Doc 9868

Procedures for
Air Navigation Services

Training

First Edition — 2006

International Civil Aviation Organization

Doc 9868

Procedures for Air Navigation Services

Training

First Edition — 2006

International Civil Aviation Organization

Published in separate English, French, Russian and Spanish 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

Doc 9868, *Procedures for Air Navigation Services*
Order Number: 9868
ISBN 92-9194-785-7

AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
No.	Date	Entered by
1	25/8/11	ICAO
2	2/5/13	ICAO
3	13/11/14	ICAO

CORRIGENDA		
No.	Date	Entered by

TABLE OF CONTENTS

FOREWORD ..... **(v)**

1. Historical background ..... (v)
2. Scope and purpose ..... (v)
3. Status ..... (vi)
4. Implementation ..... (vi)
5. Publication of differences ..... (vi)
6. Contents of the document ..... (vii)

CHAPTER 1. Definitions and acronyms **1-1**

1.1 Definitions 1-1
1.2 Acronyms 1-5

CHAPTER 2. General provisions for competency-based training and assessment **2-1**

2.1 Introduction 2-1
2.2 Competency-based approach to training and assessment 2-1
2.3 The competency framework 2-2

Attachment to Chapter 2 — An example of an ISD methodology: The ICAO course development methodology 2-A-1

CHAPTER 3. Competency-based training and licensing for the multi-crew pilot licence (MPL) **3-1**

3.1 Introduction 3-1
3.2 Assessment 3-1
3.3 Training 3-1

Appendix 1 to Chapter 3 — Multi-crew pilot licence training scheme 3-1-1

Appendix 2 to Chapter 3 — Multi-crew pilot licence competency units — Competency elements and performance criteria 3-2-1

Appendix 3 to Chapter 3 — Guidelines for the implementation of the multi-crew pilot licence 3-3-1

Attachment A to Chapter 3— Competency-based training and licensing for the multi-crew pilot licence — Guidance on the design and development of a multi-crew pilot licence training programme 3-A-1

Attachment B to Chapter 3 — Multi-crew pilot licence sample training objectives 3-B-1

Attachment C to Chapter 3 — Threat and error management (TEM) 3-C-1

CHAPTER 4. Competency-based training and assessment for aircraft maintenance personnel 4-1

4.1 Introduction 4-1
4.2 Existing aircraft maintenance licences and training programmes 4-1
4.3 The link between competency-based training and assessment and privileges 4-2
4.4 Issue of Licences and Authorizations 4-2
4.5 Assessment 4-4
4.6 Training 4-4

Appendix 1 to Chapter 4 — Guidelines for the implementation of competency-based training and assessment for aircraft maintenance personnel 4-1-1

Appendix 2 to Chapter 4 — Aircraft maintenance competency units — competency elements and performance criteria 4-2-1

Attachment A to Chapter 4— Competency-based training for aircraft maintenance — Guidance on the design and development of a competency-based training programme for maintenance personnel 4-A-1

Attachment B to Chapter 4 — Deriving training objectives for aircraft maintenance personnel 4-B-1

CHAPTER 5. Evidence-based training (EBT) 5-1

5.1 Applicability 5-1
5.2 Background 5-1
5.3 EBT philosophy 5-2

Chapter 6. Competencies for flight crew training, course developer and instructor, and MPL examiner and inspector 6-1

6.1 Course developer and instructor qualifications 6-1
6.2 MPL examiner and inspector qualifications 6-2

Attachment to Chapter 6 — Competencies of instructors, MPL examiners and inspectors, and course developers 6-A-1

Chapter 7. Upset prevention and recovery training (UPRT) 7-1

7.1 Applicability 7-1
7.2 Background 7-1
7.3 UPRT approach 7-1
7.4 Regulatory requirements 7-2
7.5 Training 7-2
7.6 Regulatory oversight 7-5

FOREWORD

1. Historical background

1.1 The *Procedures for Air Navigation Services — Training* (PANS-TRG) are the result of the evolution of the work initiated by the Flight Crew Licensing and Training Panel (FCLTP) on the implementation of the training required for the pilot licences and ratings found in Annex 1 — *Personnel Licensing*, including the multi-crew pilot licence (MPL).

1.2 The FCLTP, at its first meeting (Montréal, 8 to 19 December 2003), identified a clear need for licensing and training material that, although too detailed to take the form of Standards, was of sufficient importance to provide universal benefit to States. The need called for material that had to be harmonized and subjected to a formal consultation and approval process and that called for a higher level of adherence on the part of States than that required of guidance material. The FCLTP determined that the establishment of the PANS-TRG would be the appropriate document for use by all States.

1.3 The first amendment to the PANS-TRG was issued in 2011, following the work undertaken by the IATA Training and Qualifications Initiative on the development of a competency-based approach to the training and assessment of aircraft maintenance mechanics/technicians/engineers (AMMTEs), including those personnel with licensed or authorized privileges.

1.4 Between 2006 and 2010, aeroplane accidents resulting from a loss of control in flight (LOC-I) event were the leading cause of fatalities in commercial aviation. Recognizing the need to identify and effectively implement mitigating strategies, the prevention of aeroplane upsets quickly became an ICAO priority. Following extensive studies of the LOC-I phenomena, in collaboration with Civil Aviation Authorities (CAAs), aviation accident investigative bodies, LOC-I focus groups, industry associations, original equipment manufacturers (OEMs), and subject matter experts from around the world, it became readily apparent that deficiencies in current training practices were contributing factors in most aeroplane upset-related accidents. Consequently, ICAO has introduced improvements to existing Standards and Recommended Practices (SARPs) and corresponding guidance material that will introduce and support aeroplane upset prevention and recovery training (UPRT) requirements.

2. Scope and purpose

2.1 The *Procedures for Air Navigation Services — Training* (PANS-TRG) are complementary to the Standards and Recommended Practices (SARPs) contained in Annex 1.

2.2 The PANS-TRG specifies, in greater detail than in the SARPs, the actual procedures to be applied by training organizations when providing training for aeronautical personnel. This edition, including the third amendment to PANS-TRG, contains procedures for the development and implementation of various competency-based training programmes designed to meet the Annex 1 requirements for the MPL and the aircraft maintenance mechanic/technician/engineer (AMMTE) licence, as well as those flight crew training

programmes developed under the evidence-based training (EBT) concept, which provides an alternative means of satisfying the recurrent training requirements of Part I of Annex 6. Amendment 3 also details the methodologies to successfully introduce both on-aeroplane upset prevention and recovery training (UPRT) at the commercial pilot (aeroplane) and multi-crew pilot licensing levels, as well as providing UPRT in a flight simulation training device at the commercial air transport pilot and type rating level. UPRT provisions are promulgated in the amendment to Annex 1 and Annex 6, Part I that will become applicable on 13 November 2014. The information herein is further supplemented by guidance published in the *Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011).

3. Status

3.1 The Procedures for Air Navigation Services (PANS) do not have the same status as SARPs. While the latter are *adopted* by Council in pursuance of Article 37 of the Convention on International Civil Aviation and subject to the full procedure of Article 90, the PANS are *approved* by the Council and recommended to Contracting States for worldwide application.

3.2 While the PANS may contain material that may eventually become SARPs when it has reached the maturity and stability necessary for adoption as such, it may also comprise material prepared as an amplification of the basic principles in the corresponding SARPs and designed particularly to assist the user in the application of those SARPs.

4. Implementation

The implementation of PANS-TRG procedures is the responsibility of Contracting States; they are applied in the actual training only after, and in so far as, States have enforced them. However, with a view to facilitating their processing towards implementation by States, they have been prepared in language that will permit direct use by the personnel of approved training organizations and others associated with the development and implementation of a training programme for the multi-crew pilot licence, flight crew recurrent training, aeroplane upset prevention and recovery and the aircraft maintenance mechanic/technician/engineer licence.

5. Publication of differences

5.1 The PANS do not carry the status afforded to Standards adopted by the Council as Annexes to the Convention and, therefore, do not fall under the obligation imposed by Article 38 of the Convention to notify differences in the event of non-implementation. Attention of States is drawn, however, to the provision in Annex 15 related to the publication, in their Aeronautical Information Publications, of lists of significant differences between their procedures and the related ICAO procedures.

5.2 The ICAO course development methodology is based on the Instructional Systems Design (ISD) model used for much of the competency-based training material in this document. It is, however, acknowledged that there are a variety of ISD models that may be equally appropriate and that States may wish to apply in the development of competency-based training. It might also be the case that no single methodology has all

the elements needed and that a number of methodologies will have to be drawn upon for the design of a particular course. In addition, methodological prescriptions are counter-productive, as all training methodologies should display the flexibility and adaptability needed to accommodate changes in training circumstances, goals and technology. For this reason, differences in the systems approach methodologies and models used for the design of competency-based training need not be published, so long as the methodologies contain the ISD elements that govern the three basic procedural steps of a needs analysis, design and production, and evaluation.

6. Contents of the document

6.1 Chapter 1 — Definitions and acronyms

This chapter contains a list of terms and their technical meanings as used in this document. In some cases, the terms are defined in other ICAO documents.

6.2 Chapter 2 — General provisions for competency-based training and assessment

6.2.1 This chapter outlines the general principles and procedures to be followed in the design and implementation of a competency-based approach to training and assessment. It outlines its key features and describes how the competency-based approach is to be used by course developers, instructors, and examiners.

6.2.2 Developments in the late 1950s and 1960s in the application of systems engineering methodologies, such as ISD and the Systems Approach to Training (SAT), to the design of training curricula resulted in the implementation of structured, performance-based training programmes. Competency-based training also evolved from later developments in mastery learning and criterion-referenced testing, whereby knowledge and skills had to be demonstrated at levels that met the entry-level occupational requirements and assessments had to be based on observable behaviours or outcomes. The 1970s saw the widespread use of competency-based principles in both vocational and technical education and training in the United States which, by the 1980s and 1990s, had spread to Europe and to other parts of the world.

6.2.3 A description of the ICAO course development methodology is provided in the Attachment to Chapter 2. Since, as mentioned in 5.2 above, several other ISD methodologies are available, the purpose of this document is not to prescribe the specific methodology to be used. Instead, it outlines the elements to be included in the procedural steps that constitute ISD methodology in general and how to apply them to the design of a competency-based training programme.

6.3 Chapter 3 — Competency-based training and licensing for the multi-crew pilot licence (MPL)

This chapter outlines the principles and procedures that are applicable to the development and implementation of an MPL course and that shall be followed in addition to those outlined in Chapter 2. Chapter 3 also contains the competency units, competency elements and performance criteria developed for the MPL. Attachment A to Chapter 3 contains guidance material on the design and development of an MPL training programme; Attachment B contains examples of training objectives.

