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Operational Suitability Data (OSD)
Flight Crew

Gulfstream GV / GV-SP (G500/G550) / GIV-X (G450/G350)

21 May 2015

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Revision Record

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JOEB Report Rev. 7	JOEB report Gulfstream GV / GV-SP (G500/G550) / GIV-X (G450/G350)	15 Jun 2006
OSD FC Original	Replaces and incorporates the JOEB report for the Gulfstream GV / GV-SP (G500/G550) / GIV-X (G450/G350)	21 May 2015

Contents

Acronyms

AC ..... Advisory Circular

AFM ..... Aircraft Flight Manual

AGL ..... Above Ground Level

AMC ..... Acceptable Means of Compliance

AP ..... Autopilot

AT ..... Autothrottle

CBT ..... Computer Based Training

CPD ..... Common Procedures Document for conducting Operational Evaluation Boards, dated 10 June 2004

CRM ..... Crew Resource Management

CS-FCD ..... Certification Specifications for Operational Suitability Data (OSD) Flight Crew Data CS-FCD, Initial issue, 31 January 2014

CS-FSTD(A) ..... Certification Specifications for Aeroplane Flight Simulation Training Devices of 4 July 2012

Difference Level ..... A designated level of difference as defined in CS-FCD

DU ..... Display Unit

EASA ..... European Aviation Safety Agency

EFB ..... Electronic Flight Bag

EFIS ..... Electronic Flight Instrument System

EGPWS ..... Enhanced Ground Proximity Warning System

EU-OPS ..... Commission Regulation (EC) No 859/2008 of 20 August 2008 amending Council Regulation (EEC) No 3922/91 as regards common technical requirements and administrative procedures applicable to commercial transportation by aeroplane.

EVS ..... Enhanced Vision System

FAA ..... Federal Aviation Administration

FADEC ..... Full Authority Digital Engine Control

FAR ..... Federal Aviation Regulation

FCS ..... Flight Control System

FFS ..... Full Flight Simulator (Level C/D)

FPA ..... Flight Path Angle

FPV ..... Flight Path Vector

FSB ..... Flight Standardization Board

FTD ..... Flight Training Device

GM ..... Guidance Material

HUD ..... Head-up Display

ISI ..... Independent Standby Instrument

LIFUS ..... Line Flying Under Supervision

LPC ..... Part-FCL Licence Proficiency Check

LOFT ..... Line Orientated Flying Training

LST ..... Licence Skill Test

MDR ..... Master Difference Requirements

MEL ..... Minimum Equipment List

MFD ..... Multi-Function Display

MMEL ..... Master Minimum Equipment List

MMO ..... Maximum Operating Mach Number

NAA ..... National Aviation Authority

ND ..... Navigation Display

OEB ..... Operational Evaluation Board

ODR ..... Operator Differences Requirements

OPC ..... Operator Proficiency Check

OSD ..... Operational Suitability Data

Part-FCL ..... Flight Crew Licensing: Annex I to Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)

Part-ORO ..... Organisation Requirements for Air Operations: Annex III to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)

Part-SPA ..... Specific Approvals: Annex V to Commission Regulation (EU) No 965/2012 of 05 Oct 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (as amended)

PF ..... Pilot Flying

PFD ..... Primary Flight Display

PIC ..... Pilot In Command

PM ..... Pilot Monitoring

QRH ..... Quick Reference Handbook

RAAS ..... Runway Awareness Advisory System

Route Sector ..... as defined in Part-FCL [“Route sector" means a flight comprising take-off, departure, cruise of not less than 15 minutes, arrival, approach and landing phases]

SIC ..... Second In Command

SFD ..... Standby Flight Display

SMC ..... Standby Multifunction Controller

TASE ..... Training Areas of Special Emphasis

TAWS ..... Terrain Awareness and Warning System

TCAS ..... Traffic Alert and Collision Avoidance System

V2 ..... Take-off Safety Speed

VNAV ..... Vertical Navigation

Preamble

1. Introduction

Where references are made to requirements and where extracts of reference texts are provided, these are at the amendment state at the date of evaluation or publication of this document. Users should take account of subsequent amendments to any references, in particular concerning requirement for civil aviation aircrew and air operations.

Determinations made in this document are based on the evaluations of specific configurations of aircraft models, equipped in a given configuration and in accordance with current regulations and guidance.

Modifications and upgrades to the aircraft evaluated require additional OSD assessment for type designation, training / checking / currency, operational credits, and other elements within the scope of the OSD evaluations.

In accordance with Commission Regulation (EU) No 69/2014 of 27 Jan 2014, the Operational Suitability Data contained in this document are identified as follows:

[M]..... mandatory Operational Suitability Data, bearing the status of rule (see GM No 3 to 21A.15(d))

[AMC] ..... non-mandatory Operational Suitability Data, bearing the status of Acceptable Means of Compliance (see GM No 3 to 21A.15(d))

2. Operational Evaluation Gulfstream GV / GV-SP (G500/G550) / GIV-X (G450/G350)

An integrated team composed of 8 pilots from the FAA and JAA conducted the Operational Evaluation (OE) as a joint effort.

A JOEB Gulfstream V ‘catch up’ evaluation was completed on 14 June 2004, taking existing evaluations from the FAA FSB report into consideration.

The joint evaluation of the Gulfstream V-SP aircraft by the JAA and the FAA was completed on 20 February 2003. System differences were reviewed and Normal, Abnormal, and Emergency procedures compared for the Gulfstream V and Gulfstream V-SP. Sample Operator Difference Requirements were examined and proposed differences training reviewed. Both the Gulfstream V-SP and the Gulfstream V aircraft were flown to assess any potential differences in handling qualities.

The joint evaluation of the Gulfstream IV-X aircraft by the JAA and FAA was completed in May 2004. System differences were reviewed and Normal, Abnormal, and Emergency procedures compared for the Gulfstream IV-X, the Gulfstream V and the Gulfstream V-SP.

The Gulfstream V-SP is the baseline aircraft that is more commonly known as the “G550” by installation of ASC011. The “G500” is a derivative of the “G550” by installation of ASC010 (which reduces the amount of fuel that can be carried and makes HUD and VGS or HUD optional equipment) therefore all references in this report to the “Gulfstream V-SP” also apply to the “G550” and the “G500”.

The Gulfstream IV-X is the baseline aircraft more commonly known as the “G450” by installation of ASC005. The “G350” is a derivative of the “G450” by installation of ASC004 (which reduces the amount of fuel that can be carried) therefore all references in this report to the “Gulfstream IV-X” also apply to the “G450” and the “G350”.

The flight control hydraulics of the GIV-X have been modified to replicate the handling characteristics of the Gulfstream V and the Gulfstream V-SP.

T-2 tests were conducted on the Gulfstream V-SP aircraft and on a Gulfstream V FFS, as well as on a Gulfstream GIV-X aircraft and on a Gulfstream V-SP aircraft.

3. Head-Up Display – HUD

A JOEB evaluation of the HUD installed in the GV and GV-SP aircraft was conducted on 20 March 2004, taking into account a previous FSB evaluation which included approximately 30 approaches. Further flying was carried out in December 2004.

