Doc 9906-AN/472

THE QUALITY ASSURANCE MANUAL FOR FLIGHT PROCEDURE DESIGN

VOLUME 6 – FLIGHT VALIDATION PILOT TRAINING AND EVALUATION

(Development of Flight Validation Pilot Training Programme)

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Amendments

Record of Amendments and Corrigenda

The issue of amendments is announced regularly in the *ICAO Journal* and in the supplement to the *Catalogue of ICAO Publications and Audio-visual Training Aids,* which holders of this publication should consult. The space below is provided to keep a record of such amendments.

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Preface

The *Quality Assurance Manual for Flight Procedure Design* (Doc 9906) consists of six volumes:

Volume 1 – *Flight Procedure Design Quality Assurance System*;

Volume 2 – *Flight Procedure Designer Training*;

Volume 3 – *Flight Procedure Design Software Validation*;

Volume 4 – *Flight Procedures Design Construction (to be developed);*

Volume 5 – *Validation of Instrument Flight Procedures; and*

Volume 6 – *Flight Validation Pilot Training and Evaluation*

Instrument flight procedures based on conventional ground-based navigational aids have always necessitated a high level of quality control. However, with the implementation of area navigation and associated airborne database navigation systems, even small errors in data could lead to catastrophic results. This significant change in data quality requirements (accuracy, resolution and integrity) has led to the requirement of a systemic quality assurance process (often part of a State Safety Management System). The *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS, Doc 8168) Volume II, Part 1, Section 2, Chapter 4, *Quality Assurance*), refers to this manual and requires that the State take measures to 'control' the quality of the processes associated with the construction of instrument flight procedures. This manual aims to provide guidance in attaining these stringent requirements for quality assurance in the procedure design process. All six volumes address crucial areas related to the attainment, maintenance and continual improvement of procedure design quality. Data quality management, procedure designer training, and validation of software are all integral elements of a quality assurance system.

Volume 1 – *Flight Procedure Design Quality Assurance System*, provides guidance for quality assurance in the procedure design processes, such as procedure design documentation, verification and validation methods, guidelines about the acquisition/processing of source information/data. It also provides a generic process flow diagram for the design and the implementation of flight procedures.

Volume 2 – *Flight Procedure Designer Training*, provides guidance for the establishment of flight procedure designer training. Training is the starting point for any quality assurance programme. This volume provides guidance for the establishment of a training programme.

Volume 3 – *Flight Procedure Design Software Validation*, provides guidance for the validation (not certification) of procedure design tools, notably with regard to criteria.

Volume 4 – *Flight Procedures Design Construction* (to be incorporated later).

Volume 5 – *Validation of Instrument Flight Procedures,* provides guidance for conducting the validation process of instrument flight procedures, including safety, flyability and design accuracy.

Volume 6 – *Flight Validation Pilot Training and Evaluation,* provides guidance for the establishment of flight procedure validation pilot training. Training is the starting point for any quality assurance system. This volume provides guidance for the establishment of a training and evaluation programme.

Note— In the independent volumes, when a reference is made to the term "manual", in the context of this document, without any further specification, it is presumed to refer to this volume of the Quality Assurance Manual for Flight Procedure Design.

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Abbreviations

AIP	Aeronautical Information Publication
AIS	Aeronautical information service
ATS	Air traffic services
FPD	Flight procedure design
FV	Flight Validation
FVP	Flight Validation Pilot
FVSP	Flight Validation Service Provider
GNSS	Global navigation satellite system
GV	Ground Validation
ICAO	International Civil Aviation Organization
IFP	Instrument flight procedure
RNAV	Area navigation
RNP	Required navigation performance
SKA	Skills, Knowledge, and Attitudes

Definitions

Competency. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard.

Competency-based training and assessment. Training and assessment that are characterized by a performance orientation, emphasis on standards of performance and their measurement and the development of training to the specified performance standards.

Competency element. An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and has an observable outcome.

Competency framework. A competency framework consists of *competency units*, *competency elements*, *performance criteria*, *evidence and assessment guide* and *range of variables.* Competency units, competency elements and performance criteria are derived from job and tasks analyses of procedure designers and describe observable outcomes.

Competency unit. A discrete function consisting of a number of competency elements.

Evidence and assessment guide. A guide that provides detailed information (e.g. tolerances) in the form of evidence that an instructor or an evaluator can use to determine if a trainee meets the requirements of the competency standard.

Flight inspection. The operation of a suitable equipped aircraft for the purpose of calibrating ground based NAVAIDS or monitoring/evaluating the performance of Global Navigation Satellite System (GNSS).

Flight Procedure Designer. A person responsible for flight procedure design who meets the competency requirements as laid down by the State.

Flight Validation Pilot (FVP). A person performing Flight Validation who meets the competency requirements as laid down by the state.

Flight validation service provider (FVSP). A body that provides flight validation services.

Flyability. The ability to keep an aircraft within predefined tolerances of designed lateral and vertical flight track.

Instrument flight procedure. A description of a series of predetermined flight manoeuvres by reference to flight instruments, published by electronic and/or printed means.

Instrument flight procedure process. The process in developing an instrument flight procedure from the data origination to the publication.

Mastery test. A test that evaluates a trainee's ability to perform a terminal objective. A mastery test should match as closely as possible the conditions, behaviours and standards of terminal objectives

Material-dependent training. A well-documented and repeatable training package that has been tested and proven to be effective.

Obstacle. Obstacle is a man-made structure, terrain, trees or any known restricted airspace or areas that may constitute a hazard for flight operations.

Performance criteria. A simple, evaluative statement on a required outcome of the competency element and a description of the criteria used to judge if the required level of performance has been achieved. Several performance criteria can be associated to a competency element.

Progress test: A test that measures a trainee's ability to meet key enabling objectives.

Stakeholder**:** An individual or party with vested interests in an instrument procedure flight validation.

Skills, knowledge, attitudes (SKA). The skills/knowledge/attitudes (SKA(s)) are what an individual requires to perform an enabling objective derived from performance criteria. A skill is the ability to perform an activity that contributes to the effective completion of a task. Knowledge is specific information required for the trainee to develop the skills and attitudes for the effective accomplishment of tasks. Attitude is the mental state of a person that influences behaviour, choices and expressed opinions.

Terminating event**.** A cue or indicator that a task has been completed.

Training objective**.** A clear statement that is comprised of three parts, i.e. the *desired performance* or what the trainee is expected to be able to do at the end of particular stages of training, the *performance standard* that must be attained to confirm the trainee's level of competence and the *conditions* under which the trainee will demonstrate competence.

Training provider. In the context of this manual, a body that provides flight validation pilot training.

Triggering event**.** A cue or indicator that a task should be initiated.

Validation. Activity to confirm that the requirements for a safe and efficient execution of instrument flight procedures have been fulfilled. This activity consists of Ground and Flight Validation.

Verification. The activity whereby the current value of a data element is checked against the value originally supplied.

Final Draft approved IFPP pre-ED review applied

Foreword

Instrument flight procedures are an integral component in the airspace structure. Thousands of aircraft fly instrument departure, arrival, or approach procedures to airports around the world. As such the safety and efficiency of these procedures is important and the development of these procedures should be subject to a quality assurance system.

The purpose of validation is to obtain a qualitative assessment of procedure design including obstacle, terrain and navigation data, and provide an assessment of flyability of the procedure so as to ensure a proper standard for all publications.

The terms “flight validation” and “flight inspection” are often misinterpreted as the same concept. Flight validation and flight inspection are separate activities that, if required, may or may not be undertaken by the same entity.

a) Flight validation is concerned with factors other than the performance of the navigation aid or system that may affect the suitability of the procedure for publication, as detailed in PANS-OPS, Volume II, Part I, Section 2, Chapter 4, Quality Assurance.

b) Flight inspection is conducted with the purpose of confirming the ability of the navigation aid(s)/system upon which the procedure is based, to support the procedure, in accordance with the Standards in Annex 10 — *Aeronautical Telecommunications* and guidance in the *Manual on the Testing of Radio Navigation Aids* (Doc 8071). Personnel performing flight inspection duties should be qualified and certified in accordance with Doc 8071, Volume I, *Testing of Ground-Based Radio Navigation Systems*.

A procedure design organization may not have the expertise necessary to determine under which conditions flight validation and/or flight inspection may be necessary. For this reason it is recommended that a review by the flight validation and/or flight inspection organizations be included in the State’s procedure design process flow. The State is responsible for the overall performance of the procedure, as well as of its quality and suitability for publication.

PANS-OPS, Volume II, Part I, Section 2, Chapter 4, *Quality Assurance* requires the State to have a written policy requiring minimum qualifications and training for flight validation pilots, including those flight inspection pilots that perform flight validation of instrument flight procedures. This policy also includes standards for the required competency level for flight validation pilots. This manual contains recommended qualifications and training, as well as guidance concerning the skills, knowledge and attitudes (SKA) to be addressed in training and evaluation of flight validation pilots.

The pilot in command is responsible for the safe operation of the flight in accordance with applicable State regulations; however, due to the nature of flight validation requirements, it is understood that some of the regulations related to altitude and aircraft positioning must be waived by the state in order to properly validate published procedures.

The implementation of procedures is the responsibility of Contracting States, which implies that the State authorities have the final responsibility for procedures published within their territory. The validation process may be carried out by the States themselves or delegated by States to third parties (ATS providers, private companies, other States, etc.). The Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS, Doc 8168) requires that the States take measures to perform validation of instrument flight procedures to ensure the quality and safety of the procedure design for its intended use before publication. In all cases, including when third parties are involved in any step of the validation process, States carry the ultimate responsibility for the procedures published in their national Aeronautical Information Publication (AIP). This manual has been developed to provide guidance to Contracting States in developing a competency standard for flight validation pilots to

ensure the quality of the flight procedures they publish. The manual provides a means, but it is not the only one, for establishing Flight Validation Pilot Competency and Training. Latitude is permitted to satisfy local conditions. The manual may be of interest to any person or organization involved in the flight validation domain.

Final Draft approved IFPP/8 EDL reviewed

1. Introduction

1.1. General

The State is responsible for the safety of all instrument flight procedures in its airspace. Safety is achieved by the application of the criteria in Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS) and associated ICAO provisions. Measures are required to control the quality of the process used to apply the criteria.

PANS-OPS, Volume II, Part I, Section 2, Chapter 4 *Quality Assurance* provides procedures with which each State must comply for quality assurance in flight procedure design. Guidance material for quality assurance supplementing provisions in PANS-OPS is provided in each volume of the *Quality Assurance Manual for Flight Procedure Design* (Doc 9906).

Training is one of the most important elements of quality assurance. Each State should establish standards for the required competency level for flight validation pilots. Each State should also ensure that flight validation pilots acquire and maintain this competency level through initial training, recurrent/refresher training and OJT.

This manual is a guideline for States and other stakeholders who are to meet these requirements.

1.2 Target Audience of the Manual

The *Quality Assurance Manual for Flight Procedure Design vol. 6, Flight Validation Pilot Training and Evaluation* will be useful to:

- State authorities that approve training courses/programmes conducted by flight validation service providers (FVSP), training providers, etc. where applicable (see Note 1);
- FVSP(s) that validate flight procedures (see Note 2); and
- Organizations/institutes that provide training courses/programmes for flight validation (training providers).

Note 1 — This statement in the manual does not imply that State authority must approve/certify the training course/ programme.

Note 2 — A FVSP may be a State authority, an air navigation service provider (ANSP) or an independent third party.

Figure 1-1 below indicates the relationship among these parties.

