

Doc 9906
AN/472
Volume 6



Quality Assurance Manual for Flight Procedure Design

Volume 6 **Flight Validation Pilot Training and** **Evaluation (Development of a Flight** **Validation Pilot Training Programme)**

Approved by the Secretary General
and published under his authority

First Edition — 2012

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Published in separate English, French, Spanish, Russian,
Arabic and Chinese editions by the
INTERNATIONAL CIVIL AVIATION ORGANIZATION
999 University Street, Montréal, Quebec, Canada H3C 5H7

For ordering information and for a complete listing of sales agents
and booksellers, please go to the ICAO website at www.icao.int

First edition 2012

**Doc 9906, *Quality Assurance Manual for Flight Procedure Design*
Volume 6 — *Flight Validation Pilot Training and Evaluation*
(*Development of a Flight Validation Pilot Training Programme*)**

Order Number: 9906-6

ISBN 978-92-9249-066-9

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AMENDMENTS

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PREFACE

Instrument flight procedures based on conventional ground-based navigation 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 for a systemic quality assurance process (often part of a State Safety Management System (SMS)). 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, which consists of six volumes, 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, as detailed below. 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 (Development of a Flight Procedure Designer Training Programme)*, provides guidance for the establishment of flight procedure designer training. Training is the starting point for any quality assurance programme. This volume also 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 Procedure Design Construction* (to be developed 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 (Development of a Flight Validation Pilot Training Programme)*, 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 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

AD	Aerodrome
AIP	Aeronautical Information Publication
AIS	Aeronautical information service
ANSP	Air navigation service provider
APV	Approach procedure with vertical guidance
ARINC	Aeronautical Radio, Inc.
ATC	Air traffic control
ATS	Air traffic services
CPL/IR	Commercial pilot licence/instrument rating
CRM	Cockpit resource management
CRM	Collision risk model
DA	Decision altitude
DME	Distance measuring equipment
DR	Dead reckoning
FPA	Flight path angle
FPD	Flight procedure design
FMS	Flight management system
FVP	Flight validation pilot
FVSP	Flight validation service provider
GNSS	Global navigation satellite system
GV	Ground validation
HAS	Height above surface
IAS	Indicated airspeed
ICAO	International Civil Aviation Organization
IFP	Instrument flight procedure
MDA	Minimum descent altitude
MSA	Minimum sector altitude
OAS	Obstacle assessment surface
OJT	On-the-job training
PANS	Procedures for air navigation services
PBN	Performance-based navigation
PFD	Planned flight data
PinS	Point-in-space
RNAV	Area navigation
RNP AR	Required navigation performance authorization required
SARPs	Standards and Recommended Practices
SBAS	Satellite-based navigation system
SIAP	Standard instrument approach
SID	Standard instrument departure
SKA	Skills, knowledge and attitudes
SMS	Safety management system
STAR	Standard instrument arrival
TAS	True airspeed
TAWS	Terrain avoidance warning system
VASIS	Visual approach slope indicator system

VNAV	Vertical navigation
VSDG	Visual segment design grade
VSS	Visual segment surface

.....

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 task 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 whether a trainee meets the requirements of the competency standard.

Flight inspection. The operation of a suitably equipped aircraft for the purpose of calibrating ground-based NAVAIDS or monitoring/evaluating the performance of the 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 the predefined tolerances of the 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. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

- a) are located on an area intended for the surface movement of aircraft; or
- b) extend above a defined surface intended to protect aircraft in flight; or
- c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Performance criteria. Simple, evaluative statements on the required outcome of the competency element and a description of the criteria used to judge whether the required level of performance has been achieved.

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 and attitudes (SKA) 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.