6.4 Chapter 4 — Competency-based training and assessment for aircraft maintenance personnel

This chapter outlines the principles and procedures that are applicable to the development and implementation of an AMMTE course and that shall be followed in addition to those outlined in Chapter 2. Chapter 4 contains the competency units, competency elements and performance criteria developed for the AMMTE licence. Attachment A to Chapter 4 contains guidance material on the design and development of an AMMTE training programme; Attachment B contains examples of training objectives. Implementation of competency-based training programmes for AMMTE is optional. Paragraph 3.1 of Annex 1, Appendix 2 enables the use of such competency-based training programmes as an alternative means of compliance with the Annex 1 experience requirements.

6.5 Chapter 5 — Evidence-based training (EBT)

This chapter is intended to provide guidance to Civil Aviation Authorities, operators and approved training organizations in the recurrent training of pilots to develop and evaluate crew performance according to a set of competencies and the related knowledge, skills and attitudes (KSA).

6.6 Chapter 6 — Competencies for flight crew training, course developer and instructor, and MPL examiner and inspector

Annex 1 contains Standards for the issuance of the flight instructor rating and for granting authorizations to flight simulation training device (FSTD) instructors. Chapter 6 of this document and its Attachment contain the qualifications to be held, and the competencies to be demonstrated, by those instructors, MPL examiners and inspectors, and course developers employed in a competency-based training programme. In competency-based programmes, instructor competencies are made explicit, and instructors have to demonstrate their instructional skills and their knowledge of the subject matter and training course content. Instructor competencies relative to flight simulation and the delivery of FSTD-based training are also essential where extensive use is made of FSTDs. MPL examiners and inspectors must demonstrate competencies in competency-based assessment techniques.

6.7 Chapter 7 — Upset prevention and recovery training

This chapter is intended to provide procedures to Civil Aviation Authorities, operators and approved training organizations in the delivery of upset prevention and recovery training for aeroplane pilots. This training is required for the MPL, the type-rating and the training of commercial air transport pilots, and is highly recommended for the CPL(A).

Table A. Amendments to the PANS-TRG

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
1st Edition (2006)	Flight Crew Licensing and Training Panel (2005)	*Procedures for Air Navigation Services — Training* (PANS-TRG)	19 July 2006 23 November 2006
1	Secretariat with the assistance of the Next Generation of Aviation Professionals (NGAP) Task Force and the International Air Transport Association (IATA) Training and Qualifications Initiative (ITQI)	A new Chapter 4, supported by additional definitions, containing procedures to facilitate the implementation of competency-based training and assessment for aircraft maintenance personnel.	13 May 2011 25 August 2011
2	Secretariat with the assistance of the Next Generation of Aviation Professionals (NGAP) Task Force and the International Air Transport Association (IATA) Training and Qualifications Initiative (ITQI)	New Chapter 5 which contains procedures supporting the implementation of the concept of evidence-based training (EBT), consisting of: a) the applicability, background and philosophy of EBT; b) reference to guidance material providing the detailed means of implementation. The amendment also expands the qualifications of instructors in the current Chapter 5.	4 January 2013 2 May 2013
3	Secretariat	Amendment concerning the introduction of provisions regarding upset prevention and recovery training (UPRT) for aeroplane pilots.	23 April 2014 13 November 2014

Chapter 1. DEFINITIONS AND ACRONYMS

1.1 DEFINITIONS

When the following terms are used in this document, they have the following meanings:

Air operator certificate (AOC). A certificate authorizing an operator to carry out specified commercial air transport operations.

Aircraft operating manual. A manual, acceptable to the State of the Operator, containing normal, abnormal and emergency procedures, checklists, limitations, performance information, details of the aircraft systems and other material relevant to the operation of the aircraft.

Note.— The aircraft operating manual is part of the operations manual.

Approved maintenance training organization (AMTO). An approved training organization performing training for aircraft maintenance technicians/engineers/mechanics.

Assessment (Evidence) 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 candidate meets the requirements of the competency standard.

ATA chapters. A common industry referencing standard for aircraft technical documentation.

Note.— The competency frameworks of Chapter 4 use references to the ATA chapters numbering, due to its widespread use in civil aviation.

Certify as airworthy (to). To certify that an aircraft or parts thereof comply with current airworthiness requirements after maintenance has been performed on the aircraft or parts thereof.

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 an observable outcome.

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

Configuration deviation list (CDL). A list established by the organization responsible for the type design with the approval of the State of Design which identifies any external parts of an aircraft type which may be missing at the commencement of a flight, and which contains, where necessary, any information on associated operating limitations and performance correction.

Criterion-referenced test. A test, the measurement of which is compared with an objective standard (and not against another measurement).

Dispatch Deviation Procedures Guide (DDPG). Manual to identify any procedure to dispatch an aircraft with allowable systems/components inoperative or missing.

Note.— Large aircraft manufacturers may choose to produce operating and maintenance procedures in documents such as Dispatch Deviation Procedure Guides, for use by operators.

Error. An action or inaction by an operational person that leads to deviations from organizational or the operational person's intentions or expectations.

Note — See Attachment E of Annex 13 — Aircraft Accident and Incident Investigation *for a description of operational personnel.*

Error management. The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequence of errors and mitigate the probability of further errors or undesired states.

Note.— See Attachment C to Chapter 3 and Circular 314 — Threat and Error Management (TEM) in Air Traffic Control *for a description of undesired states.*

Event. A combination of a task or a sub-task and the conditions under which the task or sub-task is to be performed.

Facilitation technique. An active training method, which uses effective questioning, listening and a non-judgemental approach and is particularly effective in developing skills and attitudes, assisting trainees to develop insight and their own solutions and resulting in better understanding, retention and commitment.

Generic Standard Shop Practices Manual. Manual that has been developed by an operator or by an Approved Maintenance Organization that provides guidance and direction to shop personnel with respect to all aspects of in-house procedures as applied to the various maintenance and maintenance support activities that has been accepted or approved by the regulator for the scope of activities for that organization.

Generic Standard Storage Practices Manual. Manual that has been developed by an operator or by an Approved Maintenance Organization that provides guidance and direction to maintenance support personnel engaged in the storage and preservation of aircraft parts, components, and other materials used in aircraft maintenance activities. The scope of the manual forms part of the organization's accepted or approved maintenance programme as indicated by the regulator.

Human Factors principles. Principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Instructional Systems Design (ISD). A formal process for designing training which includes analysis, design and production, and evaluation.

Large aeroplane. An aeroplane of a maximum certificated take-off mass of over 5 700 kg.

Maintenance. The performance of tasks required to ensure the continuing airworthiness of an aircraft, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

Maintenance Defect Reporting Sheet. Is used by aircraft maintenance personnel to report any defects and malfunctions being found during aircraft inspections.

Maintenance organization's procedures manual. A document endorsed by the head of the maintenance organization which details the maintenance organization's structure and management responsibilities, scope of work, description of facilities, maintenance procedures and quality assurance or inspection systems.

Maintenance programme. A document which describes the specific scheduled maintenance tasks and their frequency of completion and related procedures, such as a reliability programme, necessary for the safe operation of those aircraft to which it applies.

Maintenance records. Records which provide a description of work accomplished on the aeronautical products or parts thereof including the work and release to service certification, as required by Civil Aviation Authorities, operators, and maintenance organizations.

Note.— The maintenance record is used to record discrepancies, corrective action, modification details, total time in service, current status of compliance with mandatory continuing airworthiness information, and the current status of the aircraft's compliance with the maintenance programme. Finally, maintenance records show that all requirements for the signing of a maintenance release have been met.

Maintenance release. A document which contains a certification confirming that the maintenance work to which it relates has been completed in a satisfactory manner, either in accordance with the approved data and the procedures described in the maintenance organization's procedures manual or under an equivalent system.

Note.— A maintenance release is also referred to as a release to service.

Master minimum equipment list (MMEL). A list established for a particular aircraft type by the organization responsible for the type design with the approval of the State of Design containing items, one or more of which is permitted to be unserviceable at the commencement of a flight. The MMEL may be associated with special operating conditions, limitations or procedures.

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

Minimum equipment list (MEL). A list which provides for the operation of aircraft, subject to specified conditions, with particular equipment inoperative, prepared by an operator in conformity with, or more restrictive than, the MMEL established for the aircraft type.

Modification. A modification to an aeronautical product that means a change to the type design which is not a repair.

Non-destructive testing (NDT). An inspection technique used to test the condition of materials, components and systems used in aircraft, powerplants, associated systems, and components to examine these articles for condition and defects without causing damage to the item being inspected.

Note.— NDT testing methods may include but are not limited to ultrasonic, magnetic-particle, liquid penetrant, radiographic, eddy-current testing and structural health monitoring.

Operations manual. A manual containing procedures, instructions and guidance for use by operational personnel in the execution of their duties.

***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.

Range of variables (conditions). The conditions under which the competency units must be performed.

***Repair*.** The restoration of an aeronautical product to an airworthy condition to ensure that the aircraft continues to comply with the design aspects of the appropriate airworthiness requirements used for the issuance of the type certificate for the respective aircraft type, after it has been damaged or subjected to wear.

Scenario (event-set). Relatively independent segment of training made up of several events.

Serviceability of an aircraft part. An approved part is serviceable when it meets approved design data applicable to that part and has been manufactured and subsequently maintained in accordance with the requirements of the State of Design, Manufacture or Registry, as applicable.

Small aeroplane. An aeroplane of a maximum certificated take-off mass of 5 700 kg or less.

Special Standard Practices/Maintenance Procedures Manuals. Manuals establishing standard practices for selected processes to be applied by aircraft and component maintenance personnel for the proper handling (identification, application, working procedures, use of tools, and quality standards) of standard aeronautical hardware; e.g. welding, NDT.

Standard parts. Parts, such as fasteners, which are considered as approved parts when in accordance with a national or industry accepted standard and when referenced in the type design of the particular aircraft.

Standard Practices Manuals. Manuals establishing standard practices to be applied by aircraft and component maintenance personnel for the proper handling (identification, application, working procedures, use of tools, and quality standards) of standard aeronautical hardware.

Standard Wiring Practices Manuals (SWPM). Manuals establishing standard practices for processes in relation to any wiring used in aeronautical equipment to be applied by aircraft and component maintenance personnel for proper handling (identification, application, working procedures, use of tools, and quality standards).

Threat. Events or errors that occur beyond the influence of an operational person, increase operational complexity and must be managed to maintain the margin of safety.

Note. — See Attachment E of Annex 13 — Aircraft Accident and Incident Investigation *for a description of operational personnel.*

Threat management. The process of detecting and responding to threats with countermeasures that reduce or eliminate the consequences of threats and mitigate the probability of errors or undesired states.

Note.— See Attachment C to Chapter 3 and Circular 314 — Threat and Error Management (TEM) in Air Traffic Control *for a description of undesired states.*

Training for specialty rating. Training aimed at developing the set of particular competencies required to perform maintenance tasks on a specific type of equipment and in specific environments.

Note.— Such types of equipment include but are not limited to:

a) a specific aircraft or a broad category of aircraft;

b) an airframe or aircraft structure;

c) engines;

d) aircraft systems or components; and

e) avionic systems or components.