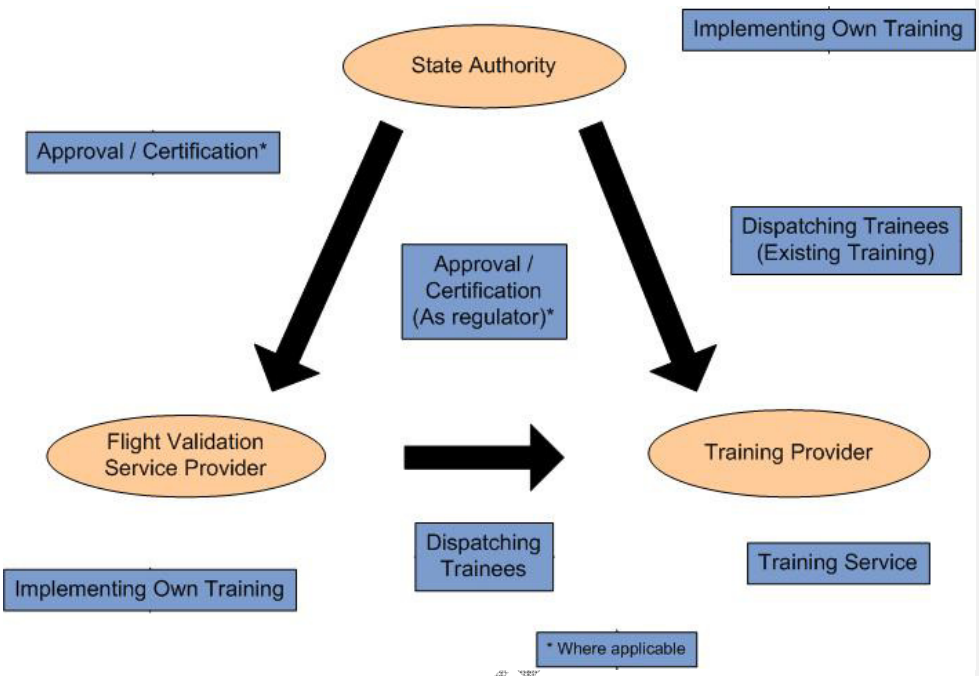

Figure 1-1

Relationships among State Authority, Flight Validation Service Provider (FVSP), and Training Provider

Final Draft approved IFP

1.3 Goals of the Manual

The primary goal of the manual is to provide guidance to organizations that are providing flight validation pilot training, particularly on developing, implementing and validating training.

A secondary goal of the manual is to provide guidance to regulators who certify and/or approve training courses and programmes, as well as organizations that dispatch trainees to training providers and who have to evaluate training courses and programmes. It may also be used as an assessment tool to evaluate the qualifications of candidate flight validation pilots. Paragraph 1.5 describes how to use the manual based on the goals described above.

1.4 Structure of the Manual

The manual consists of five chapters described below:

Chapter 1, *Introduction,* presents the manual: target audiences, goals, structure, and its use.

Chapter 2*, General Provision for Competency-based Training and Assessment,* describes general concepts of a competency-based approach including how to conduct a job and task analysis so as to derive a competency framework. This is used as a basis to design a curriculum as described in Chapter 3. Chapter 2 also includes the competency framework for flight validation pilots. In

Appendix B to this manual, a sample evidence and assessment guide for one selected competency element is provided.

Chapter 3, *Flight Validation Pilot and Evaluation Requirements,* describes the process concerning validation and post training evaluations of flight validation pilot training.

Chapter 4*, Designing Curriculum*, describes how to derive a curriculum from the competency framework. The method is applicable to all phases of training: initial training, OJT training, and refresher or recurrent training. It also includes information on:

- How to determine prerequisites;
- How to develop tests applicable to interim and/or final stage of training; and
- Other considerations in designing modules and course materials.

Chapter 5*, Instructor Competencies,* describes competencies required for instructors of flight validation pilot training.

Chapter 6, *Validating and Post-Training Evaluation of Flight Validation Pilot Training,* describes how to implement training and how to evaluate training at the following levels:

- Level 1: evaluation of trainee reaction
- Level 2: evaluation of trainee mastery learning
- Level 3: evaluation of on-the-job performance
- Level 4: evaluation of results/impact on the organization

1.5 How to use the Manual

This section outlines how different target audiences can use the manual depending on whether their purpose is in line with the primary or secondary goal outlined in paragraph 1.3.

1.5.1 Organizations Providing Flight Validation Pilot Training (Training Providers)

Organizations providing flight validation pilot training, such as independent training providers and State authorities or flight validation pilot services providers (FVSP) that provide training for their own validation pilots, can use the manual to:

- Complete the job and task analysis with the competency framework as a starting point;
- Develop training courses/programmes; and
- Evaluate training courses/programmes.

Once job and task analysis are completed, training providers can apply the method described in Chapter 2. Competency requirements for flight validation pilots may vary among States.

Developing a training course/programme includes several steps such as:

- Determining prerequisites;
- Determining training objectives (terminal objectives, enabling objectives, OJT objectives);
- Developing tests; and

- Organizing modules.
-

1.5.2 State Authorities/ Regulators

Regulators that intend to approve/certify a training course/programme can use this manual as a part of their training approval/certification of process. For instance, they can establish standards, which state that the proposed training should be developed, implemented and evaluated in accordance with a competency-based approach. Application of such an approach is described in this manual.

However, it should be noted that this use is not the primary goal of this manual.

Organizations that dispatch flight validation pilots to training providers can evaluate the training courses/programmes by checking if the training has been developed using a competency-based approach as described in this manual. Curriculum and material of well-developed training should adequately cover the competency elements in the flight validation pilot competency framework. However, it should be noted that this use is not the primary goal of the manual.

The manual can provide useful information for approval/certification/licensing criteria of flight validation pilots, where such systems are implemented. However, ICAO does not have provisions for such systems at present. Therefore it is beyond the scope of this manual to provide guidance for these systems.

Final Draft approved IFPP/8 EDL reviewed

2. General provisions for competency based training and assessment

2.1 Introduction

This chapter outlines, in a general manner, the principles and procedures to be followed in the design and implementation of a competency-based approach to training and assessment. It lists key features and briefly describes how the competency-based approach is to be used by course developers, instructors, and examiners where applicable. The chapter also provides the requirements that training providers and licensing authorities should comply with in order to implement competency-based training and assessment.

2.2 Competency based approach to training and assessment

The development of competency-based training and assessment should be based on a systematic approach whereby competencies and their standards are defined; training is based on the competencies identified and assessments are developed to determine whether these competencies have been achieved. Competency-based approaches include, but are not limited to, mastery learning, performance-based training, criterion referenced training, and instructional systems design. Competency training does not have to be all encompassing; it can be specific to select areas of training.

Competency-based approaches to training and assessment should include at least the following features:

- The justification of a training need through a systematic analysis and the identification of indicators for evaluation;
- The use of a job and task analysis to determine performance standards, the conditions under which the job is carried out, the criticality of tasks, and the inventory of skills, knowledge and attitudes;
- The identification of the characteristics of the trainee population;
- The derivation of training objectives from the task analysis and their formulation in an observable and measurable fashion;
- The development of criterion-referenced, valid, reliable and performance-oriented tests;
- The development of a curriculum based on adult learning principles, with a view to achieving an optimal path to the attainment of competencies;
- The development of material-dependent training; and
- The use of a continuous evaluation process to ensure the effectiveness of training and its relevance to line operations.

Note.— A detailed description of the ICAO course development methodology, a competency-based approach to training and assessment and an example of an ISD methodology can be found in ICAO Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868) *, Attachment to paragraph 7.*

According to the PANS-TRG document, the course development methodology comprises nine phases, which can be subdivided in three broad categories of analysis, design and production, and evaluation.

Analysis is covered through:

- Phase 1 – Preliminary study
- Phase 2 – Job analysis
- Phase 3 – Population analysis

Design and Production is covered in:

- Phase 4 – Design of curriculum
- Phase 5 – Design of modules
- Phase 6 – Production

Evaluation category is covered by

- Phase 7 – Validation and revision
- Phase 8 – Implementation
- Phase 9 – Post training evaluation

A brief description of the specific outputs of the nine phases is summarized in the following table.

Category	Phases	Outputs
Analysis	Phase 1 – Preliminary study Phase 2 –Job analysis Phase 3 – Population analysis	Training proposals, their justification and proposed course of action. Task description and performance standards. Trainees' characteristics and their existing skills and knowledge.
Design and Production	Phase 4 – Design of curriculum Phase 5 – Design of modules Phase 6 – Production	Training objectives, mastery tests and sequence of modules. Mode of delivery, training techniques and media, draft training material. Production of all trainee materials.
Evaluation	Phase 7 – Validation and revision Phase 8 – Implementation Phase 9 – Post-training evaluation	Try-out of course and revision as required Human resources trained. Evaluation of training effectiveness; plans for remedial action.

Aviation authorities should develop general requirements concerning the management of their examiners and provide guidance on:

- The selection of examiners and description of competency-based assessment training;

- The performance criteria to be considered by the examiner when assessing each competency; and
- The tolerances applicable to all competency-based tests.

2.3 The Competency Framework

The competency framework consists of competency units, competency elements, performance criteria, evidence and assessment guide and range of variables. The competency framework for Flight Validation Pilots should be based on the following competency units:

- Conduct Pre-Flight Validation
- Conduct Flight Preparation
- Conduct Simulator Evaluation (as required)
- Conduct Flight Evaluation (as required)
- Conduct Post-Flight Analysis

Competency units, competency elements and performance criteria are derived from job and task analysis of flight validation pilots and describe observable outcomes.

Note. — Definitions of competency units, competency elements and performance criteria are provided in the definitions section.

The competency framework is indicated in paragraph 6.4. A Sample Evidence and Assessment Guide for one Competency Element is provided in Appendix A, paragraph A.4 of this manual.

The Validation Process flow diagram indicating the work flow in the Validation Process is provided in Figure 5-1 of *The Quality Assurance Manual for Flight Procedure Design* (Doc 9906)
Volume 5, Validation of Instrument Flight Procedures. In general, the steps in the diagram correspond to the Competency Units in the competency framework.

2.4 Competency Framework for Flight Validation Pilots (FVP)

X	Competency Unit				
	X.X	Competency Element			
		X.X.X	Performance Criteria		
					Reference (PANS-OPS, Part-Section-Chapter)
1	**Conduct Pre-flight Validation**				
	1.1	**Review IFP Package**			
		1.1.1	**Ensure completeness of package (all forms files and data included)**		Doc. 9906 vol. 5
		1.1.2	**Ensure charts and maps are available in sufficient details to assess IFP during the FV**		Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		1.1.3	**Familiarize with target population for the procedure**		Doc. 9906 vol. 5
		1.1.4	**Discuss the procedure package with the procedure designer, as necessary**		Doc. 9906 vol. 5
		1.1.5	**Verify procedure graphics and data from forms match**		Doc. 9906 vol. 5
		1.1.6	**Verify the IFP design coding, and relevant charting information against the FMS Navigation Database**		PANS-OPS doc. 8168 vol. II III-2-5, III-5-2
		1.1.7	**Verify that controlling obstacles and obstacles otherwise influencing the design of the procedure are properly identified**		PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		1.1.8	**Review airport infrastructure and special airport regulations**		Annex 14 vol. 1 and/or 2 AIP AD
		1.1.9	**Review navigation infrastructure used by the procedure**		Procedure Design Report
		1.1.10	**Identify items that require flight inspection**		Annex 10 Doc. 8071
		1.1.11	**Determine required steps in the flight validation**		Doc. 9906 vol. 5
	1.2	**Evaluate Data and Coding**			
		1.2.1	**Prepare loadable data file for FMS**		Doc. 9906 vol. 5
		1.2.2	**Compare true courses and distances for segments between data file and procedural data**		Doc. 9906 vol. 5
		1.2.3	**Compare ARINC 424 coding for legs and path terminators between data file and procedural data**		ARINC 424 PANS-OPS doc. 8168 vol. II III-2-5, III-2-5-Appendix
	1.3	**Review special operational and training requirements**			

		1.3.1	**Review deviations from criteria and equivalent level of safety provided by waivers/mitigations**	Procedure Design Report
		1.3.2	**Review Safety case supporting the waiver/mitigation**	Procedure Design Report
		1.3.3	**Assess restricted procedures for special training and equipment requirements**	Doc. 9906 vol. 5 Doc. 9905
	1.4	**Coordinate operational issues**		
		1.4.1	**Consider temperature and wind limitations, bank angles, air speeds, climb/descent gradients**	Doc. 9906 vol. 5
		1.4.2	**Determine aircraft and equipment needed to complete the flight validation**	Doc. 9906 vol. 5
		1.4.3	**Determine airport infrastructure and navaid availability**	Doc. 9906 vol. 5
		1.4.4	**Determine the weather minima required for the flight validation**	Doc. 9906 vol. 5
		1.4.5	**Determine if a night evaluation is required (i.e., new IFR airport)**	Doc. 9906 vol. 5
		1.4.6	**Determine the flight validation coordination required (ATC, airport management)**	Doc. 9906 vol. 5
	1.5	**Document the results of the Preflight Validation**		
		1.5.1	**Assess whether the IFP is ready for further processing in the Validation Process**	Doc. 9906 vol. 5
		1.5.2	**Produce a detailed written report of the Preflight Validation**	Doc. 9906 vol. 5
2	**Conduct Flight Preparation**			
	2.1	**Conduct flight preparation for Simulator Evaluation**		
		2.1.1	**Ensure simulator and aircrew availability suitable for the flight validation**	Doc. 9906 vol. 5
		2.1.2	**Ensure availability of flight validation recorders, as required**	Doc. 9906 vol. 5
		2.1.3	**Ensure the electronic data is correctly loaded into the aircraft navigation system**	Doc. 9906 vol. 5
		2.1.4	**Review the results of the Ground Validation so far**	Doc. 9906 vol. 5
		2.1.5	**Review the required assessments during the Simulator Evaluation**	Doc. 9906 vol. 5 Pre-flight Validation report
	2.2	**Conduct flight preparation for Flight Evaluation**		
		2.2.1	**Ensure aircraft and aircrew availability suitable for the flight validation**	Doc. 9906 vol. 5
		2.2.2	**Ensure availability of flight validation recorders, as required**	Doc. 9906 vol. 5
		2.2.3	**Ensure weather requirements are met for the flight validation**	weather briefing Doc. 9906 vol. 5
		2.2.4	**Ensure proper coordination with ATC, airport operator, and/or other stakeholders is effected**	Doc. 9906 vol. 5