4. Enhanced Vision System – EVS

A JOEB evaluation of the EVS installed in the GV and GV-SP aircraft was conducted on 22 March – 30 April 2004, taking into account a previous FSB evaluation which included over 200 approaches. A further evaluation, consisting of simulator training and 29 approaches were conducted in a GIV-X on 7/8 December 2004. No operational credit for EVS was available under JAR-OPS 1 at the time of the evaluation. The evaluation also contributed to the work of the JAA AWOSG in formulating changes to JAR-OPS regulations.

5. Evaluation Basis

All operational evaluations were conducted in compliance with the JAA Terms of References for JOEBs and the JOEB Handbook, dated February 2004.

Requirements in JAA JAR-OPS 1 (§ 1.940, 1.945, 1.950, 1.965, 1.970 and 1.980 including associated appendices, AMCs and IEMs), JAR-FCL 1 (§1.215, 1.220, 1.225, 1.230 1.235, and 1.261 including associated appendices, AMCs and IEMs) were considered.

6. Operational Evaluations – Group Composition

Name	Organization	Function
Evan NIELSEN	EASA	EASA Flight Standards Manager
Jean BARIL	CJAA	JOEB Co-ordinator
Terry NEALE	CAA UK	JOEB Chairman
Jamie SHAWYER	EASA	JOEB Team Member

Operational Suitability Data (OSD) – Flight Crew

1. Aircraft Type Designation and Pilot License Endorsement [M]

With reference to Part-FCL, FCL.010 ('type of aircraft') and GM1 FCL.700, the Gulfstream V, Gulfstream V-SP and the Gulfstream IV-X aircraft have been evaluated for aircraft categorisation and license endorsement and are designated as variants of the same aircraft type.
The license endorsement is established as "**G-V**".

Manufacturer	Aircraft Model / Name	License Endorsement	Variants	Complex	SP / SP HPA / MP	OEB FC REPORT / OSD FC available	Remarks
Gulfstream Aerospace Corporation	Gulfstream IV-X (G350/G450)	G-V	X	X	MP	X	OSD FC G-V, dated 21 May 2015
	Gulfstream V						
	Gulfstream V-SP (G500/G550)						

2. Aircraft Specifics

2.1 Overview

The Gulfstream V-SP is a variant of the Gulfstream V. Major changes to the Gulfstream V-SP are the addition of a Honeywell Primus Epic avionics suite 'PlaneView', which consists of 4 multi-function 14-inch Flat Panel LCD units, 2 cockpit side-mounted Cursor Control Devices (CCD), triple CDU-850 Multi-Function Control Display Units (MCDU), main entry door relocation, additional 7th window on each side, new cockpit observer's seat, drag reduction modifications on the airframe, increased thrust and a 500 pound increase in maximum ramp and take-off mass.

The GIV-X model aircraft is essentially a GIV airframe with a GV-SP cockpit. It has a Honeywell Primus Epic avionics suite, which consists of 4 multi-function 14-inch flat panel LCD units, 2 cockpit side mounted Cursor Control Devices (CCD), triple MC-850 Multi-Function Display Units (MCDU), Visual Guidance System (VGS/HUD), Enhanced Vision System (EVS), Tay 611-8C FADEC controlled engines, a Honeywell 36-150 APU, a cockpit observers seat, and drag reduction modifications on the airframe.

The AFCS pilot / machine interface is the same for the Gulfstream V, the Gulfstream V-SP and the Gulfstream IV-X aircraft.

The EFIS / pilot interface is essentially the same for the Gulfstream IV-X, Gulfstream V and the Gulfstream V-SP. All three aircraft uses the 'display controller (DC)' as the initial interface.

The EICAS philosophy is the same for the Gulfstream IV-X, Gulfstream V and the Gulfstream V-SP. Only minor changes to CAS messages and the 'look and feel' of the synoptic and system displays have been made.

Pilot operation of the primary and secondary flight controls under normal conditions is the same for the Gulfstream V, Gulfstream V-SP and Gulfstream IV-X aircraft.

All three aircraft share the same navigation and communication equipment. Pilot operation of the equipment is the same for the Gulfstream IV-X, Gulfstream V and the Gulfstream V-SP.

The GV, GV-SP and GIV-X all have a functionally equivalent HUD and EVS.

The climb and descent profiles are the same for the Gulfstream V, the Gulfstream V-SP and the Gulfstream IV-X aircraft.

The approach profiles are the same for the Gulfstream V and the Gulfstream V-SP, however, the Gulfstream IV-X operates at slightly higher approach and landing speeds than the Gulfstream V and the Gulfstream V-SP due to a different aerofoil section. All speeds are automatically presented to the pilot in a standard manner for the Gulfstream IV-X, Gulfstream V and the Gulfstream V-SP.

Abnormal and emergency procedures are presented in the 'Quick Reference Handbook (QRH)', which are identical in format.

The Gulfstream V-SP and Gulfstream V are capable of ultra long-range flights which may require in-flight crew rest facilities.

2.2 Memory items

[AMC] Emergency procedures are an essential part of the training curriculum. To avoid confusion during training, as well as during actual operations, Training Organizations and pilots need to be made aware of the steps to be performed without immediate reference to the checklist. These steps should be defined before training is started, preferably by the operator as part of its Standard Operating Procedures.

[M] There are no memory items within the AFM for the Gulfstream V, the Gulfstream V-SP and the Gulfstream IV-X aircraft. Pilots must be able to respond to such events as hot start, engine failure on take-off, engine fire, thrust reverser unlocked, emergency descent and left engine failure with right hydraulic system failure with initial actions without immediate reference to a checklist.

[AMC] Operators should develop their own memory items in accordance with their operating philosophy.

2.3 Customization of Procedures and Checklists

[AMC] 2.1.1 EASA evaluated standard Gulfstream procedures and checklists. Any customization should be evaluated by the Competent Authority.

[M] 2.1.2 The manufacturer has developed procedures to be followed in case of abnormal and emergency situations. It is the manufacturer's philosophy to not identify any steps in these procedures as so-called "Memory Items". Yet pilots are expected to perform some of those initial

and critical steps without reference to any documentation. The manufacturer has advised that the following emergency procedures should be initially performed promptly without reference to a checklist:

Rejected Take-off, Engine Failure/Fire after V1, Emergency Descent, Rapid Decompression, AP or AT Uncommanded Disconnect, Engine Exceedance, Overspeed, Stall Protection / Stall Warning Activation, Flight Control Jams, Total Loss of Braking, EGPWS Alert, Windshear Alert, TCAS Alert. In addition, crews are expected to don oxygen masks promptly when appropriate – for example when smoke is detected.

Operators and training providers must ensure that pilots are trained in accordance with this or other acceptable defined procedures that satisfy these provisions for time-critical emergencies.

2.4 Aircraft Approach Category [M]

With reference to Part-CAT, CAT.OP.MPA.320(b) the approach category for the G-V variants is as follows:

Aircraft	Category
Gulfstream V Gulfstream V-SP	C
Gulfstream IV-X	D

The approach category can be higher dependent on the operation. The determination should be made by the operator based on approach speed calculations in accordance with applicable regulations.