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 training (or 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.

1.2 ACRONYMS

AD Airworthiness directives

AMM Aircraft maintenance manual

AMMTE Aircraft maintenance mechanic/technician/engineer

AMO Approved maintenance organization

AMTO Approved maintenance training organization

APU Auxiliary power unit

ATA Air Transport Association (of America)

ATO Approved training organization

BITE Built-in test equipment

CAA Civil Aviation Authority

CMM Component maintenance manual

CPL(A) Commercial pilot licence (aeroplane)

CRM Crew resource management

CRS	Certificate of return to service
DDPG	Dispatch Deviation Procedures Guide
EBT	Evidence-based training
FIM	Fault Isolation Manual
FSTD	Flight simulation training device
IOE	Initial operating experience
ISD	Instructional systems design
KSA	Knowledge, skills and attitudes
LOC-I	Loss of control in flight
LOSA	Line operations safety audit
LWTR	Licence without type rating (an aircraft maintenance technician licence)
MEL	Minimum equipment list
MM	Maintenance manual
MMEL	Master minimum equipment list
MOPM	Maintenance organization’s procedures manual
MPL	Multi-crew pilot licence
MRM	Maintenance resource management
NDT	Non-destructive test(ing)
OEM	Original equipment manufacturer
OJT	On-the-job training
QA	Quality assurance
QAD	Quick attach/detach
SMPM	Special maintenance procedures manual
SOP	Standard operating procedure
SPM	Standard practices manual
SRM	Structural repair manual

SWPM Standard wiring practices manual

TEM Threat and error management

TR Type rating (on an aircraft maintenance licence)

UPRT Upset prevention and recovery training

———————————

Chapter 2. GENERAL PROVISIONS FOR COMPETENCY-BASED TRAINING AND ASSESSMENT

2.1 Introduction

Chapter 2 outlines the requirements that training organizations and Licensing Authorities need to 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 shall 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.

2.2.2 Competency-based approaches to training and assessment shall 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;

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 and 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.

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 the Attachment to Chapter 2.

2.2.3 Licensing Authorities shall develop general requirements concerning the management of examiners and provide guidance on:

a) the selection of examiners and description of competency-based assessment training;

b) the performance criteria to be considered by the examiner when assessing each competency; and

c) the tolerances applicable to all competency-based tests.

2.3 The competency framework

2.3.1 The 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 shall be derived from job and tasks analysis and shall describe observable outcomes.

Note.— Definitions of competency units, competency elements and performance criteria are provided in Chapter 1.

2.3.2 The competency framework for flight crew shall be based on the following competency units:

1. Apply threat and error management principles
2. Perform ground and pre-flight operation
3. Perform take-off
4. Perform climb
5. Perform cruise
6. Perform descent
7. Perform approach
8. Perform landing
9. Perform after-landing and post-flight operation

2.3.3 The competency frameworks for aircraft maintenance personnel shall be based on the following competency units:

Aircraft systems maintenance personnel	***Aircraft structure maintenance personnel***	***Aircraft component maintenance personnel***
1. Perform fault isolation 2. Perform maintenance practices 3. Perform service 4. Remove component/ assembly 5. Install component/ assembly 6. Adjust 7. Test 8. Inspect	1. Perform aircraft structural repair inspection 2. Perform structural damage investigation, cleanup and aerodynamic smoothness check 3. Perform special process application 4. Perform metal rework/ testing 5. Perform structural repair	1. Perform testing fault isolation 2. Perform disassembly 3. Clean 4. Perform inspection/check 5. Repair 6. Perform assembly 7. Perform storage

Aircraft systems maintenance personnel	***Aircraft structure maintenance personnel***	***Aircraft component maintenance personnel***
9. Check 10. Clean 11. Paint 12. Repair 13. Perform MEL and CDL/DDPB Procedures		

— — — — — — — —

Attachment to Chapter 2
AN EXAMPLE OF AN ISD METHODOLOGY: THE ICAO COURSE DEVELOPMENT METHODOLOGY

1. Introduction

1.1 The ICAO course development methodology, like any other ISD methodology, uses a systematic approach to training development. It therefore constitutes a quality assurance tool for ATOs that supports compliance with requirements and the development of appropriate training activities. It does so by identifying the key competencies that need to be achieved, determining the most effective way of achieving them and establishing valid and reliable assessment tools to evaluate their achievement.

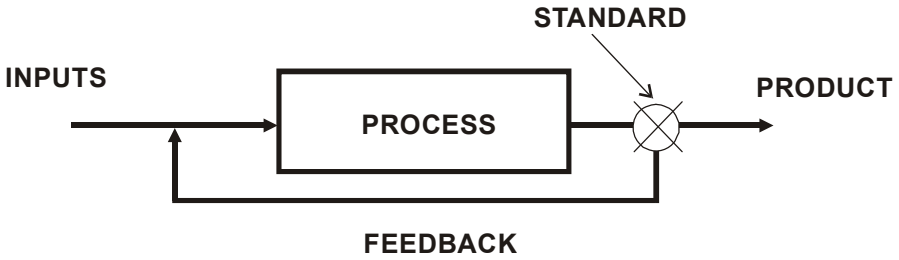
1.2 Such a tool, however, cannot be effectively implemented without the support of all stakeholders. Stakeholders include personnel involved in management, instruction design, instruction delivery, instruction assessment, licensing, operations and, of course, trainees. Successful implementation of competency-based training and assessment depends to a large extent on the support of this systematic approach at all levels of an organization.

1.3 The ICAO course development methodology has three broad categories — analysis, design and production, and evaluation — which can be subdivided into nine phases. A brief description of the specific outputs of the nine phases is summarized in the following table and a more detailed description of each phase's process is provided below.

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

2. Phase 1 — Preliminary study

2.1 The purpose of this phase is to provide management with the information needed to make a decision whether training is required and, if so, what training strategy to use. It consists of two sets of related activities: a problem analysis and a training requirement analysis. Often a job performance problem is detected. In order to accurately define a problem, a systems approach is used whereby symptoms, system or systems affected, and causes are identified.



2.2 A problem is defined by its symptoms and symptoms can be defined as differences between desired and actual performance. Before a symptom can be meaningfully described, it is necessary to determine the “desired standard of performance”. The “desired standard of performance” should be interpreted as the product standard or process standard of a system against which we compare the actual product/process. It follows that a symptom is generated when the users/customers of the product/process of a system, or other interested persons, recognize this difference and send a message of disagreement or alert (feedback component of the system). Therefore, a symptom is a consequence of a performance problem affecting the product/process of the system.

2.3 Causes of performance problems are directly linked to the *inputs* and *processes* of the system under analysis. Causes may be external; inputs that come from other systems or sub-systems are not appropriate. Causes may also be internal, a part of the process itself.

2.4 Identifying the system affected is key to clearly defining performance problems. It not only points to training solutions but also non-training solutions that could be applied. Usually, the system affected is linked to other systems or sub-systems that have to be considered in the analysis.

2.5 The systems approach is also very useful when designing a new system. The selection of an appropriate location for the new system in the overall organizational structure is very important in terms of its interrelation with other systems/sub-systems.

2.6 Once the problem is clearly defined, it may be deemed necessary to develop new competency-based training, arrange for alternative training or proceed with non-training approaches. If new competency-based training is to be developed, then a training development plan should be established that includes the details of the resources required. Often, the preliminary analysis will show that there is not a single solution to a problem but that a combination of several solutions is preferable.

2.7 If a decision is made that competency-based training should be developed, decisions are then made on potential modes of delivery; for example, should training be based on validated competency-based training materials or be left to the judgement of the instructor? Should the instruction be individualized or given in a group?

2.8 Validated competency-based training material takes the form of a well-documented and repeatable package that has been tested and shown to be effective. A validated course is said to be material-dependent as opposed to instructor-dependent**.** The former is the predominant form used in ICAO course development, but instructor-dependent training should not be ruled out in certain specific and limited areas (such as training a very small number of specialist technicians on new equipment). Usually this decision is made once for the whole course of training.

2.9 In some circumstances, organizations may find it useful to evaluate the effectiveness of a proposed solution. This can be done by using cost benefit or risk management analysis. If a training course or programme is to be developed, a plan for subsequently evaluating the actual benefits resulting from the training after it has been implemented should also be foreseen.

3. Phase 2 — Job analysis

3.1 Training should be designed so that it enables all qualified trainees to perform their tasks at acceptable levels of competence. Job analysis can define these levels. It is important that the focus of training courses be towards enabling employees to competently perform tasks, and not only “learn about” or “understand” the subject matter. The purpose of job and task analysis is twofold: to gather information on how, where and with what information a job is done in order to define the skills, knowledge and attitudes (SKAs) required, and to determine the job performance objectives.

3.2 The main steps of a job and task analysis consist of:

1) collecting and analysing existing relevant documentation and information from the field;

2) obtaining a consensus among subject matter experts regarding job performance standards;

3) checking the validity of the analysis; and

4) reviewing the information. The most appropriate subject matter experts are master performers.

In Step 2), a technique that has been found particularly successful is known as a DACUM session (develop a curriculum). This is a form of controlled brainstorming between two or three subject matter experts guided by the course development team. By systematically extracting a consensus of opinion on the job, errors and omissions are avoided. During Step 3), direct observations and interviews on the job complement the results of the DACUM session in Step 2. In Step 4, the holders of the job may discover alternative ways of carrying out certain tasks, which may prove more effective. If so, the task analysis should be revised and reviewed by subject matter experts.

3.3 A job can be broken down into a number of functions. A function represents a major subdivision of a job with a distinct identity. One function may be common to several jobs. Each function can be broken down into a number of operations which, depending on the level of detail, are called tasks, sub-tasks or task elements. The result of a function is observed and measured through the results of the tasks that constitute it.

3.4 A task can be considered as a system with inputs, process, standards, outputs/products and feedback. The characteristics of a task are listed below against system components:

System component	***Task characteristics***
Inputs	A triggering event Equipment, tools, job aids, documentation, references
Process	Perform all necessary steps (i.e. sub-tasks) to achieve the output/product. It should be worded with an active verb.
Output/product	A measurable and observable result of the process A terminating event
Product standard	A specification of what the output should look like
Feedback	Result of the comparison between product and standard. If the result is compliant with the standard, the terminating event of the task has been reached. If not, the task process has to be started again until the product meets the standard.

3.5 A sub-task is a single step in the process of a task; it is measurable and observable and requires the use of several SKAs. The process standard is the sequence and correct performance of each sub-task. The validity of each task process (sequence of sub-tasks) is established with a subject matter expert.

3.6 It is often difficult to tell whether an activity should be called a function or a task, a sub-task or a task element. Frequently, the same activity would be labelled differently depending on the context. The main objective of this phase is to describe operations in a way that will be helpful when carrying out the subsequent phases of course development.

3.7 The SKAs are what a performer requires to perform a sub-task i.e. underlying knowledge (recall), underlying cognitive skills (classifying, problem-solving, rule-using, etc.), psycho-motor skills and attitudes.