		2.2.5	**Ensure the electronic data is correctly loaded into the aircraft navigation system**	Doc. 9906 vol. 5
		2.2.6	**Review the results of the Ground Validation so far**	Doc. 9906 vol. 5 Ground Validation report
		2.2.7	**Review the results of the Simulator Evaluation (if performed)**	Doc. 9906 vol. 5 Simulator Evaluation report
		2.2.8	**Review the required assessments during the Flight Evaluation**	Doc. 9906 vol. 5 Pre-flight Validation report Simulator Evaluation report
3	**Conduct Simulator Evaluation**			
	3.1	**Conduct database verification**		
		3.1.1	**Ensure the data from the flight validation database matches that used in the procedure design**	ARINC 424 Doc. 9906 vol. 5
		3.1.2	**Ensure the data produces the desired flight track.**	ARINC 424 Doc. 9906 vol. 5
	3.2	**Conduct flyability and human factors assessment**		
		3.2.1	**Fly each segment of the IFP on-course and on-path**	Doc. 9906 vol. 5
		3.2.2	**Validate the intended use of IFP as defined by Stakeholders and described in the conceptual design**	Doc. 9906 vol. 5
		3.2.3	**Evaluate other operational factors, such as charting, required infrastructure, visibility, intended aircraft category**	Doc. 9906 vol. 5
		3.2.4	**Evaluate the aircraft maneuvering area for safe operations for each category of aircraft to use the IFP**	Doc. 9906 vol. 5
		3.2.5	**Evaluate turn anticipation and rate of turns required**	Doc. 9906 vol. 5
		3.2.6	**Evaluate the IFP complexity, required cockpit workload, and any unique requirements**	Doc. 9906 vol. 5
		3.2.7	**Check that waypoint spacing and segment length are suited for aircraft performance.**	Doc. 9906 vol. 5
		3.2.8	**Evaluate the aircraft position at the DA and/or MDA, and the ability to execute a normal landing**	Doc. 9906 vol. 5
		3.2.9	**Evaluate required climb or descent gradients, if any**	Doc. 9906 vol. 5
		3.2.10	**Evaluate the proposed charting for correctness and clarity, and for ease of interpretation**	Doc. 9906 vol. 5
		3.2.11	**Evaluate TAWS warnings (if applicable)**	Doc. 9906 vol. 5
	3.3	**Complete associated validation tasks**		
		3.3.1	**Confirm Waypoint fixes cross reference to map and navigation positioning**	Doc. 9906 vol. 5
		3.3.2	**Indicate TAWS alerts**	Doc. 9906 vol. 5

		3.3.3	**Confirm that the final approach segment of the procedure follows the intended track and takes the aircraft to the intended point on the ground**	Doc. 9906 vol. 5
		3.3.4	**Verify that deviations from design criteria do not compromise safety**	Doc. 9906 vol. 5
	3.4		**Verify chart depiction and details**	
		3.4.1	**Verify that the chart has sufficient detail to safely navigate and identify considerable terrain or obstacles**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		3.4.2	**Verify that the chart accurately portrays the procedure and is easily interpreted**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		3.4.3	**Verify flight track matches chart and takes aircraft to intended aiming point**	Doc. 9906 vol. 5
		3.4.4	**Verify true and magnetic course to next waypoint indicated on the FMS or GNSS/PFD accurately reflects the procedure design.**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		3.4.5	**Verify segment distances indicated by the aircraft navigation system accurately reflect the procedure design.**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		3.4.6	**Verify the flight path angle (FPA) indicated on the FMS or GNSS/PFD accurately reflects the procedure design**	Doc. 9906 vol. 5
		3.4.7	**Verify that waypoint spacing and segment length are sufficient to allow the aircraft to decelerate or change altitude on each leg without bypassing.**	PANS-OPS doc. 8168 vol. II III-2-1
	3.5	**Record validation flight**		
		3.5.1	**Record and save electronic flight data**	Doc. 9906 vol. 5
4	**Conduct Flight Evaluation**			
	4.1	**Conduct database verification**		
		4.1.1	**Ensure the data from the flight validation database matches that used in the procedure design**	ARINC 424 PANS-OPS doc. 8168 vol. II III-2-5 and III-5-2
		4.1.2	**Ensure the data produces the desired flight track.**	ARINC 424 PANS-OPS doc. 8168 vol. II III-2-5 and III-5-2
	4.2	**Assess obstacles and infrastructure**		
		4.2.1	**Verify the listed controlling obstacle for each segment of the IFP**	Doc. 9906 vol. 5
		4.2.2	**Conduct obstacle assessment to the lateral limits of each segment**	Doc. 9906 vol. 5

		4.2.3	**Document any uncharted controlling or significant obstacles with position and elevation.**	Doc. 9906 vol. 5
		4.2.4	**Assess the visual segment surface (VSS)**	PANS-OPS doc. 8168 vol. II I-4-5
	4.3	**Conduct flyability and human factors assessment**		
		4.3.1	**Fly each segment of the IFP on-course and on-path**	Doc. 9906 vol. 5
		4.3.2	**Validate the intended use of IFP as defined by Stakeholders and described in the conceptual design**	IFP Design report Doc. 9906 vol. 5
		4.3.3	**Evaluate other operational factors, such as charting, required infrastructure, visibility, intended aircraft category**	Doc. 9906 vol. 5
		4.3.4	**Evaluate the aircraft maneuvering area for safe operations for each category of aircraft to use the IFP**	Doc. 9906 vol. 5
		4.3.5	**Evaluate turn anticipation and rate of turns required**	Doc. 9906 vol. 5
		4.3.6	**Evaluate the IFP complexity, required cockpit workload, and any unique requirements**	Doc. 9906 vol. 5
		4.3.7	**Check that waypoint spacing and segment length are suited for aircraft performance.**	PANS-OPS doc. 8168 vol. II III-2-1
		4.3.8	**Evaluate the aircraft position at the DA and/or MDA, and the ability to execute a normal landing**	Doc. 9906 vol. 5
		4.3.9	**Evaluate required climb or descent gradients**	PANS-OPS doc. 8168 vol. II I-4-3 to 6, I-3-2
		4.3.10	**Evaluate the proposed charting for correctness and clarity, and for ease of interpretation**	Doc. 9906 vol. 5
		4.3.11	**Evaluate TAWS warnings (if applicable)**	Doc. 9906 vol. 5
	4.4	**Complete associated validation tasks**		
		4.4.1	**Verify all required runway markings, lighting, and communications**	Annex 14 Doc. 9906 vol. 5
		4.4.2	**Verify the navigation aid/navigation sensor performance supports the procedure design (if applicable)**	Doc. 9613 Doc. 8071
		4.4.3	**Confirm Waypoint fixes cross reference to map and navigation positioning**	Doc. 9906 vol. 5
		4.4.4	**Verify runway VASIS is coincident with vertical path angles and document if not**	Doc. 9906 vol. 5
		4.4.5	**Verify if ATC communication requirements and navaid reception requirements are met**	Doc. 9906 vol. 5

		4.4.6	**Ensure Radar coverage is available for all portions of the procedure where required**	Doc. 9906 vol. 5
		4.4.7	**Indicate TAWS alerts**	Doc. 9906 vol. 5
		4.4.8	**Confirm that the final approach segment of the procedure follows the intended track and takes the aircraft to the intended point on the ground**	Doc. 9906 vol. 5
		4.4.9	**Verify that deviations from design criteria do not compromise safety**	Doc. 9906 vol. 5
		4.4.10	**If night evaluation is required, determine the adequacy of airport lighting systems prior to authorizing night minimums**	Doc. 9906 vol. 5
	4.5	**Verify chart depiction and details**		
		4.5.1	**Verify that the chart has sufficient detail to safely navigate and identify considerable terrain or obstacles**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		4.5.2	**Verify that the chart accurately portrays the procedure and is easily interpreted**	
		4.5.3	**Verify flight track matches chart and takes aircraft to intended aiming point**	Doc. 9906 vol. 5
		4.5.4	**Verify true and magnetic course to next waypoint indicated on the FMS or GPS accurately reflects the procedure design.**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		4.5.5	**Verify segment distances indicated by the aircraft navigation system accurately reflect the procedure design.**	Annex 4 PANS-OPS doc. 8168 vol. II I-3-5, I-4-9 and III-5-1
		4.5.6	**Verify the flight path angle (FPA) indicated on the FMS or GNSS/PFD accurately reflects the procedure design**	Doc. 9906 vol. 5
		4.5.7	**Verify that waypoint spacing and segment length are sufficient to allow the aircraft to decelerate or change altitude on each leg without bypassing.**	PANS-OPS doc. 8168 vol. II III-2-1
	4.6	**Record validation flight**		
		4.6.1	**Prepare suitable recording device**	Doc. 9906 vol. 5
		4.6.2	**Assure the required data is recorded**	Doc. 9906 vol. 5
		4.6.3	**Record and save electronic flight data**	Doc. 9906 vol. 5
		4.6.4	**Produce the appropriate documentation of the recording for inclusion in the IFP package**	Doc. 9906 vol. 5
5	**Conduct Post-flight Analysis**			
	5.1	**Assess the results of the flight validation phase**		
		5.1.1	**Review all aspects of the flight validation phase to complete the assessment**	Doc. 9906 vol. 5
		5.1.2	**Determine if assessment has been satisfactory or not**	Doc. 9906 vol. 5

	5.2	**Complete the IFP processing (in case of satisfactory flight validation)**		
		5.2.1	**Ensure the completeness and correctness of the IFP package to be forwarded**	Doc. 9906 vol. 5
		5.2.2	**Confirm that required flight inspection of navigation aids and/or lighting (if required) has been completed**	Doc. 8071 Annex 14
	5.3	**Return the IFP to the procedure designer(s) for corrections (in case of unsatisfactory flight validation)**		
		5.3.1	**Provide detailed feedback to the procedure designer(s) and other stakeholders**	Doc. 9906 vol. 5
		5.3.2	**Suggest mitigation and/or corrections for unsatisfactory results**	Doc. 9906 vol. 5
	5.4	**Document the results of the flight validation phase**		
		5.4.1	**Complete a detailed written report of the flight validation phase**	Doc. 9906 vol. 5
		5.4.2	**Ensure any findings and operational mitigations are documented**	Doc. 9906 vol. 5
		5.4.3	**Forward uncharted controlling obstacle position and elevation data to procedure designer(s) (if any)**	Doc. 9906 vol. 5
		5.4.4	**Ensure recorded data is processed and made available for archiving**	Doc. 9906 vol. 5

3 Flight Validation Pilot requirements and evaluation

3.1 Pre-requisite Pilot Qualification and Experience Requirements

Due to the impact on safety, States should ensure the highest level of experience and qualification possible when certifying flight validation pilots.
The qualifications for Flight Validation Pilots shall include at least a commercial pilot license with instrument rating. Alternatively an equivalent authorization from the State meeting the Annex 1 skill and knowledge requirements for issuing the commercial pilot license and instrument rating is acceptable. The licence held by the flight validation pilot should be for the aircraft category (e.g. aeroplane or helicopter) appropriate for the procedure to be validated. In addition, flight validation pilots shall meet all the experience requirements for the airline transport pilot license in the relevant category of aircraft (e.g. aeroplane or helicopter) as defined in Annex 1. The flight validation pilot does not have to be the pilot-in-command of the validation flight nor is he required to have the type rating on the aircraft used for the validation flight.

Note.— The provisions of Annex 1, 2.6.3.1.2 or 2.6.4.1.2, may be applicable with regard to meeting the experience requirements for the airline transport pilot license.

Refer to Appendix A for general SKA.

3.2 Flight Validation Pilot Specific Skills, Knowledge and Attitudes (SKA)

Some general SKA(s) are particularly useful for flight validation pilots and are a great aid to those seeking to become an “expert performer”.