The normal ‘final’ landing flap position is 39 degrees for the Gulfstream V, the Gulfstream V-SP and the Gulfstream IV-X aircraft.

2.5 Standby Instrument

[AMC] With LNAV selected as the primary navigation source, DME is not displayed (except when HSI mode is selected on the RFMU located on the centre pedestal). Therefore, operators should install an EFIS type standby instrument, on the forward instrument panel, that incorporates a DME display. The EBDI on the Gulfstream V-SP and Gulfstream IV-X satisfy this requirement and it is available as an option on the Gulfstream V.

3. Operator Differences Requirements (ODR)

[M] Acceptable ODR tables between the Gulfstream V, the Gulfstream V-SP and the Gulfstream IV-X are contained at Appendix 1.

Evaluated ODR tables are Gulfstream generic and therefore may not include items that are applicable to particular operators.

[AMC] Operators using more than one variant must have approved ODR tables pertinent to their fleet.

4. Master Differences Requirements (MDR) [M]

4.1 MDR Tables

MDR tables for the G-V variants are shown below. Definitions of the various levels for Training / Checking / Currency are those used in the CPD.

Master Differences Requirements (MDR) Table				
		FROM AIRPLANE		
TO AIRPLANE		GV-SP	GV	GIV-X
	GIV-X	C / B / A	C / B / A	- - -
	GV	C / B / A	- - -	C / B / A
	GV-SP	- - -	C / B / A	C / B / A

5. Specifications for Training

[AMC] The Gulfstream GV, GV-SP and GIV-X are equipped with four elliptical emergency exits, which are unique to Gulfstream. Appropriate evacuation technique and current passenger size, especially when a life jacket is worn must be considered and trained. Operators should ensure that any life rafts carried can be deployed through these exits.

[AMC] Engine “spool-up” time is longer than most transport category jet aircraft and can range from 8 seconds at sea level to 30 seconds at high altitude to move from idle thrust to maximum continuous thrust. At low altitude e.g. during circling, the spool-up time will be significantly increased if Flaps are < 22°. Training should emphasise these points. A thorough pre-flight briefing, highlighting engine spool-up times should be accomplished prior to conducting training or checking

in the following areas: stalls, touch-and-go landings, simulated one-engine inoperative manoeuvres and reduced flap approach and landing.

[AMC] Flight crew should be made aware of the risks during a go-around from an LNAV/VNAV approach. The danger is related to the requirement to set an altitude below actual aircraft altitude during the final approach. Until such time as modifications are made so that the altitude selector setting procedures are similar to procedures used during an ILS approach, LNAV/VNAV approaches to a go-around must stress FMA awareness and the requirement to reset the altitude selector, after the go-around has been initiated, to the go-around altitude.

[AMC] Prior knowledge on EFIS, FMS operation and integrated avionics is recommended for initial training on the G-V.

[AMC] Early exposure to the FGS and FMS is important, especially for pilots with no previous EFIS or FMS experience. Establishing early confidence in manually flying the aircraft, converting from manual to automatic (FMS controlled) flight mode and back is equally important due to heavy reliance on the FGS. In the event of a flight path deviation due to input error or system malfunction, the flight crew must be able to comfortably transition from automatic to manual mode and back in an orderly fashion. Crew awareness of the FMA in all phases of flight is necessary whenever the Flight Director or Autopilot is in use.

5.1 G-V Initial Type Rating Training

[AMC] The following items should be included in G-V initial type rating training:

Systems Integration Training

- Automated Flight Guidance System (AFGS)
- Primary Flight Display mode annunciations
- Flight Management System (FMS)
- Display Controllers (DC)
- Head-Up Display System (HUD) (optional)
- Enhanced Vision System (EVS) (optional)
- PlaneView system – (Gulfstream V-SP / Gulfstream IV-X)
- Cursor Control Device – (Gulfstream V-SP / Gulfstream IV-X)

Flight Training (FFS Level C or D, and/or aircraft)

- Dual hydraulic system malfunctions
- Aileron/elevator disconnect (jammed controls in each axis)

- ILS approach on standby instruments
- Primary Flight Display (PFD), Navigation Display (ND), EICAS reversionary modes
- Integrated use of EICAS messages, switch positions and synoptic pages to determine aircraft system status
- Using autopilot for completion of the emergency descent manoeuvre (EDM)
- Delayed engine response to full power applications at various altitudes (especially high altitude stalls, touch and go landings and any manoeuvre with flaps < 22°)
- Head-Up Display System (HUD) (optional)
- Enhanced Vision System (EVS) (optional)
- PlaneView System – (Gulfstream V-SP / Gulfstream IV-X)
- Lateral Control Switch Function (Gulfstream IV-X)

5.1.1 Training Areas of Special Emphasis (TASE)

[M] The following items must receive special emphasis during G-V initial type rating training:

- EGPWS
- Flight Management System (FMS)
- Airborne Collision Avoidance System (ACAS)
- Automatic Mode of Wing and Cowl Anti-ice Systems.
- Head-Up Display System (HUD)
- Enhanced Vision System (EVS)
- PlaneView system – (Gulfstream V-SP / Gulfstream IV-X)
- Cursor Control Device – (Gulfstream V-SP / Gulfstream IV-X)
- Fuel characteristics and fuel temperature management at high altitudes and cold temperatures – (Gulfstream V and Gulfstream V-SP)
- Engine “spool-up” times

[AMC] Operators may add additional elements as required by their operation, and these will vary. Training organisations should review their training courses when applicable aircraft modifications occur. Training organisations may add additional elements as required by the operator.

5.2 Differences Training

The following differences training were evaluated:

- Gulfstream V-SP on to the Gulfstream V
- Gulfstream V-SP on to the Gulfstream IV-X
- Gulfstream V on to the Gulfstream V-SP
- Gulfstream V on to the Gulfstream IV-X
- Gulfstream IV-X on to the Gulfstream V
- Gulfstream IV-X on to the Gulfstream V-SP

[AMC] The Gulfstream provided differences training was evaluated and found to be in compliance with the AMC 1.261(c)(2) of JAR-FCL1 (A) Subpart F.

[M] Differences training must include the elements specified in the relevant ODR tables.

5.3 HEAD-UP DISPLAY (HUD) Training

The GV, GV-SP and GIV-X HUDs are functionally equivalent. All provisions for HUD training apply to all variants.

[M] Pilot training for HUD must be accomplished in an FFS Level C with a daylight visual display, or an FFS Level D. Each pilot in command must receive a minimum of 3 hours ground school instruction followed by a minimum of 4 hours of FFS training in the left-hand seat of an FFS Level C with a daylight visual display, or an FFS Level D. A HUD equipped aircraft may be used for in-flight training if an FFS is not available. In-flight training must consist of a minimum of 4 hours in the left-hand seat.