3.8 Task analysis is not necessarily required for all tasks. It is required, however, for all tasks that are critical. The criticality of a task can be determined through consideration of the following factors:

a) Importance: can be determined by asking the question: How serious are the consequences if the tasks are performed incorrectly or not performed at all?

b) Difficulty: can be determined by asking the question: How frequently do employees make performance errors?

c) Frequency: can be described through the specification of a mean time between execution of the task.

Tasks that are found critical will be emphasized during training; therefore, all relevant information is required for them.

3.9 Other data are also gathered during task analysis for a given task, such as the triggering and terminating event, a description of how the task should be carried out, the SKAs that are needed, any special difficulty in performing the task, the inputs needed to carry out the task (environmental conditions, equipment, documentation, etc.), and the standard required to evaluate job performance. A performance standard clearly distinguishes between correct or acceptable performance and incorrect or unacceptable performance. If it can be observed and measured, the product standard describes the expected output of a task. A process standard specifies the way a task should be performed and provides a means to evaluate performance even if there is no output.

3.10 The method described above for task analysis is widely and commonly used but other methods do exist. Two such methods are:

a) *Cognitive task analysis* — This method was developed to address the increasing shift to cognitive skills in job performance. The job of flight crews can be considered to have strong cognitive components. The purpose of cognitive task analysis is to outline the mental processes and skills needed to perform a task at a high proficiency level. While cognitive task analysis methods are resource-intensive, they can supplement generic task analysis methods. As a detailed description of the methods and techniques involved in cognitive task analysis is beyond the scope of this document, readers may wish to consult the reference list provided at the end of this attachment.

b) *Team task analysis* — While generic task analysis focuses on an individual's performance, work in more sophisticated and complex environments is increasingly carried out in teams. Team task analysis methods are used to identify critical teamwork behaviours. A detailed description of the methods and techniques developed to date for team task analysis is beyond the scope of this document. Readers may consult the reference list for additional material.

4. Phase 3 — Population analysis

4.1 The purpose of this phase is to study the target population (future trainees) with a view to identifying the SKAs that they already have and to collecting information on preferred learning styles and on the social and linguistic environments of prospective trainees, all of which could have an impact on the training design.

4.2 The target population may be a mixture of experienced and newly recruited personnel, groups differing in age, etc. All this information is important for determining the SKAs already possessed by the target population and for designing the most appropriate programme of instruction.

4.3 This mixture of experience may be accommodated through a modular training design, which is more flexible than a "traditional system". In a modular system, each major task would require a module containing clear performance objectives, exercises, handouts and tests. The modular system would be designed in such a way that trainees would enter the course at the level where they cannot pass the exercises and tests.

4.4 Population analysis is also an opportunity to initiate a dialogue with members of the target population so they can voice attitudes to be taken into account in the design of the

training. This dialogue should be maintained throughout training to ensure that due regard is taken of the learning problems, reactions and attitudes of those receiving the instruction. This dialogue is valuable not only for the information it provides but also for the positive attitudes that it helps to create among the trainees because they are being consulted and know that their needs are being considered.

5. Phase 4 — Design of curriculum

5.1 Steps for curriculum development

The steps to carry out curriculum development are to:

a) determine the use of job aids;
b) restate the aim of the training;
c) derive terminal objectives from tasks identified in Phase 2;
d) outline a competency-based mastery test for each terminal objective;
e) list relevant enabling objectives for each terminal objective;
f) check that all skills, knowledge and attitude requirements for the job are covered by the objectives;
g) determine possible similarities in enabling objectives;
h) sequence all objectives; and
i) group the objectives into training modules and sequence the modules.

5.2 Job aids or training as solutions

5.2.1 The first step of this phase is to determine whether the skills, knowledge or attitudes needed are best provided by the development of job aids, or training, or both. A job aid is any device made available on the job and designed to facilitate correct performance of the task by extending the performer's capability to retain and utilize information (e.g. numerical tables, checklists, guidelines, and forms). A job aid is less costly to develop than training, and implementation costs are usually very small. Sometimes a job aid is preferable to training, not on grounds of costs but in terms of effectiveness. The focus should be on providing only that training for which job aids cannot be substituted.

5.2.2 The preparation of job aids is a particularly good solution for tasks involving many simple operations or procedures that can be completely described. Job aids are also useful for tasks that are performed infrequently, require a high degree of accuracy but not speed, comprise many decision points which must be performed in a definite sequence, and are subject to frequent changes.

5.3 Definition of training objectives

5.3.1 The main purpose of Phase 4 is to provide detailed information on what the training is intended to achieve, i.e. the training objectives, and how this achievement will be tested. The objectives will describe what the trainees must be able to do after training. Objectives should be expressed in terms of measurable performance (what specific concrete results are to be achieved).

5.3.2 Every training objective should include descriptions of the desired performance or behaviour of the trainee after training, the conditions under which the trainee is to perform the task, and the standards that describe how the trainee should perform the task.

5.3.3 The overall purpose of the training already specified in Phase 1 will require several types of objectives. A given course will have several terminal objectives, each one corresponding to a task. Each terminal objective, in turn, will have several enabling objectives, which describe the desired performance for sub-tasks. Finally, post-training objectives describe what the trainee should be able to do after a defined period of practice on the job.

5.4 Design of competency-based assessments

5.4.1 Another purpose of Phase 4 is to prepare valid and reliable tests that will measure whether or not the training objectives have been achieved. In order for tests to be effective, they must be valid and reliable. A test is valid when it measures what it sets out to measure. The more closely a test matches a performance objective, the more valid it is. A reliable test is one that will obtain consistent results when administered by different instructors. More precisely, a reliable test will allow several instructors to come up with the same evaluation on trainees' performances. This implies that instructors have clear instructions on how to administer the test, and precise and unambiguous evaluation instruments (score key).

5.4.2 The use of criterion-referenced tests is advocated in the ICAO course development methodology. When the performance of a trainee is compared to other trainees, and a judgement is made based on this comparison, this is a norm-referenced test. When, for example, students are ranked based on their performance in reference to each other, this is in fact a norm-referenced evaluation. When a measurement is compared with an objective standard (not against another measurement), this is a criterion-referenced evaluation.

5.4.3 In the ICAO course development methodology, mastery tests are used to determine if a trainee meets the standard of performance established in the terminal objectives. This training standard should be as closely related as possible to the corresponding standard established during job and task analysis. The conditions, behavior and standards assessed during the test should reproduce as closely as possible what was described in the training objective for a given task or sub-task. If a trainee demonstrates in a mastery test that the standard has been met or surpassed, the trainee passes, independent of a comparison to the scores of other trainees. This is what is meant by the "pass or fail" concept.

5.4.4 Designing tests prior to designing modules, handouts and training manuals (Phase 5) may seem a departure from most conventional training. However, designing the mastery test at this point has two important functions: it ensures that the test is designed to focus on how trainees meet the training objective and it curbs the natural tendency of designing tests that focus on training materials rather than job performance.

5.4.5 Trainees' attitudes towards a test will be influenced by the way it is administered. This attitude can range from cooperative to extremely hostile. Proper test administration can help create an attitude that is positive and cooperative.

5.4.6 Feedback to trainees and discussion of test results should be standard practice. Test results should be used as diagnostic tools to help the instructor and trainees take remedial steps to ensure mastery and should be analysed in terms of performance relating to specific objectives. There should only be two grades — pass and fail. If they do not meet the criterion, they would be reported as having failed the course. In addition, one of two options would be noted: either that they had attended the course but had not completed it satisfactorily, or that arrangements would be made for further training on the modules that they had failed. When determining whether trainees should undergo additional training, consideration should be given to whether the modules that the trainee failed are related to tasks that have been assessed as critical.

6. Phase 5 — Design of modules

6.1 A training strategy makes the most effective use of available resources, techniques, needs and constraints to ensure that trainees accomplish their training objective. The overall strategy must consider the number and characteristics of the target population, the resources required (e.g. equipment, financial, and facilities), organizational issues, and repeatability of the course. The above considerations will determine the choice of instructional techniques, amount of practice, modes of delivery, media selection, tests and sequence.

6.2 The grouping of objectives into modules and the sequencing of these modules will have been decided in Phase 4. Modules are designed once the training strategy is established. Each module should be designed to ensure that trainees are capable of performing the module objective to the standard required at the end of the module. This will usually require that the module follow the sequence below:

a) gaining attention and motivating the learner;
b) demonstrating what the trainee will be able to accomplish after learning (the objective);
c) explaining how the accomplishment will be tested;
d) stimulating the recall of prerequisite learning;
e) presenting the subject matter content to be learnt, piece by piece;
f) providing opportunities for the trainee activity (partial practice; global practice);
g) reinforcing learning by providing feedback on the trainee's practice;
h) assessing the performance of the trainee (mastery test); and
i) enhancing retention of what has been learnt so that it can be transferred to other situations.

6.3 Selecting a mode of delivery for each module and each instructional event within each module depends on many factors. The importance of the factors may vary according to the objective. Individual modules (and, by extension, a complete training course) may consist of both individualized and group training.

6.4 The most creative decisions in course development are the selection of training techniques. Optimal learning will occur when the training technique is enjoyable and allows the trainee to be active. However, the enjoyment of a training technique will fade if it is used too often; thus, it is necessary to look for variety. Just as within a course or module there is scope to vary the mode of delivery, so there is scope to vary the training technique. Training techniques include lectures, demonstrations, guided group discussions, role play, case studies/projects, games, laboratory exercise, supervised

practice, leaderless groups, field visits, self-paced learning, independent study, tutorials, supervised practice, and on-the-job practice.

6.5 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 objective. For example, if the information includes motion, such as interpretation of movement on a radar display, then some form of medium that can represent movement should be used. The options include live demonstration, e-learning, simulation, multimedia projection, text, and the instructor, according to the learning requirements. Sometimes special effects, such as stop-action or slow motion, are required.

6.6 Four main factors govern the choice of media: instructional appropriateness, economy, simplicity and availability. To meet the requirement of instructional appropriateness, media selection should take into account the mode of delivery, the objectives of instruction, and the type of capabilities to be learned, e.g. verbal and motor skills. Since certain media items represent a considerable investment, it may be necessary to plan ahead and strike a compromise which will limit future decisions. The objective should be to select the hardware in order to keep options as flexible as possible.

7. Phase 6 — Production and developmental testing

7.1 The ICAO course development methodology is designed to prepare a comprehensive and standardized training package (STP) for each course. Each package contains all of the material required for that particular course, presented in such a manner that any competent instructor will be able to readily deliver the course. In Phase 6, all necessary training material required to achieve each module's training objective is prepared, i.e. detailed lesson plans, instructor's notes, students' handbooks and handout material, and audio-visual or other training material.