- *Demonstrate three-dimensional visualization (skill)*
- *Multi-tasking (skill)*
- *Mathematical understanding (skill/ knowledge) (Doc 9906 Volume 2, paragraph 3.3.2)*
- *Demonstrate ability to work as part of a team (attitude)*
- *Cockpit Resource Management (CRM) (attitude)*
- *Attention to detail (attitude)*

These SKA(s) are not necessarily a pre-requisite to start training as a flight validation pilot, nor does the absence of those SKA(s) make it impossible to perform on the job. It is possible that such SKA(s) develop during the process of training or later during job performance.

The activities of flight validation pilots are considered critical to the safety of aviation. The approval of erroneous, incomplete or badly designed flight procedures, inaccurate minima, insufficient obstacle clearance and inadequate infrastructure to support the procedure has direct consequences to the users.

Flight validation pilot training and evaluation are critical elements of quality assurance. Each State should establish standards for the required competency level of flight validation pilots. Each State should ensure that flight validation pilots have acquired and are maintaining competency levels through formal ground training, supervised on-the-job training (OJT), recurrent training and/or can demonstrate performance to an acceptable level. This chapter is a guideline for States and other stakeholders who are to meet these requirements.

In order to adequately validate instrument procedures, flight validation pilots should possess the following basic underpinning knowledge:

- Basic knowledge of Standards, Procedures and guidance pertinent to Aeronautical Information Services (i.e., Annex 15)
- Understand PBN and conventional instrument procedure construction such as Instrument Departures, SIDs/STARs and holding/reversal procedures, (PANS OPS, Doc 9905)
- Understand PBN concept (Doc 9613)
- Basic knowledge of Standards, procedures and guidance pertinent to flight inspection (i.e., Annex 10, Doc 8071)
- Understand the basic concept of and differences between flight validation and flight inspection
- Basic knowledge of Standards, Procedures and guidance pertinent to Aerodrome (i.e., Annex 14, Doc 9137 and 9157)
- Basic knowledge of Standards, Procedures and guidance pertinent to charting and aviation publications (i.e., Annex 4, Doc 8697)
- Understanding of ARINC 424 coding
- Understanding of Human Factors (Doc 9683)
- Understanding of different types of aircraft operations (such as air ambulance, arctic flying versus domestic airlines) and Aircraft's Performance (i.e., limitations and equipment)
- Understanding obstacle assessment methodology
- Basic understanding of the safety assessment process
- Basic understanding of Geodesy (Doc 9906, Volume 2, paragraph 3.3.3.8)
- Comprehensive understanding of Doc 9906, Volume 5, Validation of Instrument Flight Procedures

4 Design Curriculum

4.1 Introduction

4.1.1 The following paragraphs describe different types of flight validation training. All types are interdependent. Therefore, when planning the most effective and efficient training path, training providers and other stakeholders need to bear in mind the interdependence of these different types of training. Each organization will achieve training effectiveness and efficiency in different ways.

4.1.2 The duration of a course should not be a priority. It should be derived from a course plan that is competency-based. It is recognized, however, that the duration of a course impacts cost-effectiveness both for training providers and their clients. As the duration of a course is lengthened, the client organization faces a human resource planning challenge. As it is shortened, the training provider faces a training quality and training effectiveness challenge. For longer training phases (e.g. four weeks or longer) training providers should consider to break the long period into multiple shorter training periods.

Training providers can address these challenges by determining more or less stringent prerequisite skills, knowledge and attitudes for initial training. This will impact the time required to achieve training objectives. The course duration can then be adjusted accordingly.

4.1.3 The final goal of training is to ensure flight validation is performed to the requirements specified in the competency framework.

It will be up to each training provider to establish a balance between the factors described above while ensuring the quality and effectiveness of training.

4.1.4 Course developers, course instructors and trainees are all stakeholders in the instructional process.

- Course developers are responsible for the development and production of all course materials. The goal is to produce training packages that can stand alone, that are material-dependent and are performance-oriented.
- Course instructors are responsible for delivery of all course content and instructional events. They are responsible for completing all activities involved in the instructional process as well as guiding and counseling trainees.
- Trainees are responsible for actively engaging in the training and the successful completion of all course module activities and assessment materials.

4.1.5 In order for a trainee to achieve full competency on the job, he or she will go through a training programme consisting of several phases of training. These phases are described below. Depending on the trainee's entry level of skill and knowledge, he or she may forego some parts in phases of training. Each phase of training will involve a curriculum development process. The steps to carry out the curriculum development are to:

- State the aim of the training;
- Derive terminal and enabling objectives from the competency framework identified in Chapter 2;
- Design a competency based mastery test for each terminal objective;
- Ensure that all skills, knowledge and attitude required for each enabling objective are covered;

- Sequence terminal and enabling objectives; and
- Group objectives into modules.

4.2 Training phases

4.2.1 Initial Training

Initial training is the first phase of training where actual procedure design topics and criteria are covered. The purpose of initial training is to provide basic skills and knowledge to flight validation pilot trainees. The curriculum of initial training is derived from the competency framework. The associated duration and mastery test are relevant to the programme.

4.2.2 On-the-job Training (OJT)

While on-the-job training cannot be considered a specific training course in the formal sense, it is an essential phase in a training programme. Its purpose is to reinforce formal training and support the achievement of competency standards. Similar to initial training, on-the-job training curriculum will be derived from the competency framework and driven by training objectives. If appropriate, OJT phases can also follow recurrent and refresher training.

4.2.3 Recurrent Training

The purpose of recurrent training is to address changes in the available criteria and regulations. It is essential that the flight validation pilot updates his or her knowledge and skills in accordance with the latest criteria, technologies, and benchmarks from his/her usual flight validation activity against identified best practices. Regular recurrent training should therefore be planned accordingly. It is recommended that recurrent training be conducted at least once every two years.

4.2.4 Refresher Training

The purpose of refresher training is to strengthen skills and knowledge that have weakened through disuse and the passage of time. Given the safety critical nature of the flight validation function, it is strongly recommended that FVSP(s) identify skills and knowledge that have weakened with time and that refresher training is planned accordingly. Refresher training curriculum should be derived from the competency framework and can be combined with recurrent training.

4.3 Process to derive training objectives from the Competency Framework

Training providers must establish training objectives for all courses offered. Training objectives must be established using the competency framework in Chapter 2. The training provider must define which competency elements must be mastered at the end of course modules and establish training objectives for each module accordingly. It should be noted that training providers can use different courses and different methods to support trainees in achieving similar objectives. Course durations, course titles and course contents will vary depending on the training provider. It is emphasized that establishing the training objectives for a course with a given duration will always have an impact on entry requirements (prerequisite SKAs) for the course.

4.3.1 Example for Establishing Training Objectives for Flight Validation Pilot Training

4.3.1.1 Training objectives comprise three parts: conditions of performance, expected behaviour and a standard. There are two types of training objectives: terminal objectives and enabling objectives.

Training objectives are derived from competency elements. For example: Within Competency Unit 1 (Conduct Pre-Flight Validation), Competency Element 1.1 “Review IFP Package” is found. An objective can then be formulated as follows:

Conditions of Performance	Given a proposed IFP
Expected Behavior	the FVP reviews the content for completeness and correctness
Standard	in accordance with doc. 9906-AN472, Volume 5, doc. 8168

4.3.1.2 A trainee will then undergo a module of training at the end of which the trainee will be required to perform the terminal objective as formulated in a mastery test.

4.3.1.3 In order to achieve the terminal objective, there are several enabling objectives the trainee needs to master. Enabling objectives may be derived from performance criteria. For example: Competency Unit 1, Competency Element 1.2 “Evaluate data and coding”, Performance Criteria 1.2.3 states Compare ARINC 424 coding for legs and path terminators between data file and procedural data. One enabling objective of the module on the ARINC 424 coding would be

Conditions of Performance	Given an ARINC 424 data set
Expected Behavior	The FVP can interpret the IFP legs and path terminators and verify if the data set represents the designed procedure
Standard	The correct selection of ARINC 424 path terminators in a given circumstance can be identified with a defined level of confidence and within a reasonable time

4.3.1.4 To be able to achieve this enabling objective, the trainee will require specific knowledge and skills. For example, the trainee is required to:

Skills	Apply methods and knowledge to identify corrupt data
Knowledge	Identify all sources of necessary data as well as the format in which data is presented

Attitude	Understand importance for accurate un anambiguous translation of the procedure into the database

Note: Refer to Appendix A for general information on skills, knowledge and attitudes.

4.3.2 Establishing on-the-job training objectives

4.3.2.1 Establish on-the-job (OJT) training objectives from the competency framework in Chapter 2.

4.3.2.2 The purpose of the OJT phase is to consolidate the skills and knowledge acquired during initial training. Training objectives for OJT phases should be established from the competency framework. The difference between the training objectives and the OJT objectives is the standard, which trainees should achieve to demonstrate that they have mastered the competency. Often it is not possible to achieve full mastery of a competency through training alone. Experience and practice on the job is required to meet the full performance standard stated in the competency framework. When deriving training objectives, especially for initial training, the course development team should determine the performance standard they expect trainees to achieve. For example, it may not be possible to expect a trainee to perform database verification without errors. There may be a minimum number of errors that are acceptable in the achievement of this objective. The acceptable number and type of errors should be discussed by the course developer, with input from experts in the field. Some errors, even during training, are not acceptable because they indicate a lack of skill, knowledge or attitude that may impact safety. Other types of errors are less critical and may be acceptable in the initial training. OJT objectives, however, need to be as close or equivalent to the expected job performance. Therefore the standards for OJT objectives are more demanding.

4.3.2.3 Example for establishing OJT training objectives

4.3.2.3.1 The terminal objective for the OJT phase following a training course is derived from the competency elements. The following example uses Competency Unit 1 “Conduct Pre-Flight Validation”, Competency Element 1.1 “Review IFP package”, Competency Element 1.2 “Evaluate data and coding” , Competency Element 1.4 “Coordinate operational issues” and Competency Element 1.5 “Document the results of the Pre-Flight Validation”. In order to achieve the OJT terminal objectives, there are several enabling objectives the trainee needs to master. Enabling objectives can be derived from the performance criteria. See the following explanations:

4.3.2.3.2 Performance Criteria 1.1.1 “Ensure completeness of package”
Students must ensure that all forms, files, and data are included and that the charts and maps are available in sufficient detail to assess IFP during the flight validation. They must be familiar with procedure design constraints, requirements, and intended users to determine the acceptability and geographical context to assist in the flight validation process.

4.3.2.3.3 Performance Criteria 1.2.3. “Compare ARINC 424 coding for legs and path terminators between data file and procedural data”.

Students must be able to verify that the navigation database represents the procedure as documented and charted. They must be familiar with ARINC 424 path terminators and their limitations. Furthermore they must be aware of limitations of the onboard navigation system with regard to the correct execution of the selected path terminators.

4.3.2.3.4 Performance Criteria 1.4.5 "Determine if a night evaluation is required (i.e., new IFR airport)"
Students must be able to determine if the procedure requires an evaluation by night. Therefore they must be aware of any obstacle safeguarding issues, such as penetration of Obstacle Limitation Surfaces according to Annex 14 — *Aerodromes* and the requirements for lighting.

4.3.2.3.5 Performance Criteria 1.5 "Produce a detailed written report of the Pre-Flight Validation"

The student must demonstrate the ability to prepare a detailed written report of the results of the Pre-Flight Validation.

4.3.3 Skills, knowledge and attitudes (SKA) required to achieve training objective

4.3.3.1 Example for establishing pre-requisite skills, knowledge and attitudes to achieve training objectives.

4.3.3.1.1 When a training provider has established training objectives for a course, it will be necessary to establish entry requirements for that course, in order to ensure that the objectives can be achieved in the time given. Training objectives, course length and pre-requisite skills, knowledge and attitudes are always directly related. Course content, scope and course length in the following example are not meant to be prescriptive.

Course goal	At the end of this course, the participant will be able to Conduct Pre-Flight Validation in accordance with Doc 9906, Volume 5 and the competency framework specified in Chapter 2 of this manual.
Target population	Pilots who want to qualify as FV Pilot according to doc. 8168 PANS-OPS vol. 2, Part I, Section 2, Chapter 4
Course duration	Fifteen days
Pre-requisite skills, knowledge and attitudes	CPL/IR and experience required for an ATPL

Training providers are invited to state the pre-requisites of the respective courses referring to the mastery of competency elements and performance criteria in Chapter 2 of this manual.

4.4 Process of sequencing objectives and organizing modules of training

4.4.1 The various training courses can be divided into modules. The flexibility of a modular approach allows training providers to establish the most effective duration for the course, to address individual learning styles and characteristics, and to measure results on job performance.