[M] 5.3.1 HUD Training Areas of Special Emphasis (TASE)

The following items must receive special emphasis as specified, during ground and flight training in all referenced training:

Ground training:

- Crew Co-ordination and CRM
- Crew briefings and callouts
- Duties of PF and PM

Flight Training:

- Use of the caged and un-caged mode, especially in crosswind conditions
- Use of the Pitch Limit Indicator (PLI) during windshear and TAWS escape manoeuvres
- Approaches using the Flight Path Vector (FPV)

- Misuse of the acceleration cue as a potential Flight Path Angle (FPA)
- Relationship of glide path angle to the airport symbology
- Use of the flare cue during approach and landings
- Recovery from unusual attitudes
- TCAS RA
- Take-off performance using the FPA as an aid in meeting the required climb gradient
- Steep turns
- Importance of the 'design eye position' indicators in acquiring the full HUD image
- HUD repeater imagery, use and CRM implications

5.3.2 Checking

[AMC] To ensure pilots do not become 'HUD dependent', training and checking should ensure proficiency is also maintained without the use of HUD.

[AMC] A minimum of three approaches and one go-around should be flown using the HUD during the Operator Proficiency Check (OPC). At least one of these approaches may be substituted by approaches in an aeroplane using approved procedures.

[AMC] Skill tests / license proficiency checks should include at least one take-off and departure procedure and one instrument approach and landing using the HUD and one without the HUD.

5.4 Enhanced Vision System (EVS)

The GV, GV-SP and GIV-X HUDs are functionally equivalent. All provisions for EVS training apply to all variants.

The EVS is certified for use during all phases of flight and ground operations. Additionally, EVS is intended to allow the pilot to observe an obstruction on the runway, such as an aircraft or vehicle, earlier in the approach, and to observe and thus avoid potential runway incursions during ground operations in reduced visibility conditions.

[M] EVS operational credit is subject to the pilot on the right-hand seat having some useable form of EVS presentation available. The video function of the PlaneView system fulfils this requirement and is described in the relevant AFM.

[AMC] Operators should consider where, and on which screen, EVS information is displayed, taking into account the AFM provisions.

5.4.1 EVS Prerequisites

[M] Pilots undergoing EVS training must be fully proficient in the use of the HUD.

5.4.2 EVS Training

[M] Pilot training for EVS must be accomplished in an FFS Level C with a daylight visual display, or an FFS Level D. Each pilot in command must receive a minimum of 4 hours ground school instruction followed by a minimum of 2 hours of FFS training in the left-hand seat of an FFS Level C with a daylight visual display, or an FFS Level D. In-flight training must consist of a minimum of 2 daylight approaches and 2 night time approaches with vertical guidance in the left-hand seat.

[AMC] EVS approaches may be conducted as part of LIFUS. Pilots occupying the right-hand seat should undergo the same theory instruction and a minimum of one departure and two approaches, including one go-around from minima in the FFS or aircraft.

[M] 5.4.3 EVS Training Areas of Special Emphasis (TASE)

The following items must receive special emphasis as specified, during ground and flight training in all referenced training courses:

Ground training:

- Crew Co-ordination and CRM
- Crew briefings and callouts including annunciation of published minima and EVS minima
- Transition from EVS imagery to non-EVS imagery, visual conditions
- Use of videos of actual EVS approaches
- Visual anomalies (e.g., “blooming” and “noise”)
- Importance of cross-checking HUD presentations against EVS visual scene presentation to enable pilots to recognise malfunctions of the ground-based navigation equipment and improper presentation of elements in the visual scene during an approach
- Use of barometric altitude and/or radio altitude at low heights, including temperature correction if applicable
- Possible lack of obstacle clearance following go-around below normal published minima
- Importance of calibration checks
- Limitations and failure modes
- Duties of PF and PM
- Weather limitations
- Eye level to camera level
- Taxi speed awareness especially in low visibility

Flight Training:

- Crew Co-ordination and CRM
- Crew briefings and callouts including annunciation of published minima and EVS minima
- Transition from EVS imagery to non-EVS imagery, visual conditions. Maximum use should be made of videos of actual EVS approaches as seen through the combiner

- Importance of “design eye position” in acquiring the correct EVS image
- Use of the yoke mounted ‘ON/OFF’ switch “clear” mode
- Precision and non-precision approaches in both day and night conditions
- Weather limitations
- Loss of airspeed and heading display within HUD presentation due to EVS imagery
- Taxi speed awareness in low visibility
- Use of the caged and un-caged modes in crosswind conditions
- Runway lights
- EVS repeater imagery, use and CRM implications
- Limitations and failure modes

5.4.4 Checking

[AMC] A minimum of three approaches and one go-around should be flown using the EVS during the Operator Proficiency Check (OPC). At least one of these approaches may be substituted by approaches in an aeroplane using approved procedures. A one engine inoperative approach and a one engine inoperative go-around should be flown without the use of the EVS to maintain proficiency in flying without the use of EVS.

[AMC] Skill tests / license proficiency checks should be flown in an approved FFS Level C with a daylight visual display, or an FFS Level D. It should include taxi to or from the ramp or gate, one take-off and departure procedure and one instrument approach and landing using the EVS in simulated limiting weather conditions. A one engine inoperative approach and a one engine inoperative go-around should be flown without the use of the EVS to maintain proficiency of flying without the use of EVS.

[AMC] EVS approaches should be flown making maximum appropriate use of the autoflight system. If EVS approaches are to be flown manually (e.g. if the autopilot is unserviceable), proficiency checks should alternate between EVS approaches being manually flown and flown using automation.

5.5 Recurrent Training

Recurrent training must be compliant with EU regulations for civil aviation aircrew and air operations, as applicable, and include the identified Training Areas of Special Emphasis.

6. Line Flying Under Supervision (LIFUS) / Supervised Operating Experience (SOE)

LIFUS should be performed in accordance with ORO.FC.220 and AMC1 ORO.FC.220(e). Furthermore, GM1 ORO.FC.220(d) provides guidelines for operators to use when establishing their individual requirements. Supervised Operating Experience (SOE) may be established in accordance with Part-FCL, FCL.720.A (g) through the operational suitability evaluation.

6.1 LIFUS following G-V Initial Type Rating Training

[AMC] In the case of pilots completing the initial type rating for the GVI, a minimum of 10 route sectors LIFUS / SOE should be performed, followed by a line check (as PF and as PM). Operation with and without the use of HUD / EVS in different phases of flight should be addressed.

[AMC] Where there is a change of operating conditions or route structure, this should be taken into account and may need additional route sectors to cover these elements.

7. Specifications for Checking – License Skill Test / License Proficiency Check

[M] A proficiency check conducted on one G-V variant is valid for the Gulfstream V-SP, the Gulfstream V and the Gulfstream IV-X, provided that the differences have been addressed during recurrent training.

8. Specifications for Recent Experience and Currency

8.1 Recent Experience

Recent experience requirements are contained in Part-FCL, FCL.060.

[M] Take-offs and landings performed on the Gulfstream V-SP, the Gulfstream V or the Gulfstream IV-X are valid for all variants.

8.2 Currency

[AMC] Operators should consider establishing currency requirements for pilots operating G-V variants.

[AMC] Pilots operating the Gulfstream V-SP, the Gulfstream V and/or the Gulfstream IV-X as variants should be scheduled to fly the relevant variants on a regular basis.