7.2 To ensure that the training material is effective and suitable to the target population, it is essential that it be tried out as it is being developed and be revised as necessary. Mastery tests, in particular, should be tried out. Each test should be validated by ensuring that the test reflects the conditions, performance and standards of the objectives; it is technically accurate based on the review of a subject matter expert; and it is administered to a sample of skilled and unskilled performers of the target population. A high proportion of the skilled should pass the test, and a high proportion of the unskilled should fail. If "Master performers" do not score well on a test, the course developer should ensure that the course objective to which the test refers is really valid, i.e. that the task is actually part of the job.

7.3 Once training materials have been developmentally tested and then revised sufficiently, the next step is to refine and package the training materials in a form suitable for validation and later use. All material should be checked for technical content and accuracy by a subject matter expert. There should be standardization of format and presentation, which will facilitate production. The training material must be attractive, well formatted, and faithful to the course design.

8. Phase 7 — Validation and revision

8.1 During Phase 7, the capability of the competency-based instructional materials to effectively guide trainees to successful performance on the mastery tests is assessed.

Test results usually do not show that 100 per cent of the experimental trainee group have achieved 100 per cent of the objectives. This may be due to the fact that the training materials may still have some problems at this stage; the tests themselves, even after developmental testing, may not be a perfect measuring device; or the trainees may not be representative of the target population. To allow for these shortcomings, a validity criterion, which states that 80 per cent of the trainees should achieve 80 per cent of the objectives, is commonly used. The validity criterion should be determined based on the criticality of the tasks to be carried out on the job.

8.2 During validation delivery of a course, a representative sample of the target population should be given the course and their answers and reactions carefully recorded. To ensure accurate validation results, large samples of trainees are required. Instructors should administer the training while Course Developers observe and take notes. Data from the validation delivery should be analysed and required revisions determined. The data of greatest interest concern the objectives that are not met at the end of training, and why they are not met. Revisions should be made to any module that does not satisfy the validation criterion. If the revision is extensive, another validation should be conducted.

8.3 If training material is ineffective, it may cause a number of reactions: low test results, adverse comments by the participants and instructors, inability to perform the tasks once assigned to the field, too many errors, or excessive dependence on supervisors.

9. Phase 8 — Implementation

9.1 After validation, the revised training material should be used for regular delivery of the course. Training delivery, in its broadest sense, includes forecasting of delivery volumes, scheduling of classes, enrolment of trainees, preparation for and conducting of course sessions, and evaluation of effectiveness, including follow-up of trainees back on the job.

9.2 The quality of implementation of a training programme depends not only on the quality of the material but also on the qualifications of the instructors and on the effectiveness of administrative support.

10. Phase 9 — Post-training evaluation

10.1 Evaluation of training takes place at several points in the development approach — notably in the developmental testing and in validation. The higher levels of evaluation, however, cannot be done until a substantial number of trainees have followed the course; it is this latter post-course evaluation which is the final phase — Phase 9. The purpose of post-course evaluation is to determine the extent to which the training programme fulfilled the purpose for which it was designed and if corrective actions are required.

10.2 There are four levels of evaluation:

Level 1: Trainee reactions to the training process
Level 2: Trainee mastery of the end-of-course objectives
Level 3: Resulting job performance of ex-trainees
Level 4: Resulting effect on the organization’s operational objectives such as quality of service and productivity

10.3 In each of the four levels of evaluation, a comparison needs to be done of the actual effects of the training with those which were intended when the objectives were set.

- At Level 1: an evaluation of whether the classroom reactions of the trainees are the same as the reactions hoped for when the training techniques were chosen in Phase 5.
- At Level 2: an evaluation of whether the trainees actually learned the task stated as training objectives in Phase 4.
- At Level 3: in-depth look at whether, when back at their jobs, the trainees' performance improved to the required standard, which was defined in Phase 2.
- At Level 4: an evaluation of whether the training achieved the improvement in the organization's operational performance, which was the stated objective of the whole training programme in Phase 1.

10.4 The measurement of objectives at Level 3 and particularly Level 4 is complicated by the reality that training generally is not the only solution to an operational problem or to an individual performance problem. The training could be excellent but may not produce the predicted improvements at Levels 3 and 4 if management fails to implement other solutions identified as necessary to solve the problem, e.g. changes in the job environment, tools, and supervisory practices. Moreover, it is likely to be very difficult to single out the contribution of training, particularly if other solutions are not implemented.

10.5 The extent of evaluation to be undertaken for a given course depends on the importance of the training and on the time and resources available. It is suggested that, at the very least, evaluation at Levels 1 and 2 should be done routinely. Generally, some effort should be directed toward evaluating the impact of courses on job performance (Level 3). This could take the form of written feedback from supervisors of former trainees, or of reporting performance deficiencies within a few months after training — a relatively modest undertaking. If conditions warrant, more extensive study could be undertaken of the impact of courses on job performance. Level 4 evaluation might be done in cases where the operational problem was not solved and it is necessary to determine how training or other solutions would have to be modified to solve the problem. Sometimes this would be done in order to establish the credibility of the training organization.

Reference list

Annett, John, David Cunningham, and Peter Mathias-Jones, *A method of measuring team skills,* Ergonomics, 2000, Vol. 43, No. 8, pp. 1076–1094.

Brenner, T., K. Sheehan, W. Arthur, and W. Bennett, *Behavioral and Cognitive Task Analysis Integration for Assessing Individual and Team Work Activities,* accessed on 10 September 2004, at http://www.ijoa.org/papers/98symposium/brenneretal.html.

Cannon-Bowers, Janis and Eduardo Salas, *Team Performance and Training in Complex Environments: Recent Findings from Applied Research,* Current Directions in Psychological Science, 1998, pp. 83–87.

Militello, Laura G. and Robert J. B. Hutton, *Applied cognitive task analysis (ACTA): a practitioner's toolkit for understanding cognitive task demands*, Ergonomics, 1998, Vol. 41, No. 11, pp. 1618–1641.

Ryder, Joan M. and Richard E. Redding, *Integrating Cognitive Task Analysis into Instructional Systems Development,* ETR&D, Vol. 41, No. 2, pp. 75–96.

———————————

Chapter 3. COMPETENCY-BASED TRAINING AND LICENSING FOR THE MULTI-CREW PILOT LICENCE (MPL)

3.1 Introduction

This chapter provides the elements for a competency-based multi-crew pilot licence (MPL), with which approved training organizations (ATOs) and Licensing Authorities shall comply.

3.2 Assessment

3.2.1 Licensing Authorities and ATOs shall use the competency units, competency elements and performance criteria in approving and developing their own licensing and training programmes for the MPL, as contained in the competency-based framework at Appendix 2 to this chapter. Licensing Authorities shall develop or approve the range of variables and the evidence and assessment guide and/or practical test standards required for assessing applicants for the MPL.

3.2.2 The MPL holder shall meet the requirements of an operator's structured initial operating experience (IOE) programme, evaluation of which shall be conducted on completion of IOE by means of an operator's line check or equivalent means accepted by the Licensing Authority.

3.2.3 Licensing Authorities shall ensure that TEM competency elements are assessed as an integral part of each of the other eight phase-of-flight competency units established for the MPL.

Note.— Refer to Attachment C to this chapter and Chapter 2 of the Human Factors Training Manual (Doc 9683) for guidance material on TEM.

3.3 Training

3.3.1 All MPL training programmes shall be developed with the use of an ISD methodology.

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 the Attachment to Chapter 2.

3.3.2 Each phase of the MPL Training Scheme (see Appendix 1 to this chapter) shall be composed of instruction in underpinning knowledge and in practical training segments. Training in the underpinning knowledge requirements for the MPL shall therefore be fully integrated with the training of the skill requirements.

Note.— Refer to "Guidelines for the Implementation of the MPL" in Appendix 3 to this chapter.

3.3.3 The training course for an MPL licence shall include continuous evaluation of the training programme and of the students following the programme that is acceptable to the Licensing Authority. Evaluation shall ensure that:

a) the competencies and related assessment are relevant to the task of a co-pilot of an aircraft certificated for more than one pilot; and

b) the students acquire the necessary competencies in a progressive and satisfactory manner.

Corrective action shall be taken if in-training or post-training evaluation indicates a need to do so.

3.3.4 The advanced phase of an MPL training course shall include a sufficient number of take-offs and landings to ensure competency, which shall not be less than twelve. These take-offs and landings shall be performed under the supervision of an authorized instructor in an aeroplane for which the type rating shall be issued.

3.3.5 The Licensing Authority may accept a reduction, from twelve to six, of the number of take-offs and landings required for the advanced phase of training, provided that:

a) the approved training organization has demonstrated to the satisfaction of the Licensing Authority that it does not negatively affect the acquisition of the required skill by the student; and

b) a process is in place to ensure that corrective action can be made if in-training or post-training evaluation indicates a need to do so.

— — — — — — — —

Appendix 1 to Chapter 3
MULTI-CREW PILOT LICENCE TRAINING SCHEME

MPL Training Scheme Minimum 240 hours of training including PF and PNF*					
	Phase of training	*Training items*	*Flight and simulated flight training media — Minimum level requirement*		*Ground training media*
Integrated TEM principles	**Advanced** Type rating training within an airline-oriented environment	• CRM • Landing training • All weather scenarios • LOFT • Abnormal procedures • Normal procedures	Aeroplane: Turbine Multi-engine Multi-crew certified	12 take-offs and landings as PF**	• CBT • E-learning • Part-task trainer • Classroom
			FSTD: Type IV	PF/PNF	
	Intermediate Application of multi-crew operations in a high-performance, multi-engine turbine aeroplane	• CRM • LOFT • Abnormal procedures • Normal procedures • Multi-crew • Instrument flight	FSTD: Type III	PF/PNF	
	Basic Introduction of multi-crew operations and instrument flight	• CRM • PF/PNF complement • IFR cross-country • Upset prevention and recovery • Night flight • Instrument flight	Aeroplane: Single or multi-engine	PF/PNF	
			FSTD: Type II		
	Core Flying Skills Specific basic single pilot training	• CRM • VFR cross-country • Solo flight • Basic instrument flight • Principles of flight • Cockpit procedures	Aeroplane: Single or multi-engine	PF	
			FSTD: Type I		

— — — — — — — —

* PF — Pilot Flying; PNF — Pilot Not Flying.