The grouping of the objectives into modules and the sequencing of the modules define the training strategy.

4.4.2 A given module can have several terminal objectives. Each one will have several enabling objectives, which describe the desired performance derived from performance criteria. Finally,

OJT objectives describe what the trainee should be able to do after a defined period of practice on the job.

4.4.3 Each module should be designed to ensure that trainees are capable of performing the objectives to the standard required at the end of the module. This will normally require that the module follows the sequence described as:

- Defining what the trainee will be able to accomplish after learning (the objective);
- Explaining how the accomplishment will be tested (methodology);
- Stimulating the recall of pre-requisite learning;
- Presenting the subject-matter content to be learned, piece by piece (based on Competency Unit, Competency Element and Performance Criteria);
- Providing opportunities for the trainee to practice (laboratory exercises, projects);
- Reinforcing learning by providing feedback on the trainees' practice (enabling objective test, presentation);
- Assessing the performance of the trainee (mastery test); and
- Enhancing retention of what has been learnt so that it can be transferred to other situations (example of strategy, presentation of different projects by other trainees.)

The system should allow for building complexity into the training through the creation of additional modules.

A variety of instructional techniques can be used to achieve training objectives including lectures, guided group discussions, case studies/projects, laboratory exercises, supervised practice, leaderless groups, field visits, e-learning, tutorials, on-the-job practice, etc. For each training technique there are usually several alternative media for presenting information to the trainees, and these should be selected to suit the training objectives.

4.4.4 An example of a flight validation pilot training programme is provided in paragraph 4.7.

4.5 Developing Mastery Tests

4.5.1 Purpose of Mastery Tests

4.5.1.1 A mastery test evaluates a trainee's ability to perform on-the-job. All trainees must be tested on their level of mastery of terminal objectives identified throughout the course. Training programmes must provide an appropriate level of assessment. As much as possible, mastery tests should match conditions, behaviours and standards of objectives.

4.5.1.2 Whenever possible, the mastery test should require trainees to demonstrate the necessary ability to perform on the actual equipment. Test items should require trainees to demonstrate desired performance based on the objective(s) being covered. Testing items must match the performance standard and conditions under which trainees are being evaluated as closely as possible.

4.5.1.3 Design of the mastery test should not take place until all terminal objectives have been clearly defined. Mastery tests can then be developed or outlined before putting together the training curriculum. Outlining the mastery test before producing a course structure allows for greater alignment between training and on-the-job performance. It is important to remember that trainees are being tested on their ability to perform specific tasks on-the-job. By designing tests before the curriculum is designed, tests can focus on the `need to know` rather than the `nice to know', thereby ensuring an efficient and effective use of training time.

4.5.2 Validity and Reliability

4.5.2.1 The most important requirement of the mastery test is that it must be valid and reliable. A mastery test is considered valid if it measures what it is intended to measure. A valid test must therefore reproduce as faithfully as possible the conditions, behaviour and standards identified by the objectives; and cover all skills, knowledge and attitudes required to achieve these.

4.5.2.2 A reliable test refers to the capability of yielding the same scores with different people scoring the test. The test should also yield comparatively similar results when administered at different points in time to equally competent trainees. The reliability of a mastery test is dependent on the quality of instructions provided to the trainee. It is important that test instructions are always complete, clear and unambiguous.

4.5.3 Mastery Test Format

4.5.3.1 Ideally, mastery tests would reproduce the conditions of a job performance. Simulations and case scenarios are a good example of a test format that reproduces these conditions. However, it may not always be possible to design mastery tests in these formats. Multiple choice or short answer tests can be designed in such a way as to present a case in which the test-taker should demonstrate his/her ability to perform given terminal objectives. There are several advantages as well as disadvantages to the various types of test a training provider chooses to provide. Please refer to paragraph 9.7 for an outline of test selection criteria.

4.5.3.2 A mastery test should be based on the training objectives covered throughout the course. Developers of the course must describe the context in which observable and measurable outcomes will be identified. For each desired level of mastery, training programmes must structure testing materials on the basis of the competency framework outlined in Chapter 2.

4.5.3.3 Mastery tests should be:

- Balanced so that the distribution of items reflects the relative importance of the objectives being covered;
- Efficient so delivery of the exam is not too time-consuming; it should allow for quick but efficient scoring and the processing of results; and
- Include a scoring key and a model answer (if appropriate) so that a minimum amount of interpretation is needed when scoring trainee's responses.

4.5.4 Mastery Test Design

4.5.4.1 For a given terminal objective, trainees will undergo a corresponding module or modules of training. A mastery test will be conducted at the end during which the trainee will be required to perform the terminal objective(s) as formulated by the training provider. Each objective should be developed in accordance with the competency framework.

4.5.4.2 Depending on each training environment, it is up to the training provider to establish appropriate test items for mastery test. The following example is provided as an outline of a sample test:

a) Terminal objective. Given valid sets of electronic IFP/paper documentation and data, ARINC 424 data set, and IFP operational background, the trainee will be able to conduct Pre-Flight validation, using the following criteria specified in the Competency Framework within an acceptable time period identified by the course instructor. All criteria are in accordance with the Competency Framework as derived from paragraph 6.4 of this manual.

b) Before writing a test item for this objective, the following questions should be answered:

- In what context is the terminal object being carried out?
- What conditions are being stated for the trainee to complete the objective?
- What is the expected behaviour for this objective?
- To what standards should behaviour be carried out?

Conditions: given electronic/paper IFP data, ARINC 424 documentation and data, and an operational scenario, the student

Behaviour: will be able to verify the IFP package is complete and accurate, compare the ARINC 424 code to the IFP paper product and determine if the Pre-Flight validation of the IFP is satisfactory in accordance with Doc 9906, Volume 5

c) Sample test item based on the above terminal objective. Given a valid set of electronic/ paper data and ARINC 424 data set for an RNAV approach procedure, conduct the Pre-Flight Validation using the steps outlined in the Competency Framework of this manual. Figure 9-1 illustrates the mastery test design process.

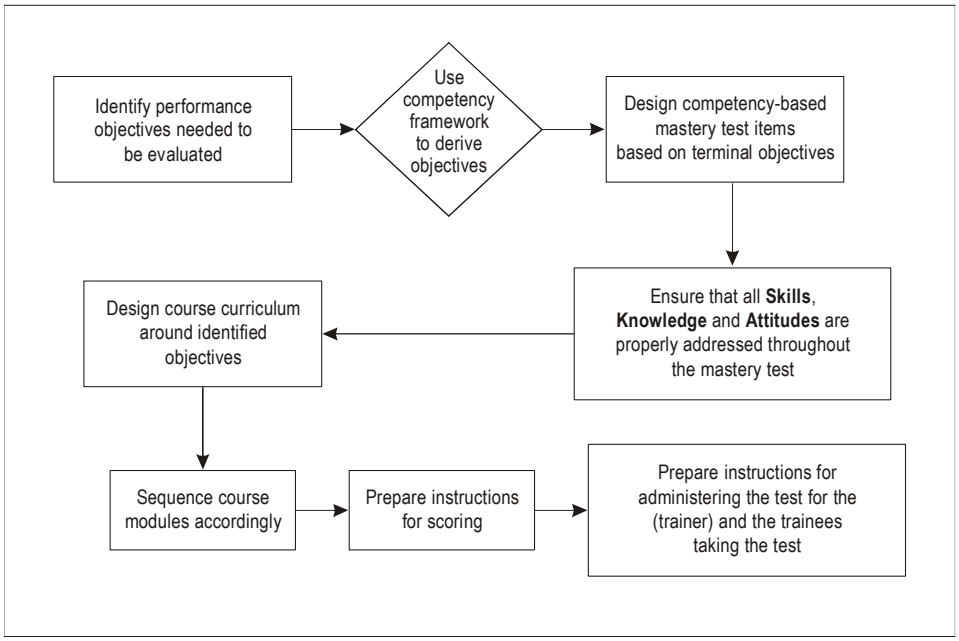

Figure 4-1 Mastery Test Design Process

4.5.5 Progress Test

The purpose of a progress test is to measure a trainee's ability to meet key enabling objectives. It provides immediate feedback to trainees regarding their success or failure to meet enabling objectives. During this part of the module, and through trainee feedback, instructors should consult with trainees on areas of difficulty or where additional clarification is necessary. Instructors use the feedback to assess the effectiveness of their instruction.

4.5.5.1 It is not feasible or advisable to administer progress tests for every enabling objective. However, the administration of a progress test should be considered for enabling objectives that are difficult or critical to the successful achievement of terminal objectives. The number of progress tests should therefore be based on a criticality analysis of enabling objectives.

4.5.5.2 Progress tests should be designed to address specific skills, knowledge and attitudes required to support enabling objectives. SKA(s) can be assessed in the following manner:

- Skills are best measured when a performance test is utilized (task must be assigned to match the outlined objective);
- Knowledge may be tested through written or oral tests; and
- Attitudes are measured through observations of specific performance or questionnaires.

4.5.5.3 Testing can be administered orally, in a written format or a combination of both modes. Each test item, irrespective of the form, should fulfil the following requirements:

- Test appropriate level of skills, knowledge and attitude required by the objective;
- Not be identifiable from similar or related questioning;
- Clearly stated and unambiguous;
- Arranged in an encouraging sequence to motivate trainees; and
- Arranged by the type of testing item.

4.6 Considerations in designing modules and course materials

The structure of each module must take into consideration the skills, knowledge and attitudes (SKA) prerequisites necessary for trainees to reach optimum level of performance or desired objective(s). Course modules and all learning materials should be developed using a systematic step-by-step approach.

4.6.1 Module Design

4.6.1.1 The following instructional steps should be used throughout the course module, for each objective:

- Presentation of objective and mastery test;
- Indication of the relevance of module content
- Presentation of content;
- Clarification of main points;
- Provide practice opportunity or reinforcement;
- Provide feedback for participants (progress test etc.); and
- Performance of the objective and assessment of achievement.

4.6.1.2 Course objective(s) and description of the mastery test should be introduced at the beginning of the course module. This allows trainees to know exactly what is expected of them and how they will be evaluated at the end of the course. This will also reduce the level of anxiety for trainees but also help to keep instruction focused on the desired level of performance. At a minimum, the introduction should include:

- The presentation of terminal or end-of-module objectives and the mastery test;
- Intermediate objectives;
- Activities provided in the module; and
- Any reference material on the subject matter and intended length of time.

4.6.1.3 During the presentation of the module, it may be useful to provide a brief demonstration or sample of the desired performance. This may help motivate participants and provide relevant context for expected levels of proficiency. The relevance of content being presented could be identified several different ways. One method is to ask participants: "What will happen if this is done?"

4.6.1.4 Presentation of content should be divided into manageable pieces of information. Course modules should be sequenced in a logical and interesting manner. The main points of module content should be clarified immediately after the elements of content have been presented.

4.6.1.5 Activities and practice items should be provided to support the successful achievement of training objectives(s). Trainees must be provided with several opportunities to review and practice the skills and knowledge being covered before taking a mastery or progress test. This will help to ensure trainees have mastered all enabling objectives leading to the desired performance of a terminal objective.

4.6.1.6 Once critical objective(s) are completed, a progress test may be necessary. Not in every situation will a course instructor need to test for trainee's progress. For further description of when to test a trainee's progress, refer to Paragraph 8.5.6.

4.6.2 Instructional Events

4.6.2.1 Instructional events are identified as "any action, which moves the trainee towards the accomplishment of any instructional objective". When designing instructional events, course developers should ensure that they address any of the following functions:

- Gain attention and motivate trainee;
- Demonstrate what the trainee will be able to accomplish after learning;
- Demonstrate how accomplishments will be tested;
- Stimulate the recall of prerequisite learning;
- Presenting subject-matter content;
- Provide opportunity for trainees to make appropriate responses (activities to be performed by the trainee, partial practice, global practice);
- Reinforce learning by providing feedback (progress test etc.);
- Assess performance of trainees (mastery test, progress test etc.); and

- Enhance what has been learned and transfer it to other situations. (case studies, scenarios, simulations etc.).
-

4.6.2.2 Instructional events may combine two or three of these functions at a time. As an example, if a course instructor wishes to gain attention and motivate trainees, he or she can simultaneously demonstrate what the trainee will be able to do after learning has occurred.