FOREWORD

Instrument flight procedures (IFPs) are an integral component of 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 are important, and their development 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 having 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 the *Procedures for Air Navigation Services — Aircraft Operations*, (PANS-OPS), Doc 8168, Volume II, Part I, Section 2, Chapter 4, Quality Assurance; and
- 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 Testing of Radio Navigation Aids* (Doc 8071). Personnel performing flight inspection duties should be qualified and certified in accordance with the manual on *Testing of Ground-based Radio Navigation Systems* (Doc 8071, Volume I).

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 for its quality and suitability for publication.

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

The pilot-in-command is responsible for the safe operation of 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 Member 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 States themselves or delegated by them to third parties (air traffic services (ATS) providers, private companies, other States, etc.). PANS-OPS requires that States take measures to perform validation of IFPs 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 Member States in developing a competency standard for FVPs to ensure the quality of the flight procedures they publish. It also provides a means, but it is not the only one, for establishing FVP 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.

Chapter 1

INTRODUCTION

1.1 GENERAL

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

1.1.2 PANS-OPS, Volume II, Part I, Section 2, Chapter 4, Quality Assurance, provides procedures with which each State must comply with for quality assurance in flight procedure design. Guidance material for quality assurance supplementing the provisions in PANS-OPS is provided in each volume of this document.

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

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

1.2 TARGET AUDIENCE

1.2.1 This volume will be useful to:

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

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

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

1.2.2 Figure 1-1 indicates the relationship between these parties.

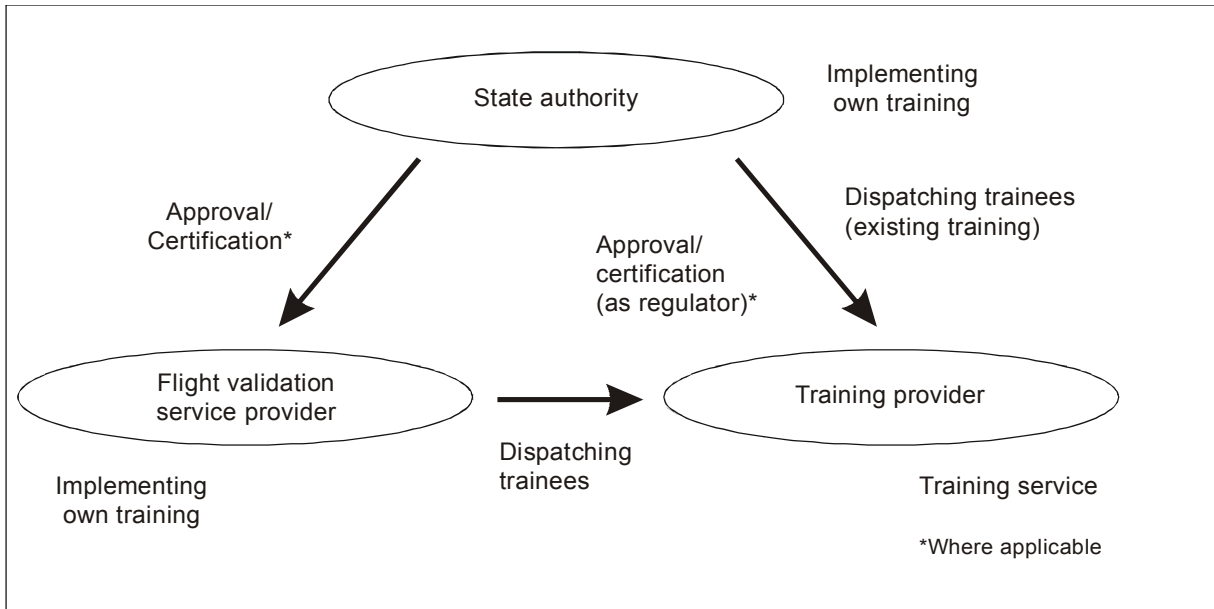


Figure 1-1. Relationships between State authority, flight validation service provider (FVSP) and training provider

1.3 GOALS

1.3.1 The primary goal of this manual is to provide guidance to organizations providing FVP training, particularly in developing, implementing and validating training.