** Limited credit may be granted in accordance with 3.3.4 and 3.3.5 of Chapter 3.

Appendix 2 to Chapter 3
MULTI-CREW PILOT LICENCE COMPETENCY UNITS — COMPETENCY ELEMENTS AND PERFORMANCE CRITERIA

	Reference	*Duty*	*Observation & assessment*
1. APPLY THREAT AND ERROR MANAGEMENT PRINCIPLES			
1.1 Recognize Threat			
1.2 Manage Threat			
1.3 Recognize Error			
1.4 Manage Error			
1.5 Recognize Undesired Aircraft State			
1.6 Manage Undesired Aircraft State			
Note.— Refer to Attachment C to this chapter and to Chapter 2 of the Human Factors Training Manual *(Doc 9683) for guidance material on TEM.*			
2. PERFORM AIRCRAFT GROUND AND PRE-FLIGHT OPERATIONS List of competency elements and performance criteria			
2.0 Recognize and manage potential threats and errors			
2.1 Perform dispatch duties			satisfactory/unsatisfactory
2.1.1 verifies technical condition of the aircraft, including adequate use of MEL	Ops. Manual	PF/PNF	
2.1.2 checks technical bulletins and notices	Ops. Manual	PF/PNF	
2.1.3 determines operational environment and pertinent weather	Ops. Manual	PF/PNF	
2.1.4 determines impact of weather on aircraft performance	Ops. Manual	PF/PNF	
2.1.5 applies flight planning and load procedures	Ops. Manual	PF/PNF	
2.1.6 determines fuel requirement	Ops. Manual	PF/PNF	
2.1.7 files an ATS flight plan (if required)	Ops. Manual	PF/PNF	
2.2 Provide flight crew and cabin crew briefings			satisfactory/unsatisfactory
2.2.1 briefs flight crew in all relevant matters	Ops. Manual	PF	
2.2.2 briefs cabin crew in all relevant matters	Ops. Manual	PF	
2.3 Perform pre-flight checks and cockpit preparation			satisfactory/unsatisfactory
2.3.1 ensures the airworthiness of the aircraft	Ops. Manual	PF	

		Reference	Duty	Observation & assessment
2.3.2	performs the cockpit preparation & briefings	Ops. Manual	PF/PNF	
2.3.3	performs FMS initialization, data insertion and confirmation	Ops. Manual	PF/PNF	
2.3.4	optimizes and checks take-off performance and take-off data calculation	Ops. Manual	PF/PNF	
2.3.5	conducts relevant briefings	Ops. Manual	PF	
2.4	**Perform engine start**			satisfactory/unsatisfactory
2.4.1	asks for, receives, acknowledges and checks ATC clearance	Ops. Manual	PNF	
2.4.2	performs engine start procedure	Ops. Manual	PF/PNF	
2.4.3	uses standard communication procedures with ground crew and ATC	Ops. Manual	PF/PNF	
2.5	**Perform taxi**			satisfactory/unsatisfactory
2.5.1	receives, checks and adheres to taxi clearance	Ops. Manual	PNF	
2.5.2	taxis the aircraft including use of exterior lighting	Ops. Manual	PF	
2.5.3	complies to taxi clearance	Ops. Manual	PF/PNF	
2.5.4	maintains lookout for conflicting traffic and obstacles	Ops. Manual	PF/PNF	
2.5.5	operates thrust, brakes and steering	Ops. Manual	PF	
2.5.6	conducts relevant briefings	Ops. Manual	PF	
2.5.7	uses standard communication procedures with crew and ATC	Ops. Manual	PNF	
2.5.8	completes standard operating procedures and checklists	Ops. Manual	PF/PNF	
2.5.9	updates and confirms FMS data	Ops. Manual	PF/PNF	
2.5.10	manages changes in performance and departure route	Ops. Manual	PF/PNF	
2.5.11	completes de-icing/anti-icing procedures	Ops. Manual	PF/PNF	
2.6	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
2.6.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
2.6.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
2.6.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
2.7	**Communicate with cabin crew, passengers and company**			satisfactory/unsatisfactory
2.7.1	communicates relevant information to cabin crew	Ops. Manual	PF	
2.7.2	communicates relevant information to company	Ops. Manual	PF/PNF	
2.7.3	makes passenger announcements when appropriate	Ops. Manual	PF/PNF	

		Reference	*Duty*	*Observation & assessment*
3.	**PERFORM TAKE-OFF** List of competency elements and performance criteria			
3.0	**Recognize and manage potential threats and errors**			
3.1	**Perform pre-take-off and pre-departure preparation**			satisfactory/unsatisfactory
3.1.1	checks and acknowledges line-up clearance	Ops. Manual	PF/PNF	
3.1.2	checks correct runway selection	Ops. Manual	PF/PNF	
3.1.3	confirms validity of performance data	Ops. Manual	PF/PNF	
3.1.4	checks approach sector and runway are clear	Ops. Manual	PF/PNF	
3.1.5	confirms all checklists and take-off preparations completed	Ops. Manual	PF/PNF	
3.1.6	lines up the aircraft on centre line without loosing distance	Ops. Manual	PF	
3.1.7	checks weather on departure sector	Ops. Manual	PF/PNF	
3.1.8	checks runway status and wind	Ops. Manual	PF/PNF	
3.2	**Perform take-off roll**			satisfactory/unsatisfactory
3.2.1	applies take-off thrust	Ops. Manual	PF	
3.2.2	checks engine parameters	Ops. Manual	PNF	
3.2.3	checks airspeed indicators	Ops. Manual	PF/PNF	
3.2.4	stays on runway centre line	Ops. Manual	PF	
3.3	**Perform transition to instrument flight rules**			satisfactory/unsatisfactory
3.3.1	applies V 1 procedures	Ops. Manual	PF/PNF	
3.3.2	rotates at VR to initial pitch attitude	Ops. Manual	PF	
3.3.3	establishes initial wings level attitude	Ops. Manual	PF	
3.3.4	retracts landing gear	Ops. Manual	PNF	
3.3.5	maintains climb-out speed	Ops. Manual	PF	
3.4	**Perform initial climb to flap retraction altitude**			satisfactory/unsatisfactory
3.4.1	sets climb power	Ops. Manual	PF	
3.4.2	adjusts attitude for acceleration	Ops. Manual	PF	
3.4.3	selects flaps according to flap speed schedule	Ops. Manual	PF/PNF	
3.4.4	observes speed restrictions	Ops. Manual	PF	
3.4.5	completes relevant checklists	Ops. Manual	PF/PNF	
3.5	**Perform rejected take-off**			satisfactory/unsatisfactory
3.5.1	recognizes the requirement to abort the take-off	Ops. Manual	PF	
3.5.2	applies the rejected take-off procedure	Ops. Manual	PF	
3.5.3	assesses the need to evacuate the aircraft	Ops. Manual	PF/PNF	
3.6	**Perform navigation**			satisfactory/unsatisfactory
3.6.1	complies with departure clearance	Ops. Manual	PF	
3.6.2	complies with published departure procedures,	Ops. Manual	PF	

			Reference	*Duty*	*Observation & assessment*
		e.g. speeds			
	3.6.3	monitors navigation accuracy	Ops. Manual	PF/PNF	
	3.6.4	communicates and coordinates with ATC	Ops. Manual	PNF	
3.7	**Manage abnormal and emergency situations**				satisfactory/unsatisfactory
	3.7.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
	3.7.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
	3.7.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
4.	**PERFORM CLIMB** List of competency elements and performance criteria				
4.0	**Recognize and manage potential threats and errors**				
4.1	**Perform standard instrument departure/en-route navigation**				satisfactory/unsatisfactory
	4.1.1	complies with departure clearance and procedures	Ops. Manual	PF	
	4.1.2	demonstrates terrain awareness	Ops. Manual	PF/PNF	
	4.1.3	monitors navigation accuracy	Ops. Manual	PF/PNF	
	4.1.4	adjusts flight to weather and traffic conditions	Ops. Manual	PF	
	4.1.5	communicates and coordinates with ATC	Ops. Manual	PNF	
	4.1.6	observes minimum altitudes	Ops. Manual	PF/PNF	
	4.1.7	selects appropriate level of automation	Ops. Manual	PF	
	4.1.8	complies with altimeter setting procedures	Ops. Manual	PF/PNF	
4.2	**Complete climb procedures and checklists**				satisfactory/unsatisfactory
	4.2.1	performs the after-take-off items	Ops. Manual	PF/PNF	
	4.2.2	confirms and checks according to checklists	Ops. Manual	PF/PNF	
4.3	**Modify climb speeds, rate of climb and cruise altitude**				satisfactory/unsatisfactory
	4.3.1	recognizes the need to change speed/rate of climb/cruise altitude	Ops. Manual	PF	
	4.3.2	selects and maintains the appropriate climb speed/rate of climb	Ops. Manual	PF	
	4.3.3	selects optimum cruise flight level	Ops. Manual	PF/PNF	
4.4	**Perform systems operations and procedures**				satisfactory/unsatisfactory
	4.4.1	monitors operation of all systems	Ops. Manual	PF/PNF	
	4.4.2	operates systems as required	Ops. Manual	PF/PNF	
4.5	**Manage abnormal and emergency situations**				
	4.5.1	identifies the abnormal condition	Ops. Manual	PF/PNF	satisfactory/unsatisfactory
	4.5.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
	4.5.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	

		Reference	*Duty*	*Observation & assessment*
4.6	**Communicate with cabin crew, passengers and company**			satisfactory/unsatisfactory
4.6.1	communicates relevant information to cabin crew	Ops. Manual	PF	
4.6.2	communicates relevant information to company	Ops. Manual	PF/PNF	
4.6.3	makes passenger announcements when appropriate	Ops. Manual	PF	
5.	**PERFORM CRUISE** List of competency elements and performance criteria			
5.0	**Recognize and manage potential threats and errors**			
5.1	**Monitor navigation accuracy**			satisfactory/unsatisfactory
5.1.1	demonstrates adequate area knowledge	Ops. Manual	PF/PNF	
5.1.2	demonstrates adequate route knowledge	Ops. Manual	PF/PNF	
5.1.3	navigates according to flight plan and clearance	Ops. Manual	PF	
5.1.4	adjusts flight to weather and traffic conditions	Ops. Manual	PF	
5.1.5	communicates and coordinates with ATC	Ops. Manual	PNF	
5.1.6	observes minimum altitudes	Ops. Manual	PF/PNF	
5.1.7	uses all means of automation	Ops. Manual	PF	
5.2	**Monitor flight progress**			satisfactory/unsatisfactory
5.2.1	selects optimum speed	Ops. Manual	PF	
5.2.2	selects optimum cruise flight level	Ops. Manual	PF	
5.2.3	monitors and controls fuel status	Ops. Manual	PF/PNF	
5.2.4	recognizes the need for a possible diversion	Ops. Manual	PF/PNF	
5.2.5	creates a diversion contingency plan if required	Ops. Manual	PF/PNF	
5.3	**Perform descent and approach planning**			satisfactory/unsatisfactory
5.3.1	checks weather of destination and alternate airport	Ops. Manual	PF/PNF	
5.3.2	checks runway in use and approach procedure	Ops. Manual	PF/PNF	
5.3.3	sets the FMS accordingly	Ops. Manual	PNF	
5.3.4	checks landing weight and landing distance required	Ops. Manual	PNF	
5.3.5	checks MEA, MGA and MSA	Ops. Manual	PF/PNF	
5.3.6	identifies top of descent point	Ops. Manual	PF	
5.3.7	conducts relevant briefings	Ops. Manual	PF	
5.4	**Perform systems operations and procedures**			satisfactory/unsatisfactory
5.4.1	monitors operation of all systems	Ops. Manual	PF/PNF	
5.4.2	operates systems as required	Ops. Manual	PNF	
5.5	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
5.5.1	identifies the abnormal condition	Ops. Manual	PF/PNF	