4.6.2.3 Presenting instructional events can vary depending on the content, materials, or the trainees themselves. In any case, instructional events should be described and documented. For example, specific instructions should be provided on how instructors summarize discussions, how to organize a role playing situation, or how to administer a mastery or progress test. When designing course modules, materials can be instructor-dependent or material-dependent. To help ensure a more consistent delivery of course content, course developers should design content that is material dependent. Material-dependent courses are courses where the instructor requires minimum interpretation of course content. In this situation instruction is dictated by the materials. This focuses the instructor's work on course facilitation. Instructor-dependent courses are courses where the instructional process is not documented. In this case, an inexperienced or new instructor will need to interpret and adapt the course materials. Material-dependent courses ensure that training is delivered in a consistent and reliable manner.

4.6.3 Production and Development of Material

4.6.3.1 In order to validate the complete training process the content of all training materials should be verified by subject matter experts. This helps to ensure that all information presented is not only accurate but also current. This subject matter review will provide further assurance that the training materials actually meet the standards of task(s) trainees will eventually perform on the job.

4.6.3.2 A sample of individuals from the target population should be trained using a draft version of the instructional materials. The feedback from this validation delivery will be used to address any major flaws in course design and correct materials. All instruction and module terminology should be clearly defined and closely match with the learning styles of trainees.

4.7 Example of Flight Validation training curriculum

4.7.1 Background

4.7.1.1 General presentation of the training programme

This sample curriculum is provided as an example of training curriculum.

TRAINING PROGRAMME STEPS

Step 0 – Pre-requisite screening programmeme

Goal: Review basic knowledge and skills required for entry in initial training course.

Means: Identify the level of skill and knowledge of each trainee to ensure trainees meet initial training entry levels.

- Meet minimum pilot qualification and experience requirements (see doc. 8168 PANS-OPS vol. 2, Part I, Section 2, Chapter 4)
- Knowledge of Instrument Flight Rules
- Mathematics

Step 1 – INITIAL FLIGHT VALIDATION PILOT TRAINING (GROUND SEGMENT)

Goal: Acquire necessary knowledge and understanding of the topics described in paragraph 8.2 of this manual.

Description:

A course that provides the training required to qualify as an FV Pilot. The course will provide familiarization with conventional and Performance-Based Navigation (PBN) procedure design criteria, airport safeguarding Standards and Recommended Practices, Validation requirements, Instrument Flight Procedure (IFP) packages as provided by procedure designers, data formats and analysis tools, data collection and documentation, reporting requirements and procedures, regulatory processes, aircraft performance determinations, aircraft avionics requirements, and flight validation guidance and resources available. The course will also provide the basic knowledge and ability to perform all aspects Validation Process including obstacle evaluation and documentation, airport and runway lighting requirements and evaluation methods, flyability and human factors assessments, charting considerations, and operational factors.

Modules 1 – 14 are not listed in any particular order but should precede Modules 15 – 18.

Modules derived *from Competency elements*

- Module 1: General Introduction to Quality Assurance and Validation of Instrument Flight Procedures
- Module 2: General Criteria for Flight Procedure Design
- Module 3: Conventional Navigation Criteria
- Module 4: Airport Design and Obstacle Limitation
- Module 5: Precision Approach Criteria
- Module 6: PBN Criteria

- Module 7: APV Criteria
- Module 8: RNP AR Criteria
- Module 9: Helicopter PinS Criteria
- Module 10: ARINC 424 Database Coding
- Module 11: Geodesy and Earth Modelling
- Module 12: Aeronautical Charting
- Module 13: Safety Assessment process
- Module 14: Understanding of different types of aircraft operations and aircraft's performance
- Module 15: Pre-Flight Validation
- Module 16: Simulator Evaluation
- Module 17: Flight Evaluation
- Module 18: Post-flight Analysis and Documentation

Teaching points (*from the evidence and assessment guide in competency framework*)

Module 1: General Introduction to Quality Assurance and Validation of Instrument Flight Procedures

- Overview of the Flight Procedure Design Process
- Demonstration of critical points where a quality assurance process is safety critical
- Introduce online resources and source materials and documents

Module 2: General Criteria for Flight Procedure Design

- Explanation of Normal Operations vs. Contingency Operations
- Explanation of Status of SARPs and PANS (or equivalent) and how latitude to those are handled
- Outline of the Procedure Design Process
- Explanation of the Amendment Process of reference documentation

Module 3: Conventional Navigation C riteria

- IAS to TAS
- Segments on Non-Precision Approach
- Terminal Area Fixes
- Turn Calculations (Newton's Law of Motion)
- Protection of Turns
- Aircraft Categories
- Arrival Segment
- Initial Segement, Straight/DME arc, DR track, Reversal/Racetrack
- Intermediate Segment
- Final Segment
- Missed Approach

- Circling
- MSA
- Charting
- Departure Procedures
- Holdings

Module 4: Airport Design and Obstacle Limitation

- Demonstration of the Obstacle Limitation Surfaces
- Explain actions to mitigate penetrations

Module 5: Precision Approach Criteria

- General introduction to Precision Approaches
- Basic ILS Surfaces
- Obstacle Assessment Surfaces (OAS)
- Collision Risk Model (CRM)
- Missed Approach
- Low visibility operations criteria
- Non-standard approach angles

Module 6: PBN Criteria

- Overview of the PBN Concept
- Long Range and RNAV Navigation History
- Function Principle of the various Navigation Methods and sensors (Rho/Theta, Range/Range)
- Design Criteria and obstacle protection for approach, departure, holding and en-route

Module 7: APV Criteria

- APV Baro VNAV
- APV SBAS

Module 8: RNP AR Criteria

- Underlying principles
- Design criteria and obstacle assessment
- Examples of published RNP AR procedure
-

Module 9: Helicopter PinS

- Introduction to Helicopter Operations
- Point-in-Space approach criteria

- Point-in-Space departure criteria
- Publication requirements for PinS

Module 10: ARINC 424 Database coding

- Database coding history
- The data chain
- ARINC 424 Path Terminators
- SID coding
- STAR coding
- Approach coding including approach transitions and missed approach
- Coding of conditional requirements (at – but not below, at – but not before)
- Behaviour of different FMS equipment
- Validation Tools

Module 11: Geodesy and Earth Modelling

- Vector Geometry
- Spherical Trigonometry
- Reference Systems
- Map Projections
- Datum Conversions

Module 12: Aeronautical Charting

- Standards, procedures, and guidance pertinent to charting and aviation publications (i.e., Annex 4, Doc 8697)
- Charting guidelines
- Charting workflow
- Charting standards
- SIAP charts
- Flight charts
- Electronic Flight Bags

Module 13: Safety Assessment Process

- Safety Assessment Process

Module 14: Understanding different types of aircraft operations and performance

- Aircraft operations (such as air ambulance, arctic flying versus domestic airlines)
- Aircraft's performance (i.e., limitations and equipment).

Module 15: Pre-Flight Validation

- Procedure package content

- Procedure package analysis and review
- Resolving procedure design ambiguities and conflicts
- Flight validation requirements of an IFP package, including any special requirements
- Flight inspection and flight validation reports
- Identification of procedure elements that require flight inspection (i.e., new fixes using ground-based navigational aids, VGSI commissioning) and the process for requesting required flight inspections
- Operational issues such as temperature and wind limitations, airspeeds, bank angles, climb/ descent gradients, etc., as specified in an IFP package
- IFP design ARINC 424 leg and path terminator coding verification

Module 16: Simulator Evaluation

- Flyability of the IFP and human factors impact assessment
- Criteria waivers assessment and equivalent level of safety provided evaluation
- Determine any special operational and/or training requirements to be added to the IFP.

Module 17: Flight Evaluation

- Local operations procedures (i.e., noise abatement procedures and/or non-standard traffic pattern).
- Aircraft and avionics requirements for the flight validation, including aircraft performance (i.e., climb or descent gradients)
- Minimums flight conditions required for the flight validation (i.e., weather, day or night)
- Coordination of flight validation mission with air traffic and/or airport operations, as needed
- SID/ STAR/en route validation
- MVA validation
- Obstacle assessment methodology
- Flyability of the procedure
- Human factors, cockpit workload
- Waivers/mitigation for deviations from design criteria
- Resolving flight validation ambiguities and conflict

Module 18: Post Flight Analysis and Documentation

- Flight validation recorders or other equipment
- Accurate flight validation reports and records

Step 2 – INITIAL FLIGHT VALIDATION PILOT TRAINING (AIRPLANE/SIMULATOR SEGMENT)

Goal: Acquire the practical skills to perform the flight validation mission using the knowledge and abilities gained during Step 1, Ground Segment.

Description:

This course provides a practical component to the flight validation training and allows the knowledge and techniques learned in Step 1, Ground Segment, to be applied in the airplane cockpit. Using an aircraft and/or flight simulator, the course includes programming the FMS, database verification, flyability assessments, human factors assessments, obstacle evaluation and assessments, airport, runway, and communication assessments, and charting evaluation. The course will consider aircraft requirements, aircraft performance, flight planning, safety issues, and record keeping requirements.

Module

- Module 1: General Flight Validation Requirements
- Module 2: Flight Planning and Safety
- Module 3: Departure, Arrival, and Approach Profiles
- Module 4: Post Flight Analysis and Documentation

Teaching points

Module 1: General Flight Validation Requirements

- Review the IFP package for completeness and accuracy
- Accurately determine the flight validation requirements of an IFP package
- Evaluate operational issues such as temperature and wind limitations, airspeeds, bank angles, climb/descent gradients, etc., as specified in an IFP package
- Verify the IFP design ARINC 424 leg and path terminator coding from the IFP package
- Evaluate the aircraft and avionics requirements for the flight validation
- Accurately load, activate, and fly the IFP flight plan for validation
- Demonstrate familiarity with any special flight validation recorders or other equipment installed

Module 2: Flight Planning and Safety

- Determine the flight validation requirements of an IFP package, including any special requirements
- Identify procedure elements that require flight inspection (i.e., new fixes using ground-based navigation aids, VASI commissioning)
- Evaluate operational issues such as temperature and wind limitations, airspeeds, bank angles, climb/descent gradients, etc., as specified in an IFP package
- Accurately determine the location and elevation of uncharted or unknown obstacles identified during the flight validation

- Evaluate airspace requirements, airport lighting, airport markings, runway environment, ATC communication requirements, and ATC radar requirements
- Determine local operations procedures (i.e., noise abatement procedures and/or non-standard traffic pattern)
- Determine the impact of any deviations from design criteria and accurately evaluate the equivalent level of safety provided
- Evaluate the aircraft and avionics requirements for the flight validation, including aircraft performance (i.e., climb or descent gradients)
- Determine the minimum flight conditions required for the flight validation (i.e., weather, day or night)
- Demonstrate familiarity with aircraft avionics systems to be used for the flight validation
- Determine any special operational and/or training requirements to be added to the IFP
- Effectively coordinate the flight validation with air traffic and/or airport operators, as needed

Module 3: Departure, Arrival, and Approach Profiles

- Demonstrate a departure profile
- Demonstrate an arrival profile
- Demonstrate an approach profile
  - Accurately load, activate, and fly the IFP flight plan for validation
  - Demonstrate familiarity with aircraft avionics systems to be used for the flight validation
  - Demonstrate familiarity with any special flight validation recorders or other equipment installed
  - Perform accurate obstacle assessments and evaluation of segment controlling obstacles
  - Accurately determine the location and elevation of uncharted or unknown obstacles identified during the flight validation
  - Accurately assess the flyability of the IFP and human factors impact
  - Determine any special operational and/or training requirements to be added to the IFP

Module 4: Post Flight Analysis and Documentation

- Create and process accurate flight validation reports and records

Step 3 – RECURRENT/REFRESHER FLIGHT VALIDATION PILOT TRAINING

Goal: Provide a course of training to update the flight validation crew on all aspects of the validation process.

Description:

The purpose of recurrent training is to address changes in the available criteria and regulations. It is essential that the flight validation pilot updates his or her knowledge and skills in accordance with the latest criteria and technologies.

Module

- Module 1: Flight Validation Updates (recurrent training)
- Module 2: Flight Validation Refresher

Teaching points

Module 1: Flight Validation Updates

- Review of Flight Validation requirements
- Review of Flight Validation process
- Review of Flight Validation procedural criteria changes
- Review of changes in guidance and procedures

Module 2: Flight Validation Refresher

- Review of key elements in procedure design criteria
- Review of elements proposed/requested by students

5 Instructor Competencies

5.1 Flight Validation Instructor Competencies

5.1.1 General

In competency-based programmes, instructor competencies are made explicit, and instructors have to demonstrate their instructional skills and their knowledge in subject matter expertise and training course content.

It should be noted that instructors for Flight Validation Training Programmes may come from various fields of expertise. Instructors must meet relevant competency standards for the subjects they instruct listed in the competency framework developed for flight validation pilots. The instructor must be able to provide rationales for the criteria provided in ICAO manuals. Furthermore, an appropriate level of experience in the practical field of the subject being taught is required.

