, AACO. FAA personnel participating in LOW and MEDIUM risk level tests will be governed by the GAC Flight Test Risk Assessment/Risk Alleviation process.

VII. STAFFING

FAA personnel that could be involved with flight testing includes Flight Test Pilots, Flight Test Engineers and Engineering Specialists. GAC will be notified of FAA personnel expected for each series of tests. The FAA will try to minimize personnel changes during a certification program in order to provide continuity. It is possible that additional FAA personnel may be brought into the program to facilitate meeting GAC schedules or that personnel may be rotated to meet other FAA commitments.

VIII. TRAINING

GAC will provide informal training for all FAA personnel who participate in the flight test program. Follow-on training and training of replacement personnel will also be provided by GAC.

FAA will provide formal training as required to assure that all personnel participating in GAC flight tests are properly qualified. This training shall include survival and physiological training as well as pilot proficiency training as necessary to maintain currency in category and class aircraft.

IX. DUTY TIME

FAA Flight Crew Members will observe the Crew Duty and Crew Rest Requirements specified in the GAC Flight Operations Manual 1 (see Ref. 4) or the Aircraft Certification Service (AIR) Flight test Operations Manual, whichever is more restrictive..

The FAA Flight Crew Members must approve any request to extend the prescribed Crew Duty/Rest requirements prior to obtaining concurrence from GAC's Chief Test Pilot.

X. PROCEDURES

GAC will provide a Risk Assessment section in all Certification Flight Test Plans submitted for Type Certification projects. This section will specify the level of risk involved and identify testing that is considered either MEDIUM or HIGH Risk.

GAC will provide a Risk Assessment section in all Certifications Plans submitted to the AACO for Completion Center and Service Center STC projects. This section will specify the level of risk involved and identify testing that is considered either MEDIUM or HIGH Risk.

GAC will provide Test Safety Hazard Analysis forms that define procedures for minimizing the associated hazards for all test points that are either MEDIUM or HIGH Risk.

GAC will convene Safety Review Boards for FAA programs when Certification testing exceeds the scope or risk of GAC Development testing.

GAC's FAA Coordinator will provide notification of Flight Test SRB activity relating to FAA Test Programs.

GAC will notify FAA of any changes to the corporate Safety Review Process.

FAA will participate as an observer in GAC Flight Test Safety Review Boards (SRB) that are convened for Certification Testing as required.

FAA will concur with the proposed risk assessments provided in the Certification Documentation mentioned above prior to issuance of the TIA.

FAA will obtain written authorization from the ACO Manager to participate in any testing classified as HIGH risk.

FAA will include in the 18B Section of each TIA a statement for the Flight Test Pilot to review the TSHAs for possible safety precautions to incorporate in the conduct of testing.

FAA Flight Test Crew members will review each Test Safety Hazard Analysis (TSHA) and must concur with the proposed risk alleviation methods prior to conducting any FAA Test Flight.

XI. CONCLUSION

FAA has reviewed the GAC processes for Flight Safety and Flight Operations and considers them acceptable to establish an adequate level of safety for FAA Flight Test programs conducted for the purposes of Type Certification and/or Supplemental Type Certification.

[redacted]
Manager, Flight Test
FAA AACO

8/7/08
Date

[redacted]
Vice President, Engineering
Gulfstream Aerospace Corp

7/30/08
Date

[redacted]
Director, Flight and Lab Test
Gulfstream Aerospace Corp

7/15/08
Date

[redacted]
Vice President, Flight Operations
Gulfstream Aerospace Corp.

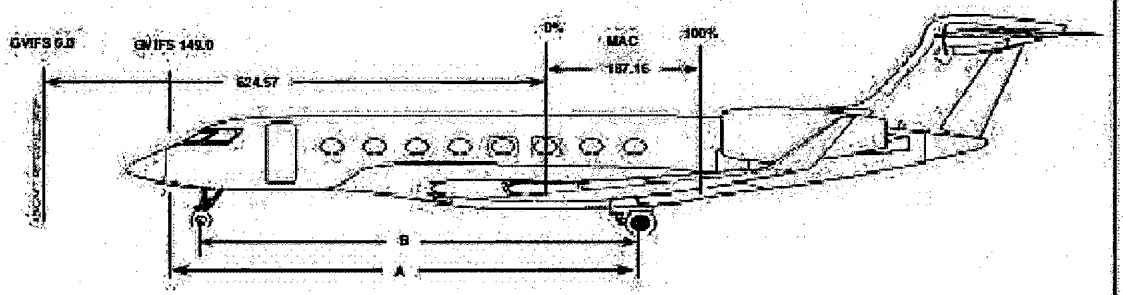
7/23/08
Date

Appendix A.11 Weight and Balance Forms

GULFSTREAM AEROSPACE
G650 WEIGHT & BALANCE MANUAL

WEIGHING RECORD

GULFSTREAM G650 S/N _____ REGISTRATION NO. _____



DISTANCE	FT & IN		IN
A			
B			
A-B			

MAIN GEAR REACTION = A + jig point = IN
NOSE GEAR REACTION = (A - B) + jig point = IN

Jig point GVIFS 149.0

$$\text{CG IN PERCENT MAC} = \frac{(\text{GVIFS IN INCHES}) - 624.57}{187.16}$$

(AIRPLANE ON WHEELS / JACKS)*

LOCATION	GROSS	TARE	ERROR	TOTAL	NET	**GVIFS	MOMENT
LEFT MAIN							
RIGHT MAIN							
SUBTOTAL MAINS							
NOSE							
TOTALS							