Appendix 1 - ODR Tables [M]

DIFFERENCE AIRCRAFT: GV-SP **BASE AIRCRAFT: GIV-X**				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max Takeoff (T.O.) Weight 91,000 lb. Increase of 17,100 lbs.	No	No	X				A	A
23 Communications	Selcal Test and CVR Test switches relocated	No	Minor	X				A	A
27 Flight Controls	Split flight controls added	Yes	Minor			CSS or CPT or PTT or FTD 5		A	A
27 Flight Controls	Trailing edge contours (TECs) added to inboard trailing edge of flaps	No	No	X				A	A
27 Flight Controls	No Alternate Flap Switch	No	Minor	X				A	A
27 Flight Controls	Standby rudder and nose wheel steering on AUX pump capability	No	Minor		X			A	A
27 Flight Controls	Spoiler Control switch added. Lateral Control Switch deleted.	Yes	Minor		X			B	A
27 Flight Controls	Vortex generators added to lower horizontal stabilizer surfaces and upper elevator surfaces	No	Minor	X				A	A
28 Fuel	Heated Fuel Return System	No	Minor		X			A	A
29 Hydraulic Power	Aux Hydraulic Boost Pump added	No	No	X				A	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
32 Landing Gear	4 brake wear indicator pins vs. 2 and WOW switches	No	Minor	X				A	A
49 APU	Different APU installed. RE220 vs. 36-150 both supplied by Honeywell.	No	Minor		X			A	A
49 APU	Bleeds off takeoff capability added.	No	Major		X			A	A
70 Powerplant	BR710 installed vs. Tay 611-8C	No	Minor		X			A	A
78 Engine Exhaust	Thrust Reverser Manual Stow switches (2) installed	No	Minor		X			A	A
Limitations	Max Takeoff Weight increased to 91,000 lbs. from 73,900 lb. Max Landing Weight increased to 75,300 lbs. from 66,000 lb. Fuel quantity 41,300 lbs. vs. 29,500 lbs. APU and Engine limitations differences.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GV-SP BASE AIRCRAFT: GIV-X				COMPLIANCE METHOD					
				TRAINING				CURR	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
Normal Takeoff	Bleeds Off	No	Minor	X				A	A

DIFFERENCE AIRCRAFT: GV-SP BASE AIRCRAFT: GIV-X				COMPLIANCE METHOD					
				TRAINING				CURR	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
23 Communications	Selcal and CVR test switches different test methodology	No	Minor	X				A	A
27 Flight Controls	Spoiler Control switch added. Lateral Control Switch deleted.	Yes	Minor		X			B	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
49 APU	Different APU installed. RE220 vs. 36-150 both supplied by Honeywell.	No	Minor		X			A	A
49 APU	Starter assisted airstart capability for main engines	No	Major		X			A	A
49 APU	Bleeds off takeoff capability added	No	No		X			A	A
70 Powerplant	Thrust increased by 1,535 lbs. to 15,385 lbs.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GIV-X **BASE AIRCRAFT: GV-SP**				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max T.O. Weight 17,100 lbs. decrease to 73,900 lbs.	No	No	X				A	A
23 Communications	Selcal Test and CVR Test switches relocated	No	Minor	X				A	A
27 Flight Controls	Alternate Flap Control switch added	No	Minor		X			A	A
27 Flight Controls	No split flight controls	Yes	Minor		X			A	A
27 Flight Controls	Trailing Edge Contours not installed	No	No	X				A	A
27 Flight Controls	No standby rudder and no nose wheel steering on AUX pump capability	Yes	Minor		X			A	A
27 Flight Controls	Lateral Control switch added. Spoiler Control Switch deleted.	Yes	Minor		X			B	A
27 Flight Controls	Vortex generators deleted from lower horizontal stabilizer surfaces and upper elevator surfaces	No	Minor	X				A	A
28 Fuel	No Heated Fuel Return System installed	No	Minor	X				A	A
29 Hydraulic Power	Aux Hydraulic Boost Pump deleted	No	No	X				A	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
32 Landing Gear	2 brake wear indicator pins vs. 4	No	Minor	X				A	A
49 APU	Different APU installed. RE220 vs. 36-150 both supplied by Honeywell.	No	Minor		X			A	A
49 APU	No Bleeds Off takeoff capability	No	No	X				A	A
70 Powerplant	Tay 611-8C installed vs. BR710.	No	Minor		X			A	A
78 Engine Exhaust	No Manual Thrust Reverser Stow switches installed.	No	Minor	X				A	A
Limitations	Max T.O. Weight decreased by 17,100 lbs. to 73,900 lb. Max landing weight decreased to 66,000 lb. Fuel quantity 29,500 lbs. vs. 41,300 lbs. APU and engine limitations differences.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GIV-X BASE AIRCRAFT: GV-SP				COMPLIANCE METHOD					
				TRAINING				CURR	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
None	None	No	No						

DIFFERENCE AIRCRAFT: GIV-X BASE AIRCRAFT: GV-SP				COMPLIANCE METHOD					
				TRAINING				CURR	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
23 Communications	Selcal and CVR test switches different test methodology	No	Minor	X				A	A
27 Flight Controls	Lateral Control switch added. Spoiler Control Switch deleted.	Yes	Minor		X			B	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
49 APU	Different APU installed. RE220 vs. 36-150 both supplied by Honeywell.	No	Minor		X			A	A
49 APU	No Bleeds Off takeoff capability	No	Minor	X				A	A
70 Powerplant	Thrust decreased 1,535 lbs. to 13,850 lbs.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GV **BASE AIRCRAFT: GIV-X**				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max T.O. Weight 90,500 lbs. Increase of 16,600 lbs.	No	No	X				A	A
20 Aircraft General	Observer seat and location changed.	No	No		VT			A	A
21 ECS	Outflow valve changed to butterfly valve.	No	Minor	X				A	A
24 Electrical Power	Revised Location of PDB circuit breaker panels	No	Minor	X				A	A
27 Flight Controls	Split flight controls added	Yes	Minor			CSS or CPT or PTT or FTD 5		A	A
27 Flight Controls	No Alternate Flap Switch	No	Minor	X				A	A
27 Flight Controls	Standby Rudder installed with nose wheel steering on the AUX pump capability (including AUX PUMP ground spoiler pressure)	Yes	Minor		X			A	A
27 Flight Controls	Spoiler Control switch added. Lateral Control Switch deleted.	Yes	Minor		X			B	A
27 Flight Controls	Vortex generators added to lower horizontal stabilizer surfaces and upper elevator surfaces	No	Minor	X				A	A
28 Fuel	Heated Fuel Return System added	No	Minor		X			A	A
29 Hydraulic Power	Aux Hydraulic Boost Pump added	No	No	X				A	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
32 Landing Gear	4 brake wear indicator pins vs. 2 and WOW switches	No	Minor	X				A	A
49 APU	Different APU installed with capability for APU assisted main engine airstart and different electrical load capabilities.	No	Minor		X			A	A
52 Doors	Main Door moved aft 24 inches	No	No	X				A	A
52 Doors	Aft Lav Dump Door relocated	No	No	X				A	A
70 Powerplant	BR710 vs. Tay 611-8C Installed	No	Minor		X			A	A
78 Engine Exhaust	Thrust Reverser Manual Stow Switches (2) installed.	No	Minor		X			A	A
Limitations	Max Takeoff Weight increased to 90,500 lbs. from 73,900 lb.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GV BASE AIRCRAFT: GIV-X				COMPLIANCE METHOD					
				TRAINING				CURR	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
None	None	No	No						