5.1.2 Instructional Competencies

The instructor must have appropriate competencies of the following fields:

- Techniques of applied instruction;
- Assessment of trainee performance;
- The learning process;
- Elements of effective teaching;
- Trainee evaluation and testing, training and learning theories;
- Training programme development;
- Lesson planning;
- Classroom instructional techniques;
- Use of training aids; and
- Analysis and correction of trainee errors;

5.1.3 Maintaining Instructional Competency Standards

It is considered essential that the instructors are given the opportunity to maintain their competency standards. This should be the responsibility of the training provider and the instructors should be given adequate means to maintain both their competencies in the subject taught and instructional competencies.

6 Validation and post-training evaluation of Flight Validation Pilot training

6.1 Introduction

This chapter describes the process concerning validation and post training evaluations of flight validation pilot training. The purpose of this process is to ensure a harmonized level of effective training. Four levels of evaluation have been identified; each of the four levels will discuss the role and responsibilities of the following organizations:

- State authorities that approve training conducted by flight validation service providers, training providers, etc. (see Note);
- Flight validation service provider (FVSP) that conduct ground and flight validation of flight procedures; and
- Training providers for flight validation.

Note: Any statement in this manual does not imply that state authority must approve and/or certify training course programme.

Stakeholders in flight validation training should be involved at different levels of the evaluation process as appropriate.

6.2 Purpose of evaluation

Each training objective has a meaningful goal or performance output identified in the competency framework. Consequently, evaluations focus on how well training objectives are met and how their achievement will impact performance on the job.

The principal goal of evaluation is to ensure a level of consistency between all organizations involved in implementation of flight validation pilot training. Figure 6-1 displays the relationships between three key organizations that plan, develop and conduct flight validation training. It is critical that all organizations validating flight procedures comply with the same competency standards to ensure safety. To properly monitor the effects of training, evaluation must be considered before, during and after training. This will provide organizations with a comprehensive look at the results of evaluation.

6.3 Evaluation approach

In order to properly evaluate how flight validation pilot training impacts FVSP, State authorities and training providers, a four-level evaluation model is used (Kirkpatrick's Model of Evaluation). This model considers trainee reaction, mastery learning, job performance, and organizational impact. Each level is assessed in sequential order, providing essential feedback on specific aspects linking training and performance outcomes. Levels 1 and 2 evaluations provide immediate feedback on the design, development and administration of all courses. Level 3 provides critical feedback to training providers regarding on-the-job performance of trainees who have successfully completed an approved course. Level 4 is the highest level of evaluation; it requires a direct line of communication between all parties involved with flight validation pilot training. Figure 10-1 describes the four levels of evaluation.

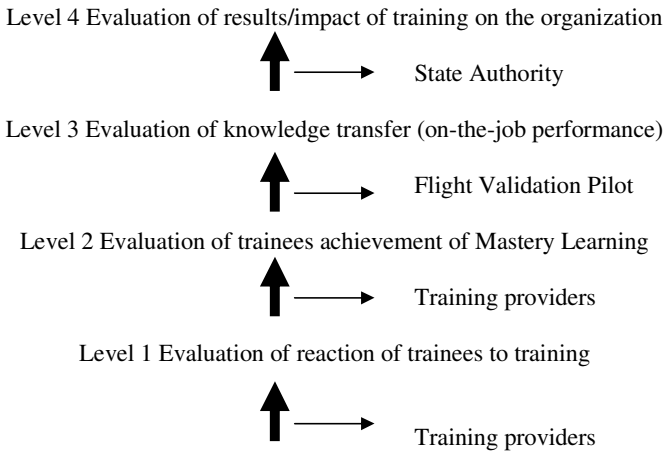

Figure 6-1 Description of Four Levels of Evaluation

6.4 Level 1: Evaluation of trainee reaction

Level 1 identifies the trainee's reactions and opinions to the training course. At this level of the evaluation, training providers are able to obtain feedback on the learning environment. Level 1 Surveys are easy and effective tools for assessing how to improve trainee motivation and provide the best possible learning environment. Training providers are responsible for the design and administering of a Level 1 Survey. This level of evaluation must be used for all newly designed training courses. Below are some guidelines to consider in developing a Level 1 Survey:

- Identify what information is needed and the goals of the evaluation;
- Design a form that captures needed information while minimizing the time required to complete and evaluate forms;
- Encourage written comments or suggestions. Even excellent "check the box" surveys are limited in information provided. Comments can point to issues that could otherwise be missed;
- Allow enough time for trainees to respond. Once training is complete, trainees are ready to leave. Therefore surveying participants at the very end of the session might promote a hurried response;
- Allowing for an anonymous survey or signature option will provide a more reliable data collection;
- Objectives of the survey should be closely aligned with the objectives of the course ; and
- Results of the evaluation are used to revise course materials as necessary. A clearly established distribution process must be in place for the dissemination of information to anyone who needs it. A suitable level of confidentiality should also be in place for all parties involved with the handling of such documentation.

When the course is delivered for the first time (validation delivery), collect feedback from trainees after completion of each training module. At the end of the course, obtain overall feedback from trainees. Level 1 Evaluation forms for the collection of end-of module and end-of course information (trainee sample survey) are provided in Paragraphs 11.8 and 11.9.

6.5 Level 2: Evaluation of trainee mastery learning

Level 2 determines to what extent training has changed attitudes, increased knowledge, and improved skills. Training providers use Level 2 evaluations to ensure that trainees have gained the desired skills, knowledge and attitudes to achieve terminal objectives. Level 2 evaluations should be based on mastery test results and apply the following principles:

- Measure trainees' performance before and after training. Comparing trainees pre-course to post course knowledge, skill and attitude data helps shape course content and structure. For example, if a significant number of trainees have already had the required skills and knowledge prior to the course, then training objectives may need to revised;
- Mastery tests should be criterion-referenced. A criterion–referenced test helps determine if trainees meet the standard of performance as established by the terminal objectives;
- Ensure that terminal objectives are used to design mastery tests that call trainees to demonstrate successful performance on the job as well as provide valid and reliable measures of performance; and
- Ensure statistics are collected on mastery test results for each module of a course. Analysis of these statistics can be used to determine whether course materials should be modified or not.

6.6 Level 3: Evaluation of Flight Validation performance

Level 3 evaluation instruments help to analyze whether trainees have transferred the skills, knowledge and attitudes they have acquired through training to actual job performance.

A Level 3 instrument collects data for the following questions:

- Is the task, for which training was provided, performed on the job?
- How confident are trainees in their ability to perform the task once training has been completed?
- How often do the trainees perform the trained task?
- Will on-the-job training reinforce the needs of the trainee or is formal training required again?
- Additional comments? (should be open-ended questions)

While a Level 2 evaluation is carried out by training providers, a Level 3 evaluation requires some coordination between training providers and on-the-job instructors and supervisors. A Level 3 evaluation identifies limitations and barriers to a trainee's performance following the delivery of training. Feedback from a Level 3 evaluation is used to revise training courses and programmes to ensure a better fit between training and job performance.

Training providers must:

- Ensure that all newly designed or revised terminal objectives are based on current job performance. Without appropriate alignment of course materials with terminal objectives and competencies, a Level 3 evaluation cannot effectively identify gaps between a trainee's performance on the job and performance required by terminal objectives;
- Complete the appropriate steps to ensure training quality; and
- Review and analyze programme reports and modify training materials accordingly.

Flight validation service providers must:

- Ensure that all newly designed or revised training materials are based on required job performance and safety standards; and
- Review and analyze programme reports and recommend modifications to training programmes as necessary.

6.7 Level 4: Evaluation of result/impact

Level 4 seeks to measure how training has benefited the organization affected. Level 4 evaluation is not always applicable because of the organizational differences in States worldwide (ANSP and State authority can be the same organization, or ANSP can be a State-authorized/ recognized privatized company, or flight validation service provider can be a third party). In some cases there is no direct interaction between the flight validation service provider (subcontracted work) and the State authority.

However, when applicable, statistics and reports are summarized to evaluate the overall impact of training on the organization especially as it relates to Safety Management. A steering committee including those responsible for safety management should be established to carry out this level of evaluation. Based on performance and safety goals set by the organization, this level of evaluation measures how training supports achievement of these goals. In this context, training is one component of a Safety Management System (SMS) that must be balanced with other organizational components.

Level 4 evaluation identifies the impact of training on organizations overall performance. Implementation of flight validation pilot training should be monitored through result-based evaluations.

FVSP, regulators and training providers should partner in constructing and analyzing Level 4 evaluations. This partnership will help link validation, and post training evaluations of flight validations with organizational goals and business objectives.

State authorities must:

- Ensure flight validation service providers are utilizing a current competency framework that can be reflected in terminal objectives:
- Review data provided by FVSP;
- Analyze statistical data based on performance goals and eventual outcome;

- Review and establish performance indicators of the flight validation system indicating job performance of flight evaluation pilots; and
- Oversee flight validation system

6.8 Course Module Opinion Sample Survey

Course instructor: _____ Module Title/Number: _____
Participant name (optional): _____
Date: _____

Instructions: Below you will find a series of questions related to the course module you have just participated in. Please take the time to complete each set of questions and answer them as accurately as possible.					
Overall View of Course Please mark the response that most closely expresses your opinion. Strongly Disagree ǀ Disagree ǀ Somewhat Disagree ǀ Agree ǀ Strongly Agree					
Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
1. The instructor for this module was easy to follow.					
2. Course content met my expectations.					
3. Materials used were easy to read and understand.					
4. Pace of the module was appropriate.					
Mastery Test					
Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
5. Information on the test was difficult to understand.					
6. Mastery test did **not** match terminal objectives.					
7. Mastery test did **not** increase my capabilities of performing the job-related task.					
Additional Comments					
8. Do you feel anything should be added to make this course more effective? Yes:____ No:_____ Please explain. _____ _____ _____					
9. Should anything be removed from this module? Yes:____ No:____ Please explain. _____ _____ _____					
10. What do you plan to take away from this module? Please explain. _____ _____ _____					
Additional Comments _____ _____ _____					

6.9 Course Validation Sample Survey

Course instructor: _____ Module Title/Number: _____
Participant name (optional): _____
Date: _____

Instructions: Below you will find a series of questions related to the training course. Please take your time to complete all sections of the survey.					
Overall View of Training Please mark the response that most closely expresses your opinion. Strongly Disagree | Disagree | Somewhat Disagree | Agree | Strongly Agree					
Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
1. The information presented was well organized.					
2. Training activities were very engaging.					
3. Information presented was applicable to my performance on the job.					
4. The objectives for this course were met.					
5. The instructor for this course was easy to understand.					
Technical Components					
Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
6. Information for this course was easy to understand.					
7. Terminology used was comprehensible.					
8. Visual materials were understandable.					
9. The practical work and written exercises were appropriate for the course.					
10. Mastery test reflected content covered throughout the course.					
Practical Issues					
Scale: 1 = Strongly Disagree; 5 = Strongly Agree	**1**	**2**	**3**	**4**	**5**
11. During this course I needed help from the instructor.					
12. I required help from other trainees.					
Additional Feedback 13. Did you find participating in this course difficult? Yes:____ No:_____ Please explain why. _____ _____ _____ 14. Did you enjoy participating in this course? Yes:____ No:____ Please explain why or why not. _____ _____ _____ 15. Was any part of the course not useful or not valuable? Yes:____ No:____ Please explain why or why not. _____ _____ _____					

16. What did you find most valuable in this course?

_____
_____
_____

17. What additional suggestions or comments do you have for improvements?

_____
_____
_____

Appendix A - Skills, knowledge and attitudes (SKA)

A.1 General

In order to perform tasks, a combination of adequate skills, knowledge and attitudes (SKA(s)) is required. A skill is the ability to perform an activity that contributes to the effective completion of a task. Knowledge is specific information required for the trainee to develop the skills and attitudes for the effective accomplishment of tasks. Attitude is the mental state of a person that influences behavior, choices and expressed opinions.

For example, for the performance criteria 1.1.1 “Ensure completeness of IFP Package”, there would be a need to have knowledge about what needs to be checked during a flight validation flight. In turn, this knowledge would be required to apply the skill of ensuring all required information is present in the IFP package. The flight validation pilot applying this skill would need to be thorough and accurate. This attitude would be reflected throughout the collection and validation process as well as in the outcome of the performance.

The skills, knowledge and attitudes necessary to achieve performance criteria and competency elements are inventoried during job and task analysis. During the curriculum design phase, the specific SKA(s) identified during job and task analysis can be categorized according to the learning associated with them. Different taxonomies can be used to achieve this categorization (see Bloom; Anderson and Krathwohl; Gagné, Briggs and Wagner). However, it is beyond the scope of this manual to describe in detail these different taxonomies and their interpretation.