1.3.2 The secondary goal is to provide guidance to regulators who certify and/or approve training courses and programmes, as well as to organizations that dispatch trainees to training providers and who have to evaluate training courses and programmes. This manual may also be used as an assessment tool to evaluate the qualifications of candidate FVPs (see 1.5).

1.4 STRUCTURE

The manual consists of six chapters and an appendix as described below:

- Chapter 1, Introduction, presents the manual, its target audiences, goals, structure and use;
- Chapter 2, General Provisions 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 that is used as a basis to design a curriculum (see Chapter 3). Chapter 2 also includes the competency framework for FVPs;
- Chapter 3, Flight Validation Pilot (FVP) Requirements and Evaluation, describes the process concerning validation and post-training evaluations of FVP training;

- d) Chapter 4, Design Curriculum, describes how to derive a curriculum from the competency framework. The method is applicable to all phases of training: initial, OJT and refresher or recurrent training, and includes information on:
 - 1) how to determine prerequisites;
 - 2) how to develop tests applicable to the interim and/or final stage of training;
 - 3) other considerations in designing modules and course materials;
- e) Chapter 5, Instructor Competencies, describes competencies required for instructors of FVP training;
- f) Chapter 6, Validation and Post-Training Evaluation of FVP Training, describes how to implement training and how to evaluate it at the following levels:
 - 1) Level 1: evaluation of trainee reaction;
 - 2) Level 2: evaluation of trainee mastery learning;
 - 3) Level 3: evaluation of flight validation performance;
 - 4) Level 4: evaluation of results/impact on the organization; and
- g) the Appendix contains a sample evidence and assessment guide for one selected competency element.

1.5 HOW TO USE THIS MANUAL

This section outlines how different target audiences can use this manual in line with the primary or secondary goal outlined in 1.3.

1.5.1 Organizations providing FVP training (training providers)

1.5.1.1 Organizations providing FVP training, such as independent training providers and State authorities or flight validation pilot services providers (FVSPs) 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
- evaluate training courses/programmes.

1.5.1.2 Once the job and task analysis is completed, training providers can apply the method described in Chapter 2, General Provisions for Competency-Based Training and Assessment, which may vary from State to State.

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

- determining prerequisites
- determining training objectives (terminal objectives, enabling objectives, OJT objectives)
- developing tests
- organizing modules.

1.5.2 State authorities/regulators

1.5.2.1 Regulators that intend to approve/certify a training course/programme can use this manual as part of their training approval/certification process. For instance, they can establish standards that state that the proposed training should be developed, implemented and evaluated in accordance with a competency-based approach, which is described in 2.2. However, it should be noted that this use is not the primary goal of this manual.

1.5.2.2 Organizations that dispatch FVPs to training providers can evaluate the training courses/programmes by checking whether the training has been developed using the competency-based approach described in 2.2. The curriculum and material of well-developed training courses should adequately cover the competency elements in the FVP competency framework. Again, it should be noted that this use is not the primary goal of this manual.

Note.— This manual can provide useful information for approval/certification/licensing criteria of FVPs, 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.

Chapter 2

GENERAL PROVISIONS FOR COMPETENCY-BASED TRAINING AND ASSESSMENT

2.1 INTRODUCTION

This chapter outlines, in general, 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. It 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

2.2.1 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.

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

- a) the justification of a training need through a systematic analysis and the identification of indicators for evaluation;
- b) 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 (SKAs);
- c) the identification of the characteristics of the trainee population;
- d) the derivation of training objectives from the task analysis and their formulation in an observable and measurable fashion;
- e) the development of criterion-referenced, valid, reliable and performance-oriented tests;
- f) the development of a curriculum based on adult learning principles, with a view to achieving an optimal path to the attainment of competencies;
- g) the development of material-dependent training; and
- h) the use of a continuous evaluation process to ensure the effectiveness of training and its relevance to line operations.