DIFFERENCE AIRCRAFT: GV BASE AIRCRAFT: GIV-X				COMPLIANCE METHOD					
				TRAINING				CURR	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
22 Autoflight	TOGA Flight Director Command Bars initiate at 12 degrees vs. 8 degrees on GIV-X.	No	No	X				A	A
23 Communications	New Audio System	No	No			X		A	A
23 Communications	Radio Tuning Through RFMU	No	Yes			X		A	A
27 Flight Controls	Spoiler Control switch added. Lateral Control Switch deleted.	Yes	Minor		X			B	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
31 Indicating / Recording Systems	Standby Engine Instrument on RFMU	No	Minor	X				A	A
31 Indicating / Recording Systems	DAU (Data Acquisition Unit) and FWC (Fault Warning Computer) replaces MAU (Modular Avionics Unit)	No	Minor	X				A	A
31 Indicating / Recording Systems	Display Controller	No	Minor			X		A	A
31 Indicating / Recording Systems	Electronic Checklist Auto Pop-up Feature enabled	No	Minor		ST, TCBI or VT			A	A
34 Navigation	IRS ON/OFF switches deleted and replaced with MSU switches	No	Minor		X			A	A
34 Navigation	EICAS FMS Joystick Panel	No	None		X			A	A
34 Navigation	6 Display Units vs. 4 Display Units	No	Minor			X		B	A
34 Navigation	No CCDs Used in Conjunction with Displays	No	Minor			X		B	A
34 Navigation	HSI on RFMU	No	Minor		X			A	A
34 Navigation	LaserTrack	No	Minor			X		B	A
34 Navigation	Standby Flight instruments have different design and location	No	Minor	X				A	A
49 APU	Different APU installed with capability for APU assisted main engine airstart and different electrical load capabilities.	No	Minor		X			A	A
70 Powerplant	Thrust increased by 900 lbs. to 14,750 lbs.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GIV-X BASE AIRCRAFT: GV				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max T.O. Weight 73,900 lbs. Decrease of 16,600 lbs.	No	No	X				A	A
20 Aircraft General	Observer seat and location changed.	No	No		VT			A	A
21 ECS	Outflow valve changed to thrust recovery outflow valve.	No	Minor	X				A	A
23 Communications	Selcal test and CVR test switches relocated	No	Minor	X				A	A
24 Electrical Power	Revised Location of PDB circuit breaker panels	No	Minor	X				A	A
27 Flight Controls	No Standby Rudder installed or nose wheel steering on the AUX pump capability	Yes	Minor		X			A	A
27 Flight Controls	No split flight controls	Yes	Minor	X				A	A
27 Flight Controls	Lateral Control switch added. Spoiler Control Switch deleted.	Yes	Minor		X			B	A
27 Flight Controls	Vortex generators deleted from lower horizontal stabilizer surfaces and upper elevator surfaces	No	Minor	X				A	A
27 Flight Controls	Alternate Flap Switch added	No	Minor		X			A	A
28 Fuel	No Heated Fuel Return System	No	Minor	X				A	A
29 Hydraulic Power	No Aux Hydraulic Boost Pump	No	No	X				A	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
49 APU	Different APU installed with no capability for APU assisted main engine airstart and different electrical load capabilities.	No	Minor		X			A	A
52 Doors	Main Door moved forward 24 inches	No	No	X				A	A
52 Doors	Aft Lav Dump Door relocated	No	No	X				A	A
Limitations	Max Takeoff Weight decreased to 73,900 lbs. from 90,500 lb. Fuel Quantity 29,500 lbs. vs. 41,300 lbs. APU and engine limitations differences	No	Minor	X				A	A

DIFFERENCE AIRCRAFT: GIV-X BASE AIRCRAFT: GV				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
None	None	No	No						

DIFFERENCE AIRCRAFT: GIV-X **BASE AIRCRAFT: GV**				**COMPLIANCE METHOD**					
				TRAINING				**CURR**	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
22 Autoflight	TOGA Flight Director Command Bars initiate at 8 degrees vs. 12 degrees on GV.	No	No	X				A	A
23 Communications	New Audio System	No	Minor			X		A	A
23 Communications	Radio Tuning Through MCDU and graphically	No	Minor		X			A	A
27 Flight Controls	Lateral Control switch added. Spoiler Control Switch deleted.	Yes	Minor		X			B	A
30 Ice and Rain	Pitot Probe Heat System changed.	No	Minor	X				A	A
31 Indicating / Recording Systems	Electronic Checklist Auto Pop-up Feature deleted	No	Minor	X				A	A
31 Indicating / Recording Systems	Standby Engine Instruments on MCDU	No	Minor	X				A	A
31 Indicating / Recording Systems	DAU (Data Acquisition Unit) and FWC (Fault Warning Computer) replaced by MAU (Modular Avionics Unit)	No	Minor	X				A	A
31 Indicating / Recording Systems	Display Controller	No	Minor			X		A	A
34 Navigation	IRS MSU switches deleted and replaced with ON/OFF switches	No	Minor	X				A	A
34 Navigation	4 Display Units vs. 6 Display Units	No	Minor			X		B	A
34 Navigation	Added Dual CCDs used in Conjunction with Displays	No	Minor			X		B	A
34 Navigation	LaserTrack removed	No	Minor	X				A	A
34 Navigation	Standby Flight instruments have different design and location	No	Minor		X			A	A
34 Navigation	MCDU on Emergency Power	No	Minor		X			B	A
49 APU	Different APU installed with no capability for APU assisted main engine airstart and different electrical load capabilities.	No	Minor		X			A	A
70 Powerplant	Thrust decreased by 900 lbs. to 13,850 lbs.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GV-SP BASE AIRCRAFT: G-V				**COMPLIANCE METHOD**					
				TRAINING				**CHK/CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max T.O. Weight 91,000 lbs. Increase of 500 lbs.	No	No	X				A	A
21 ECS	Outflow valve changed to thrust recovery outflow valve.	No	No	X				A	A
24 Electrical Power	Revised Location of PDB circuit breaker panels	No	Minor	X				A	A
25 Equipment / Furnishings	Redesign and relocation of cockpit observer's seat to behind Co-Pilot's seat	No	No		X			A	A
27 Flight Controls	Trailing edge contours (TECs) added to inboard trailing edge of flaps	No	No	X				A	A
38 Water & Waste	Fuselage conformal fresh water tank	No	Minor	X				A	A
38 Water & Waste	Relocation of vacuum lavatory waste tank from baggage compartment to above APU	No	No	X				A	A
49 APU	Bleeds off takeoff capability added	No	Major		X			A	A
52 Doors	Main Door moved forward 24 inches	No	No	X				A	A
52 Doors	Aft Lav Dump Door relocated	No	No	X				A	A
53 Fuselage	27Boundary Layer Energizers added above the canopy	No	No	X				A	A
56 Windows	Addition of 7th cabin window	No	No	X				A	A
57 Wings	7 Vortex Generators relocated outboard on each wing	No	No	X				A	A
Limitations	Max Takeoff Weight increased to 91,000 lbs. from 90,500 lb.	No	No	X				A	A