As an example, Gagné, Briggs and Wagner’s taxonomy breaks down intellectual skills in four categories: classifying, rule-using, discriminating and problem-solving. Using this taxonomy, knowledge about flight validation requirements could be categorized as the intellectual skill of classifying. When developing training materials for this skill, course developers would require trainees to define, itemize, rank, or catalogue the specific items of a flight validation checklist. Different media could be used to accomplish this.

For example, a computer program could be devised where trainees are asked to review the IFP package for completeness and accuracy. The skill of reviewing the IFP package could be categorized as the intellectual skill of rule-using. Course developers could require trainees to check, explain, and verify an IFP Procedures Package. Regarding thoroughness and accuracy (attitudes), course developers would ensure that instructors demonstrate these attitudes and they are elicited from trainees through practical exercises.

A.2 Attitudes

An attitude is the mental state of a person that influences behavior, choices and expressed opinion. Our beliefs and values are combined with our cognitive skills; thus, two components (affective and cognitive) give us our long range or persistent measurements for dealing with the world (Bootzin, 1983). While a person may have the competency to perform a task, that does not mean he or she will have the desire (attitude) to do so correctly. In other words, competencies give us the ability to perform, while attitudes give us the desire to perform. Attitudes change with various events in a person's life.

A.3 Flight Validation Pilot Specific Skills, Knowledge and Attitudes (SKA)

Some SKA(s) are particularly useful for flight validation pilots and are a great aid to those seeking to become an "expert performer". These SKA(s) are not necessarily a pre-requisite to start training as a flight validation pilot, nor does the absence of those SKA(s) make it impossible to perform on the job. It is possible that such SKA(s) develop during the process of training or later during job performance.

A.3.1 Demonstrate three-dimensional visualization (skill)

It is of great advantage to flight validation pilot trainees to have three-dimensional visualization skills in order to transfer procedure package data provided (maps, charts, obstacles) into a three-dimensional mental picture.

A.3.2 Demonstrate ability to work as part of a team (attitude)

Flight validation functions as one element of the air traffic safety system. For an efficient process, it is very desirable that flight validation pilots are adaptable and open-minded to requests and requirements from other stakeholders. This means that they need to demonstrate their ability to work as part of a team, including demonstrating communication, negotiating and group work facilitation skills.

A.3.3 Criticism (attitude)

Flight validation pilots should be both open to constructive criticism that is given regarding their work and they, in turn, should be able to critique other pilot's work in an unbiased and result oriented way. Flight validation is not an exact science; therefore, it is possible that several solutions serve the same purpose and sometimes do not exactly fit the expectations of stakeholders. Being open to criticism and being able to communicate criticism will serve the safety and efficiency of the air traffic system.

A.3.4 Sample Evidence and Assessment Guide

Competency Unit					
	Competency Element				
		Performance Criteria			
				Evidence and Assessment Guide	**Reference (PANS-OPS: Part-Section-Chapter**
1	**Conduct Preflight Validation**				
	1.1	Review IFP Package			
		1.1.1	Ensure completeness of IFP Package		
			1.1.1.1	Verify that the procedure report contains an executive summary of the procedure	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.2	Verify that the report clearly identifies the controlling obstacle for each segment	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.3	Verify that the report lists any other obstacle dictating the design of the procedure	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.4	Verify that the MDA/H or DA/H is clearly stated in the report	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.5	Verify if the procedure deviates from design criteria and if so, if a mitigation is provided	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.6	Verify if the report contains proposed ARINC 424 path terminators	IFP Design Report
			1.1.1.7	Verify that the procedure identifies and lists every navaid/navigation sensor and fix used in the procedure with its position and identification	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.8	Verify if any special local operations are described and sufficient information is provided thereof	Doc. 9906 vol. 1 Doc. 9906 vol. 5
			1.1.1.9	(Helicopters only) Verify that obstacles penetrating the OCS and OIS are documented	Doc. 9906 vol. 5 PANS-OPS vol.II, IV-1-1, IV-1-2
		1.1.2.	Determine charts and maps are available in sufficient detail to assess IFP during the FV		
			1.1.2.1	Verify all tracks (magnetic and/or true) are provided	PANS-OPS vol. II I-4-9, III-5-1
			1.1.2.2	Verify all fixes' latitude/longitude and fix formation bearings/distances are provided to the required accuracy	PANS-OPS vol. II I-4-9, III-5-1
			1.1.2.3	Verify that a profile view is provided and contains the required information	PANS-OPS vol. II I-4-9, III-5-1
			1.1.2.4	Verify that descend angle/gradients are provided with the required accuracy	PANS-OPS vol. II I-4-9, III-5-1
			1.1.2.5	Verify that missed approach climb gradients and departure procedure design	PANS-OPS vol. II I-4-9, I-3-3, I-4-6,

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				gradients are clearly shown	III-5-1
			1.1.2.6	Verify that any other important information such as “timing to define the MAPt not authorized” or “no turns before the DER/MAPt” are clearly stated	PANS-OPS vol. II I-4-9, I-3-3, I-4-6, III-5-1
			1.1.2.7	Verify that controlling obstacles for each segment are charted	PANS-OPS vol. II I-4-9
			1.1.2.8	Verify that any other obstacle dictating the design of the procedure is charted	PANS-OPS vol. II I-4-9
			1.1.2.9	Verify that the minimum box contains the required information	PANS-OPS vol. II I-4-9, I-3-3, I-4-6, III-5-1
			1.1.2.10	(Helicopters only) Verify if proceed visually or proceed VFR is clearly stated on the chart	PANS-OPS vol.II, IV-1-1, IV-1-2
			1.1.2.11	(Helicopters only) Verify if initial/intermediate and final/missed approach speeds are clearly stated on the chart	PANS-OPS vol.II, IV-1-1, IV-1-2
			1.1.2.12	(Helicopters only) Verify that a HAS (height above surface) diagram is provided for “proceed VFR” procedures	PANS-OPS vol.II, IV-1-1, IV-1-2
			1.1.2.13	(Helicopters only) Verify if the VSDA (Visual Segment Descend Angle) for PinS “proceed visually” procedures is clearly stated on the chart	PANS-OPS vol.II, IV-1-1, IV-1-2
			1.1.2.14	(Helicopters only) Verify if the VSDG (Visual Segment Design Gradient) for PinS departures is clearly stated on the chart	PANS-OPS vol.II, IV-1-1, IV-1-2
			1.1.2.15	(Helicopters only) Verify that obstacles penetrating the OCS and OIS are charted	PANS-OPS vol.II, IV-1-1, IV-1-2
		1.1.3	Familiarize with target population for the procedure		
			1.1.3.1	Verify the categories of aircraft the procedure is designed for	Doc. 9906 vol. 5
			1.1.3.2	Verify any applicable speed limits and their acceptability for the aircraft categories using the procedure	Doc. 9906 vol. 5
			1.1.3.3	Verify bank angle requirements/limitations and their acceptability for the aircraft categories using the procedure	Doc. 9906 vol. 5
			1.1.3.4	Verify climb gradient requirements and their acceptability for the aircraft categories using the procedure	Doc. 9906 vol. 5
			1.1.3.5	Verify descend gradients/angles and their acceptability for the aircraft categories using the procedure	Doc. 9906 vol. 5
		1.1.4	Discuss the procedure with the procedure designer		

			as necessary		
			1.1.4.1	Verify with the procedure designer that your interpretation of the procedure matches his intention	Doc. 9906 vol. 5
			1.1.4.2	Verify if the procedure designer requires any specific parameter in the procedure to be validated	Doc. 9906 vol. 5
			1.1.4.3	Verify if you have identified all deviations from criteria (if any) and if any action is required in the FV to assure the acceptability of the mitigation	Doc. 9906 vol. 5
			1.1.4.4	Verify that you have identified all special local operations such as noise abatement procedures etc. (if any)	Doc. 9906 vol. 5
		1.1.5	Verify procedure graphics and data from forms match		
			1.1.5.1	Verify that the fix positions latitude/longitude is consistent throughout the IFP package	Doc. 9906 vol. 5
			1.1.5.2	Verify that fix formation bearings/distances are consistent throughout the IFP package	Doc. 9906 vol. 5
			1.1.5.3	Verify that tracks (magnetic and/or true) are consistent throughout the package	Doc. 9906 vol. 5
			1.1.5.4	Verify that segment lengths of each segment are consistent throughout the IFP package	Doc. 9906 vol. 5
			1.1.5.5	Verify that descend gradients/angles are consistent throughout the IFP package	Doc. 9906 vol. 5
			1.1.5.6	Verify that climb gradients are consistent throughout the IFP package	Doc. 9906 vol. 5
		1.1.6	Verify the IFP design, coding and relevant charting information against the FMS Navigation Database		
			1.1.6.1	Verify that proposed/intended ARINC 424 path terminators are used in the database	ARINC 424 PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.2	Verify that coded latitude/longitude positions match the designed procedure	PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.2	Verify that coded tracks match the designed procedure	PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.3	Verify that coded altitudes match the designed procedure	PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.4	Verify that coded speed restrictions match the procedure	PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.5	Verify that coded descend	PANS-OPS vol. II

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				angles/gradients match the designed procedure	III-2-5, III-5-2 IFP Design Report
			1.1.6.6	Verify that coded climb gradients match the procedure	PANS-OPS vol. II III-2-5, III-5-2 IFP Design Report
			1.1.6.7	Verify that eventually coded conditional terminators (at xxxxx but not below yyyyft, at xxxxft but not before yyyyy) will produce what the designed procedure reflects	ARINC 424 IFP Design Report
		1.1.7	Verify that controlling obstacles and obstacles otherwise influencing the design of the procedure are properly identified		
			1.1.7.1	Verify that the controlling obstacle for each segment is appropriately identified with location, description and height/elevation	PANS-OPS vol. II I-4-9
			1.1.7.2	Verify if an appropriate vegetation tolerance was applied to the controlling obstacle and other obstacles (if applicable)	Doc. 9368
			1.1.7.3	Verify that any obstacle influencing the design of the procedure is appropriately identified with location, description and height/elevation (e.g. an obstacle avoided with a turn, an obstacle causing an offset track on approach or departure)	PANS-OPS vol. II I-4-9
		1.1.8	Review airport infrastructure and special airport regulations		
			1.1.8.1	Verify runway reference code number	Annex 14 Doc. 9157
			1.1.8.2	Verify runway reference code letter	Annex 14 Doc. 9157
			1.1.8.3	Verify the applicable obstacle limitation Standards and Recommended Practices (SARPs) and the enforcement thereof	Annex 14 Doc. 9157
			1.1.8.4	Verify provided mitigation for eventual obstacle limitation infringements	Annex 14 Doc. 9157
			1.1.8.5	Verify applicable noise abatement procedures	Annex 14 Doc. 9157
			1.1.8.6	Verify the available airport lighting and visual aids	Annex 14 Doc. 9157
			1.1.8.7	Verify eventual lighting activation procedures from the cockpit	Annex 14 Doc. 9157
			1.1.8.8	(Helicopters only) Review the landing location and the airspace surrounding it	Annex 14 vol. 2
		1.1.9	Review navigation infrastructure used by the procedure		
			1.1.9.1	Review flight inspection reports (if available)	Doc. 8071 IFP Design Report

			1.1.9.2	Confirm that the available navigation infrastructure is suitable for the procedure or PBN navigation specification	Doc. 9613
		1.1.10		Identify items that require flight inspection	
			1.1.10.1	Determine if new or amended fixes require flight inspection due to eventual signal reception constraints	Annex 10 Doc. 8071
			1.1.10.2	Determine if any visual aids (e.g. VASIS) require angle evaluations	Annex 10 Doc. 8071
			1.1.10.3	Determine if the navigation infrastructure requires a flight inspection (e.g. GNSS signal-in-space)	Annex 10 Doc. 8071
		1.1.11	Determine required steps in the Flight Validation		
			1.1.11.1	Verify source of obstacle and terrain data accuracy/integrity and determine if an obstacle assessment in flight is required	Doc. 9906 vol. 5
			1.1.11.2	Verify if an obstacle limitation process is enforced, if not determine if an assessment of obstacles in flight is required	Annex 14 Doc. 9906 vol. 5
			1.1.11.3	Verify if the flyability of the procedure is assured by other means (e.g. Ground Validation, overlay of existing procedure)	Doc. 9906 vol. 5
			1.1.11.4	Verify if any deviations from criteria were used in the procedure design and verify the provided mitigation. Determine the step to be taken to confirm the provided mitigation	Doc. 9906 vol. 5

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