EMPTY WEIGHT & CG DETERMINATION

ITEM	WEIGHT	CG GVIFS	CG % MAC	MOMENT
TOTAL NET (FROM ABOVE)				
SHORTAGES/SURPLUSES				
Unusable fuel (drainable portion)				
EMPTY WEIGHT				

WEIGHED BY : _____ WITNESSED BY : _____ DATE : _____

*DELETE AS APPROPRIATE. PREPARED BY : _____
**IF WEIGHED ON JACKS, USE GVIFS= 752.1 (MAIN) 224.1 (NOSE)

FIGURE 30 – W&B FORM A

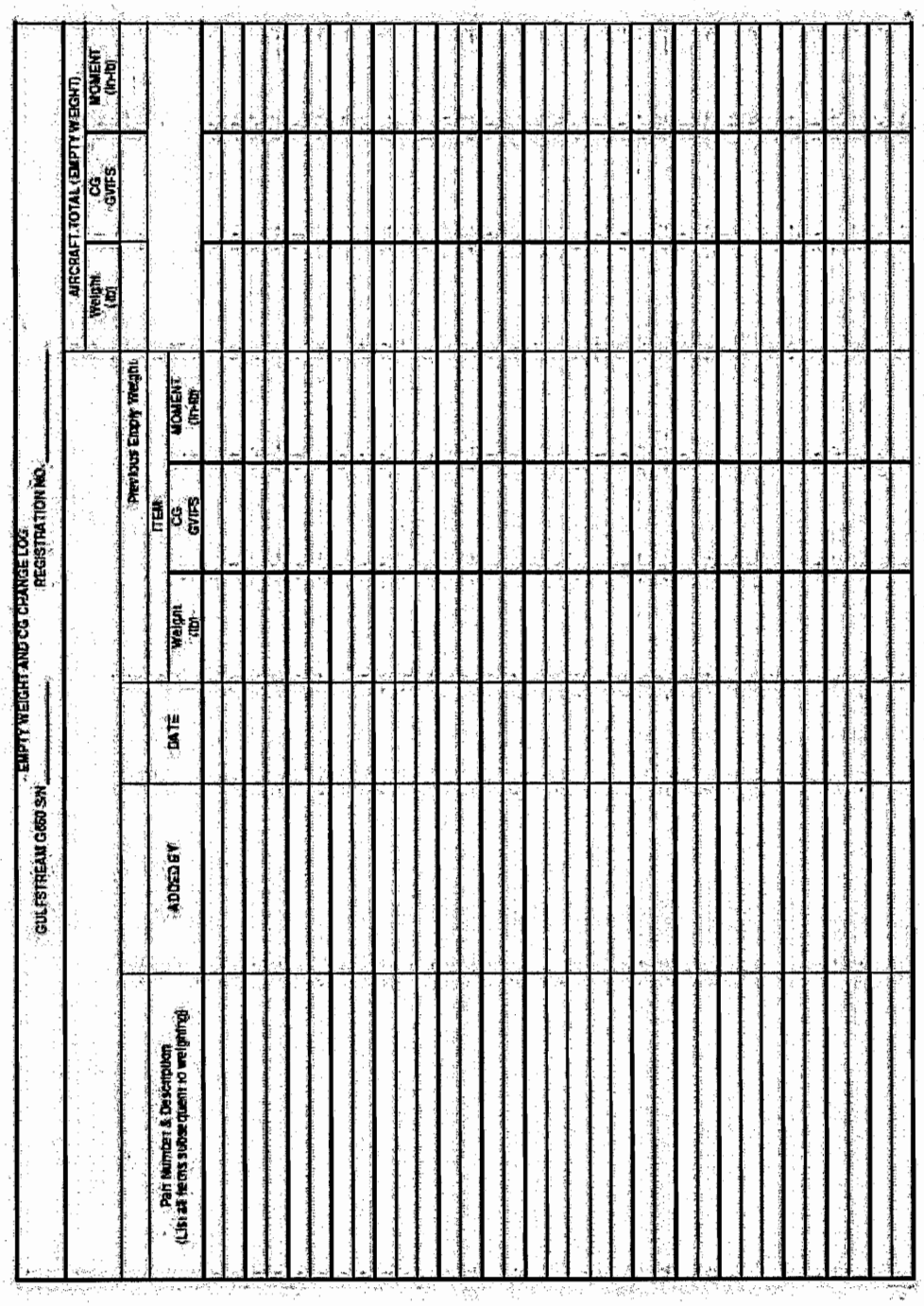


FIGURE 31 – W&B FORM C

FLIGHT LOADING COMPUTATION FORM
GULFSTREAM G650 S/N_____ REGISTRATION NO._____

Trip No.	Take-Off Field Length
Date	Temp_____ °C Allowable TOW
To	Estimated Landing Weight
From	Landing Field Length Required

ITEMS	WEIGHT	GVIFS	MOMENT
Empty Weight			
Add Operating Items			
Operating Weight			
Add Payload:			
Zero Fuel Weight (60,500 lb Max)			
Add Fuel:			
Ramp Weight (100,000 lb Max)			

FIGURE 32 – W&B FORM D

Appendix A.12 Example FTE Flight Report

G150 S/N 201
Flight 039
Flight 040
Flight 041
26 October 2008
Crew: [redacted]

Flight Data:

	039	040	041
Block Time	0+26	1+59	0+44
Flight Time	0+16	1+53	0+39
	1 Landing	5 Landings, 16 T&G	3 Landings

Purpose:
Steep Approach Landings

Configuration Notes:

- Video camera(2) Pilot and Copilot MFD view
- Pilot brake pedal position transducer installed
- DCU-5010 Software version 4.2 (EMOD 02)

Flight Summary:

[redacted]

Maintenance Issues:

[redacted]

Instrumentation Issues:
None