DIFFERENCE AIRCRAFT: GV-SP BASE AIRCRAFT: G-V				**COMPLIANCE METHOD**					
				TRAINING				**CHK/CURR**	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
Normal Takeoff	Bleeds Off	No	Minor	X				A	A

DIFFERENCE AIRCRAFT: GV-SP **BASE AIRCRAFT: G-V**				**COMPLIANCE METHOD**					
				TRAINING				**HKG/CURR**	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
22 Autoflight	TOGA Flight Director Command Bars initiate at 8 degrees vs. 12 degrees on GV.	No	No	X				A	A
23 Communications	New Audio System	No	Minor			X		A	A
23 Communications	Radio Tuning Through MCDU and graphically	No	No		X			A	A
31 Indicating/ Recording Systems	Electronic Checklist Auto Pop-up Feature deleted	No	Minor Non Normal	X				A	A
31 Indicating/ Recording Systems	DAU (Data Acquisition Unit) and FWC (Fault Warning Computer) replaced by MAU (Modular Avionics Unit)	No	Minor	X				A	A
31 Indicating/ Recording Systems	Standby Engine Parameters available on #1 MCDU only	No	Minor	X				A	A
31 Indicating/ Recording Systems	Different formatting on some synoptic displays	No	Minor		X			A	A
34 Navigation	IRS MSU switches deleted and replaced with ON/OFF switches	No	Minor	X				A	A
34 Navigation	4 Display Units Vs. 6 Display Units with different formatting.	No	Major			X		B	A
34 Navigation	Added Dual CCD's Used in Conjunction with Displays	No	Minor			X		B	A
34 Navigation	Display controllers have different menus.	No	Minor			X		A	A
34 Navigation	Standby Flight instruments have different design and location	No	Major		X			B	A
34 Navigation	Display Unit Controller has 4 overhead switches instead of 3	No	Major		X			B	A
34 Navigation	RNP and Estimated Position Uncertainty (EPU) is displayed on PFD	No	Minor		X			A	A
34 Navigation	MCDU on Emergency Power	No	Minor		X			B	A
49 APU	Bleeds off takeoff capability added	No	Minor		ST, TCBI, SU VT			A	A
70 Powerplant	Thrust increased by 635 lbs. to 15,385 lbs.	No	No	HO				A	A

DIFFERENCE AIRCRAFT: G-V BASE AIRCRAFT: GV-SP				**COMPLIANCE METHOD**					
				TRAINING				**HKG/CURR**	
DESIGN	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
20 Aircraft General	Performance Max T.O. Weight 500 lb. decrease to 90,500 lbs.	No	No	X				A	A
21 ECS	Outflow valve changed to butterfly style.	No	No	X				A	A
24 Electrical Power	Revised location of PDB's and associated circuit breakers.	No	Minor	X				A	A
25 Furnishings	Redesign and relocation of cockpit observer's seat to behind Captain's seat	No	No		X			A	A
27 Flight Controls	Trailing Edge Contours not installed	No	No	X				A	A
38 Water & Waste	Non-fuselage conformal fresh water tank	No	No	X				A	A
38 Water "& Waste	Relocation of vacuum lavatory waste tank from above APU to baggage compartment	No	No	X				A	A
49 APU	No Bleeds Off takeoff capability	No	Minor	X				A	A
52 Doors	Main Door moved aft 24 inches	No	No	X				A	A
52 Doors	Aft Lav Dump Door relocated	No	No	X				A	A
53 Fuselage	27 Boundary Layer Energizers removed from the canopy	No	No	X				A	A
56 Windows	Removal of 7th cabin window	No	No	X				A	A
57 Wings	7 Vortex generators relocated inboard on each wing	No	No	X				A	A
Limitations	Max T.O. Weight decreased by 500 lbs. to 90,500 lbs.	No	No	X				A	A

DIFFERENCE AIRCRAFT: G-V BASE AIRCRAFT: GV-SP				**COMPLIANCE METHOD**					
				TRAINING				**HKG/CURR**	
MANEUVER	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
None		No	No						

DIFFERENCE AIRCRAFT: G-V **BASE AIRCRAFT: GV-SP**				**COMPLIANCE METHOD**					
				TRAINING				**HKG/CURR**	
SYSTEM	REMARKS	FLT CHAR	PROC CHNG	LVL A	LVL B	LVL C	LVL D	CHK	CURR
22 Autoflight	TOGA Flight Director Command Bars initiate at 12 degrees vs. 8 degrees on GV-SP.	No	No	X				A	A
23 Communications	New audio system	No	Minor			X		A	A
23 Communications	Radio tuning accomplished through RFMU's	No	Minor			X		A	A
31 Indicating/ Recording Systems	Electronic Checklist has Auto pop-up Feature vs. passive checklist on GV-SP	No	Minor		X			A	A
31 Indicating/ Recording	MAU replaced by DAU and FWC	No	Minor			X		B	A
31 Indicating/ Recording Systems	Engine Parameters available on either RFMU	No	Minor	X				A	A
31 Indicating/ Recording Systems	Different formatting on some synoptic displays	No	Minor		X			A	A
34 Navigation	EICAS FMS Joystick Panel	No	None		X			A	A
34 Navigation	LaserTrack	No	Minor			X		B	A
34 Navigation	IRS ON/OFF switches replaced with IRS MSU switches	No	Minor		X			A	A
34 Navigation	6 Display Units Vs. 4 Display Units with different formatting	No	Minor			X		B	A
34 Navigation	No CCD's installed	No	Minor			X		B	A
34 Navigation	Display controllers have different menus	No	Minor			x		B	A
34 Navigation	Standby Flight instruments have different design and location	No	Minor	X				A	A
34 Navigation	Display Unit Controller has 3 overhead switches instead of 4	No	Minor			X		B	A
34 Navigation	RNP and Estimated Position Uncertainty (EPU) are not displayed on PFD	No	Minor		X			B	A
49 APU	No bleeds off takeoff capability	No	Minor	X				A	A
70 Powerplant	Thrust reduced 635 lbs. to 14,750 lbs.	No	No	X				A	A

Appendix 2

Electronic Flight Bag (EFB)

1. EFB / Chart Function

An evaluation of the Gulfstream V-SP (Gulfstream 550 “G550”) electronic ‘Jeppesen’ chart and video graphic function presented on the PlaneView cockpit display was conducted by an integrated team composed of FAA and JAA members.

This evaluation was conducted in compliance with the JAA Terms of References for JOEBs and the JOEB Handbook.

JAA Administrative & Guidance Material, Section 4: Operations, Part 3: Temporary Guidance Leaflet 36; Approval of Electronic Flight Bags (EFB), dated 01 October 2004 were used as reference.