			Reference	Duty	Observation & assessment
	5.5.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
	5.5.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
5.6	**Communicate with cabin crew, passengers and company**				satisfactory/unsatisfactory
	5.6.1	communicates relevant information to cabin crew	Ops. Manual	PF	
	5.6.2	communicates relevant information to company	Ops. Manual	PF/PNF	
	5.6.3	makes passenger announcements when appropriate	Ops. Manual	PF	
6.	**PERFORM DESCENT** List of competency elements and performance criteria				
6.0	**Recognize and manage potential threats and errors**				
6.1	**Initiate and manage descent**				satisfactory/unsatisfactory
	6.1.1	starts descent according to ATC clearance or optimum descent point	Ops. Manual	PF	
	6.1.2	selects optimum speed and descent rate	Ops. Manual	PF	
	6.1.3	adjusts speed to existing environmental conditions	Ops. Manual	PF	
	6.1.4	recognizes the need to adjust the descent path	Ops. Manual	PF	
	6.1.5	adjusts the flight path as required	Ops. Manual	PF	
	6.1.6	utilizes all means of FMS descent information	Ops. Manual	PF	
6.2	**Monitor and perform en-route and descent navigation**				satisfactory/unsatisfactory
	6.2.1	complies with arrival clearance and procedures	Ops. Manual	PF	
	6.2.2	demonstrates terrain awareness	Ops. Manual	PF/PNF	
	6.2.3	monitors navigation accuracy	Ops. Manual	PF/PNF	
	6.2.4	adjusts flight to weather and traffic conditions	Ops. Manual	PF	
	6.2.5	communicates and coordinates with ATC	Ops. Manual	PNF	
	6.2.6	observes minimum altitudes	Ops. Manual	PF/PNF	
	6.2.7	selects appropriate level/mode of automation	Ops. Manual	PF	
	6.2.8	complies with altimeter setting procedures	Ops. Manual	PF/PNF	
6.3	**Replanning and update of approach briefing**				satisfactory/unsatisfactory
	6.3.1	rechecks destination weather and runway in use	Ops. Manual	PNF	
	6.3.2	briefs/rebriefs about instrument approach and landing as required	Ops. Manual	PF	
	6.3.3	reprogrammes the FMS as required	Ops. Manual	PNF	
	6.3.4	rechecks fuel status	Ops. Manual	PF/PNF	
6.4	**Perform holding**				satisfactory/unsatisfactory
	6.4.1	identifies holding requirement	Ops. Manual	PF/PNF	
	6.4.2	programmes FMS for holding pattern	Ops. Manual	PNF	

		Reference	*Duty*	*Observation & assessment*
6.4.3	enters and monitors holding pattern	Ops. Manual	PF	
6.4.4	assesses fuel requirements and determines max. holding time	Ops. Manual	PF/PNF	
6.4.5	reviews the need for a diversion	Ops. Manual	PF/PNF	
6.4.6	initiates diversion	Ops. Manual	PF	
6.5	**Perform systems operations and procedures**			satisfactory/unsatisfactory
6.5.1	monitors operation of all systems	Ops. Manual	PF/PNF	
6.5.2	operates systems as required	Ops. Manual	PF/PNF	
6.6	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
6.6.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
6.6.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
6.6.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
6.7	**Communicate with cabin crew, passengers and company**			satisfactory/unsatisfactory
6.7.1	communicates relevant information to cabin crew	Ops. Manual	PF	
6.7.2	communicates relevant information to company	Ops. Manual	PF/PNF	
6.7.3	makes passenger announcements when appropriate	Ops. Manual	PF	
7.	**PERFORM APPROACH** List of competency elements and performance criteria			
7.0	**Recognize and manage potential threats and errors**			
7.1	**Perform approach in general**			satisfactory/unsatisfactory
7.1.1	executes approach according to procedures and situation	Ops. Manual	PF	
7.1.2	selects appropriate level/mode of automation	Ops. Manual	PF	
7.1.3	selects optimum approach path	Ops. Manual	PF	
7.1.4	operates controls smoothly and with coordination	Ops. Manual	PF	
7.1.5	performs speed reduction and flap extension	Ops. Manual	PF/PNF	
7.1.6	performs relevant checklists	Ops. Manual	PF/PNF	
7.1.7	initiates final descent	Ops. Manual	PF	
7.1.8	achieves stabilized approach criteria	Ops. Manual	PF	
7.1.9	ensures adherence to minima	Ops. Manual	PF/PNF	
7.1.10	initiates go-around if required	Ops. Manual	PF	
7.1.11	masters transition to visual segment	Ops. Manual	PF	
7.2	**Perform precision approach**			satisfactory/unsatisfactory
7.2.1	performs ILS approach	Ops. Manual	PF	
7.2.2	performs low visibility ILS CAT II/III approach	Ops. Manual	PF	
7.2.3	performs PAR approach	Ops. Manual	PF	

		Reference	Duty	Observation & assessment
7.2.4	performs GPS/GNSS approach	Ops. Manual	PF	
7.2.5	performs MLS approach	Ops. Manual	PF	
7.3	**Perform non-precision approach**			satisfactory/unsatisfactory
7.3.1	performs VOR approach	Ops. Manual	PF	
7.3.2	performs NDB approach	Ops. Manual	PF	
7.3.3	performs SRE approach	Ops. Manual	PF	
7.3.4	performs GPS/GNSS approach	Ops. Manual	PF	
7.3.5	performs ILS loc approach	Ops. Manual	PF	
7.3.6	performs ILS back beam approach	Ops. Manual	PF	
7.4	**Perform approach with visual reference to ground**			satisfactory/unsatisfactory
7.4.1	performs standard visual approach	Ops. Manual	PF	
7.4.2	performs circling approach	Ops. Manual	PF	
7.5	**Monitor the flight progress**			satisfactory/unsatisfactory
7.5.1	ensures navigation accuracy	Ops. Manual	PF/PNF	
7.5.2	communicates with ATC and crew members	Ops. Manual	PNF	
7.5.3	monitors fuel status	Ops. Manual	PF/PNF	
7.6	**Perform systems operations and procedures**			satisfactory/unsatisfactory
7.6.1	monitors operation of all systems	Ops. Manual	PF	
7.6.2	operates systems as required	Ops. Manual	PF	
7.7	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
7.7.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
7.7.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
7.7.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
7.8	**Perform go-around/missed approach**			satisfactory/unsatisfactory
7.8.1	initiates go-around procedure	Ops. Manual	PF	
7.8.2	navigates according to missed approach procedure	Ops. Manual	PF	
7.8.3	completes the relevant checklists	Ops. Manual	PF/PNF	
7.8.4	initiates approach or diversion after the go-around	Ops. Manual	PF	
7.8.5	communicates with ATC and crew members	Ops. Manual	PNF	
7.9	**Communicate with cabin crew, passengers and company**			satisfactory/unsatisfactory
7.9.1	communicates relevant information to cabin crew	Ops. Manual	PF	
7.9.2	communicates relevant information to company	Ops. Manual	PF/PNF	
7.9.3	makes passenger announcements when appropriate	Ops. Manual	PF	

		Reference	*Duty*	*Observation & assessment*
8.	**PERFORM LANDING** List of competency elements and performance criteria			
8.0	**Recognize and manage potential threats and errors**			
8.1	**Land the aircraft**			satisfactory/unsatisfactory
8.1.1	maintains a stabilized approach path during visual segment	Ops. Manual	PF	
8.1.2	recognizes and acts on changing conditions for wind shift/wind shear segment	Ops. Manual	PF	
8.1.3	initiates flare	Ops. Manual	PF	
8.1.4	controls thrust	Ops. Manual	PF	
8.1.5	achieves touchdown in touchdown zone on centre line	Ops. Manual	PF	
8.1.6	lowers nose wheel	Ops. Manual	PF	
8.1.7	maintains centre line	Ops. Manual	PF	
8.1.8	performs after-touchdown procedures	Ops. Manual	PF	
8.1.9	makes use of appropriate braking and reverse thrust	Ops. Manual	PF	
8.1.10	vacates runway with taxi speed	Ops. Manual	PF	
8.2	**Perform systems operations and procedures**			satisfactory/unsatisfactory
8.2.1	monitors operation of all systems	Ops. Manual	PF	
8.2.2	operates systems as required	Ops. Manual	PF	
8.3	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
8.3.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
8.3.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
8.3.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
9.	**PERFORM AFTER-LANDING AND POST-FLIGHT OPERATIONS** List of competency elements and performance criteria			
9.0	**Recognize and manage potential threats and errors**			satisfactory/unsatisfactory
9.1	**Perform taxi-in and parking**			satisfactory/unsatisfactory
9.1.1	receives, checks and adheres to taxi clearance	Ops. Manual	PNF	
9.1.2	taxis the aircraft including use of exterior lighting	Ops. Manual	PF	
9.1.3	controls taxi speed	Ops. Manual	PF/PNF	
9.1.4	maintains centre line	Ops. Manual	PF	
9.1.5	maintains lookout for conflicting traffic and obstacles	Ops. Manual	PF	
9.1.6	identifies parking position	Ops. Manual	PF/PNF	
9.1.7	complies with marshaller/stand guidance	Ops. Manual	PF/PNF	
9.1.8	applies parking and engine shut-down procedures	Ops. Manual	PF	

		Reference	*Duty*	*Observation & assessment*
9.1.9	completes with relevant checklists	Ops. Manual	PF/PNF	
9.2	**Perform aircraft post-flight operations**			satisfactory/unsatisfactory
9.2.1	communicates with ground personnel and crew	Ops. Manual	PF	
9.2.2	completes all required flight documentation	Ops. Manual	PF/PNF	
9.2.3	ensures securing of the aircraft	Ops. Manual	PF	
9.2.4	conducts the debriefings	Ops. Manual	PF	
9.3	**Perform systems operations and procedures**			satisfactory/unsatisfactory
9.3.1	monitors operation of all systems	Ops. Manual	PF/PNF	
9.3.2	operates systems as required	Ops. Manual	PF/PNF	
9.4	**Manage abnormal and emergency situations**			satisfactory/unsatisfactory
9.4.1	identifies the abnormal condition	Ops. Manual	PF/PNF	
9.4.2	interprets the abnormal condition	Ops. Manual	PF/PNF	
9.4.3	performs the procedure for the abnormal condition	Ops. Manual	PF/PNF	
9.5	**Communicate with cabin crew, passengers and company**			satisfactory/unsatisfactory
9.5.1	communicates relevant information to cabin crew	Ops. Manual	PF	
9.5.2	communicates relevant information to company	Ops. Manual	PF/PNF	
9.5.3	makes passenger announcements when appropriate	Ops. Manual	PF	

— — — — — — — —

Appendix 3 to Chapter 3
GUIDELINES FOR THE IMPLEMENTATION OF THE MULTI-CREW PILOT LICENCE

1. Introduction

The introduction of the multi-crew pilot licence (MPL) provides for the training of pilots directly for co-pilot duties making greater use of modern training devices such as the flight simulator. The ICAO Standards for the MPL specify the minimum number of actual and simulated flight hours (240) but do not specify the breakdown between actual and simulated. This allows part of the training curriculum that was traditionally conducted on an aeroplane to now be done on flight simulation training devices. While the airline industry has acquired considerable experience in the use of flight simulation training devices, the use of such devices in the early phase of airline pilot training has been limited. These guidelines provide guidance to States and Approved Training Organizations (ATOs) on the measures that could be taken to facilitate safe and efficient implementation of the new MPL Standards.