2. Preamble - Electronic Flight Bag (EFB)

Traditionally, all documentation and information available to flight crews for use on the flight deck has been in paper format. Much of the information is now available in an electronic format and the purpose of this report is to give recommendations to the Competent Authorities for the use of electronically processed information.

It is not intended to impose additional requirements with respect to the basic information and data sources. The operator remains responsible for ensuring the accuracy of the information used and that it is derived from verifiable sources. The approval of the electronic chart function, video graphic function and Electronic Flight Bags (EFB) is intended to cover the different methods of storage, retrieving and operational use of this information.

The electronic chart function and graphical functionality fall within Hardware Class 3 of the EFB system description; Class 3 EFB systems are installed equipment that requires airworthiness approval.

Note. With Class 3 EFB the Aircraft Flight Manual (AFM) section should make reference to a guideline which details the EFB concept and its limitations. In particular, the safety limitations of user modifiable software and the level of confidence associated with user applications need to be considered. For instance, data parameter quality (accuracy, integrity) may be affected by users which may potentially lead to erroneous information.

The electronic chart function and graphical functionality fall within Type C software application.

In general, the objective of any assessment or evaluation process is to demonstrate that the software functionality achieves the same level of integrity and availability as the “traditional” means that they would replace. At the moment the manufacturer has indicated that there is no intention to

eliminate paper back-up in the cockpit for the foreseeable future. If this is proposed in the future, it may be necessary to have a transition period where paper documentation is carried to demonstrate to the Competent Authority that an acceptable level of reliability has been achieved. As an alternative, operators may be authorised to start EFB operations without full paper back-up where other means of mitigation have been developed and are acceptable to the Competent Authority.

The Operator will also need to demonstrate how the availability of the EFB is confirmed by pre-flight checks. Instructions to flight crews will need to clearly define actions to be taken in the event of any EFB system deficiency and whether dispatch is allowed in accordance with the MEL.

3. Human / Machine Interface – EFB

The operator will need to ensure an assessment of the human machine interface and CRM aspects is carried out when using EFBs. This should include a review of the complete system to cover at least the following recommended points:

- Human / Machine Interface
- Legibility of text
- Approach, departure and navigational chart display and functionality
- Responsiveness of application
- Off-screen text and content
- Managing multiple ‘open’ applications
- Failure messages and the use of colour
- Data entry screening and data error

The JOEB evaluated the Chart Function of the EFB and made the following findings:

Human/Machine Interface

The JOEB found that the selection of individual charts was easily accomplished after only a minimum of training. Whilst there is an initial delay when the relevant airport is selected, this is still probably less than it would take to find a paper chart in a manual

Legibility of text

The text was legible in night conditions as well as bright daylight. The distance of the chart presentation from the pilot is greater than would normally be the case with paper charts but was still legible and, for added clarity, zoom could easily be used.

Approach, departure and navigational chart display and functionality

An aeroplane symbol is displayed on geo-referenced charts only. For approach charts, the symbol is only visible on the horizontal profile. The symbol is not present on those charts which are not drawn to scale. Zooming is easy and is self-evident on the presentation and the concomitant

change in scale is obvious. There are a number of options for presenting different parts of the approach charts and in different locations and the CRM implications need to be considered by operators.

Responsiveness of system

The ability to pre-select charts that the pilot knows he will probably need greatly speeds up the response time of the system in finding any given chart. In any event, the electronic response time is unlikely to be slower than its manual equivalent.

Off-screen text and content

Whilst there is no specific warning that there is more information off-screen, it is usually self-evident when scrolling or zooming has been used. Terrain awareness may be reduced using the above modes but the other pilot's INAV screen would normally be visible anyway and EGPWS is an additional mitigation

Managing multiple 'open' applications

The system does not permit opening multiple applications other than each pilot being able to make his/her own selection.

Failure messages and the use of colour

A blue CAS message is generated when the DMU cannot communicate with the LAN and a yellow CAS message is generated when a selected chart is not available. The chart presentation itself is monochrome.

Data entry screening and data error

Gulfstream have indicated that tampering with the database is not possible other than by the routine amendment process. The introduction of databases audited by EASA and found acceptable (by means of a formal Letter of Acceptance) will further enhance the integrity of the chart information.

4. Operational Considerations

The JOEB found that operators should consider the following factors when introducing the use of electronic charts:

Crew Training

The JOEB recommends the following elements be included in an Operator's training programme:

a) Overview

b) Hardware description

c) Chart legend

d) Pre-flight check including availability of relevant charts and revision status

e) Limitations if applicable

f) Specific training on use of different functions and restrictions, if any

g) Restrictions, if any, when some or all of the functionality is inoperative

h) Procedures for cross checking of database and paper charts and priority determination in the event of conflict.

i) CRM and Human Factors including chart orientation, scale, zoom function, chart area selection, screen selection and briefing techniques.

j) Role of chart function in Operator Proficiency Check

k) Discrepancy resolution between different sources (e.g. obstacles on chart and on EGPWS).

l) Crew incapacitation

Training may be accomplished on an aircraft or a suitably equipped simulator. Operators should give consideration to the need to ensure recurrent training and checking takes place in an environment that replicates the presence or absence of EFB functions as applicable to their own aircraft.

CRM considerations

Operators will need to consider which DU will be selected to display charts, which format and orientation will be used and which pilot makes selections (including zoom). Careful coordination will be necessary to ensure information is presented in its desired form and in a timely manner. The JOEB recommends operators are permitted to retain their preferences in selection of any particular format or DU but that selections should normally be made by the PNF. Operators may wish to be prescriptive about the presentations to be used or retain flexibility. In either case, the policy should be clearly specified in the Operations Manual.

Amendment Status

Operators will need to have clearly defined procedures in their Operations Manual for crews to follow in the event of expired chart validity. These may include a requirement to crosscheck individual chart dates with a paper copy and/or examination of NOTAMS. The amendment process should also be well-defined with clear responsibility for ensuring updates take place punctually.

Chart Availability

Operators should have defined procedures to:

a) Ensure charts required for any particular flight are available

b) Check validity dates of database

c) Resolve conflicts of date and/or information

d) Resolve unserviceability, including use of paper back-up if applicable

Administration

The operator should have in place clear guidance on the following:

a) Nomination of an administrator with defined responsibilities as guardian of the security of the system. This would include responsibility for the integrity of the defect reporting and rectification system.

b) Allocation of responsibility for revision procedures

c) Allocation of responsibility for issuing relevant Notices to crew.

Risk Analysis

Operators should carry out a risk analysis to cover possible failure modes.

Quality System

Operators should ensure their Quality System includes oversight and auditing of the use of the EFB and its administration with particular emphasis on the integrity of the defect reporting and rectification system.

5. Conclusion - EFB

The JOEB found the EFB as installed on the G500, G550, G450 and G350 aircraft generally easy to use and well designed. The introduction of new technology invariably necessitates a careful appraisal of all the implications. The JOEB has investigated the GAC installation and recommends the use of the EFB subject to Operators taking into account the above considerations.