2. General considerations

2.1 The level of competency expected from the MPL holder is defined in detail in Annex 1 and this document. In broad terms, the MPL holder is expected to complete the airline Initial Operational Experience phase (IOE) with high probability of success and within the time frame normally allowed for this phase. It is similar to what is expected today from graduates from the ab initio training programme who have completed their type rating training.

2.2 The general approach that is therefore suggested is to use the existing training programme (ab initio or equivalent) of the ATO as a reference and to progressively implement the new training programme allowed by the MPL, particularly the transfer from actual flight to simulated flight.

2.3 This transfer shall be made in a progressive manner whereby successive evolutions of the training programme progressively introduce a higher level of simulated flight and a reduction of actual flight. Change from one level to the next should only take place after enough experience has been gained and once its results, including the IOE, have been analysed and taken into account.

2.4 The exchange of information between Licensing Authorities, ATOs and airlines involved in MPL training should be encouraged.

3. Guidelines for the authority

3.1 a) The implementation of the MPL requires the development of an approved training programme that blends the various types of training (knowledge and practical) with

the media (classroom, various level of simulation and aeroplane). Only ATOs that are familiar with ab initio training or airline training should be considered, at least initially.

b) In view of the developmental nature of the first MPL course in each ATO, the approval should be provisional and should be confirmed only after obtaining a satisfactory result from the first course and after incorporation into the curriculum of lessons learned.

c) All the applicable Standards related to ATOs (Annex 1, Appendix 2) shall apply and all associated guidance material should apply, in particular those dealing with approval of the curriculum and quality assurance system.

d) MPL courses shall be competency-based. One of the attributes of competency-based training, as defined in this document, is the use of a continuous evaluation process to ensure the effectiveness of the training and its relevance to line operations. This aspect of continuous evaluation is especially important during the initial implementation of an MPL course.

e) Close oversight by the Licensing Authority shall be exercised during the initial phase. The need for regular feedback from the ATO to the Licensing Authority on the progress and problems faced during delivery of the course is important. How this feedback is to be provided to the Authority shall therefore be clearly stated as part of the approval.

f) The ATO shall furnish the Licensing Authority with de-identified information concerning each phase of evaluation for each student during and following the programme, including any corrective action found to be necessary. The Licensing Authority shall make this information available to ICAO upon request for the purpose of evaluating the MPL programme on a periodic basis.

g) The success of the implementation of the MPL depends to a large measure on the effective coordination and cooperation between the Licensing Authority, the ATO and the airlines hiring the graduates and pilot representative bodies. Licensing Authorities should encourage and facilitate such cooperation and coordination.

— — — — — — — —

Attachment A to Chapter 3
COMPETENCY-BASED TRAINING AND LICENSING FOR THE MULTI-CREW PILOT LICENCE — GUIDANCE ON THE DESIGN AND DEVELOPMENT OF A MULTI-CREW PILOT LICENCE TRAINING PROGRAMME

1. Introduction

This Attachment to Chapter 3 provides a description of the application of the principles and procedures of the ICAO course development methodology in the development of an MPL training programme. A description of the structure of the MPL training programme, as established in Annex 1, is provided, followed by a detailed description of the application of the different phases of the ICAO course development methodology in the development of an MPL training programme.

2. Structure of the MPL training programme

2.1 The MPL training scheme is contained in Appendix 1 to Chapter 3. The training items listed under the ***Core Flying Skills and Basic*** levels of training must be completed prior to entering the Intermediate phase of training. These first two phases of training are of the utmost importance as the student starts to develop core technical, interpersonal, procedural and aircraft-handling skills that underpin the competencies of an MPL. The learning of cockpit resource management (CRM) and threat and error management (TEM) skills is also strengthened by introducing them at the very beginning of the programme.

2.2 At the **Basic** level of competency, training on an aeroplane includes upset prevention and recovery and instrument flight. However, starting with this phase of training, use of flight simulation training devices (FSTDs), ranging from part-task training devices, through generic systems to full-motion, full-visual, high-fidelity, type-specific flight simulators that also permit the introduction of interactive air traffic control environments, will begin to dominate the training. Emphasis should be placed equally on both Pilot Flying and Pilot Not Flying tasks and performance in the training conducted during the Basic, Intermediate and Advanced phases of training.

2.3 The flight training received in the **Intermediate** phase should be conducted under IFR but need not be specific to any aeroplane type. Upon completion of this phase of training, the student should meet the competency standards representative of the Intermediate level.

2.4 At the **Advanced** level of competency, the student will be required to consistently demonstrate the knowledge, skills and attitudes needed for the safe operation of an applicable aeroplane type as specified in the terminal training objectives of the course and their corresponding performance criteria. Upon qualifying, the student will hold an MPL and integral type and instrument ratings, the privileges of which are to be exercised on a turbine-powered, commercial air transport aeroplane.

2.5 The nine competency units for the MPL are listed in Annex 1, Appendix 3, paragraph 3.1. The competency elements into which the units have been broken down and the performance criteria, which have been established against each of the competency elements, are contained in Appendix 2 to Chapter 3. For the purpose of the Standard, TEM is established as a competency unit independent of the other eight units that each correspond to a phase of flight. For the purpose of training and testing, however, the TEM competency should be considered an integral feature of all the other phase-of-flight competencies.

3. Design and development of an MPL training programme through ICAO course development methodology

3.1 Methodological principles

There are three principal activities in the ICAO course development methodology process: analysis, design and production and evaluation; each activity is broken down into three phases (Attachment to Chapter 2 refers).

3.2 Preliminary study

3.2.1 At a meeting between the aviation industry and the ICAO Air Navigation Commission (ANC) in 1997, a problem with the levels of competency of flight crew members was identified. In addition, the safety oversight audits conducted by ICAO had shown that very few States had formalized criteria for judging performance in licensing examinations or for demonstrating maintenance of competency as required by Annex 6. As a result, the ANC agreed that a ***preliminary study*** of current systems of training and an evaluation of the practicability of developing criterion-referenced training and performance standards for the licensing of flight crew should be carried out.

3.2.2 The preliminary study, which was conducted in 2000, confirmed that ICAO licensing and training Standards and associated national regulations had not kept up with developments in training methodologies and new training and aircraft technologies. Among the proposed solutions was the development of a new airline-oriented, multi-crew pilot licence and the development of competency-based licensing and training requirements for inclusion in Annex 1.

3.3 Functional/task analysis

3.3.1 The MPL training programme aims to qualify a candidate for the *job* of co-pilot on a turbine-engined commercial air transport aeroplane. The qualifications needed to perform the job of a co-pilot and the duties and responsibilities are contained in an operator's Operations Manual. Jobs can be broken down into *functions* and, in turn, functions into *tasks* and *sub-tasks*. Each sub-task might be further broken down into *task elements* (*steps*), i.e. activities that must be done in order to complete the sub-task.

3.3.2 The functional/task analysis conducted for the purpose of developing the Standards for the MPL identified nine functions (competency units) that were further broken down into a

number of tasks (competency elements). For example, the competency unit — *perform take-off* — qualifies as a function and the competency element — *perform take-off roll* — can be defined as a task. Performance criteria established against each of the competency elements contain the sub-tasks that must be carried out in order to perform the competency element, e.g. advancing the thrust levers.

3.3.3 The functional/task analysis carried out in the development of the Annex 1 Standards for the MPL provides much of the information needed by States and flight training organizations for the design and approval of training curricula. There will, however, be a need to amplify the analysis in order to provide for training in and assessment of the Core Flying Skills, Basic, Intermediate and Advanced phases of training. In addition, in order to design training around a specific task step (e.g. the operation of the flight management computer), a more in-depth analysis may need to be conducted on the sub-task in question.

3.4 Population analysis

Training for the MPL is designed for a target population of ab initio candidates who need not have had any flying experience prior to being selected for the course. Contracting States should define the qualifications, in terms of the skills, knowledge and attitudes, required for meeting the entry levels for the course and should ensure that an appropriate corresponding selection method is in place. If training is to be effective, it will also be necessary to identify and cater for the different learning modes that are prevalent in the target population.

3.5 Curriculum design

3.5.1 Training for the MPL passes through four phases of training and levels of competency (i.e. Core Flying Skills, Basic, Intermediate, and Advanced levels of competency), during which the student's training progresses from single-engine aeroplane to multi-engine turbine aeroplane and multi-crew operations and the issuance of a type rating. Prior to passing from one level to the next, the student must have demonstrably met the training objectives established for each phase of training. Upon exit from the Advanced phase of training and qualification for the MPL, the student must have met the required levels of performance needed to complete all nine of the competency units developed for the MPL.

3.5.2 The competency units and elements that comprise the Annex 1 Standards provide the overall competency-based training framework and are reflected in the training objectives developed for each phase of training and level of competency.

3.5.3 Curriculum design starts with the formulation of performance objectives. Since, in the case of the MPL, the objectives are to evaluate the effectiveness of training, they should be referred to as ***training*** objectives. In the design of a training curriculum, the overall ***goals*** of the training programme and the ***training objectives*** correspond, respectively, to the functions and tasks identified by the MPL functional/task analysis.

3.5.4 In the MPL training course, the terminal objectives should define what the student needs to demonstrate, in terms of skills, knowledge and attitudes (SKAs), at the Core Flying Skills, Basic, Intermediate and Advanced levels of competency. For these levels of training, the student must successfully achieve all the relevant mastery tests in order to

meet the objectives and reach the corresponding level of competency. Since, at the Advanced level of competency, the terminal objectives define what must be accomplished at the end of the entire course of training, they therefore reflect the performance criteria established against each of the competency elements for the licence.

3.5.5 There will be a need to administer key progress tests to ensure that the student has acquired the necessary SKAs. Students who fail a progress test should receive remedial training until such time as they have mastered that particular module.

3.6 Developing MPL training objectives

3.6.1 As described in Chapter 2, a training objective states the (observable) ***desired action*** or ***behaviours***, the (measurable) ***standard*** and the ***conditions*** relevant to what must be accomplished by the student during each phase of training prior to reaching the desired level of competency. Sample training objectives are contained in Attachment B to Chapter 3. Included with each sample objective is a sample assessment guide and an example of the application of threat and error management.

3.6.2 The ***action statement*** or the ***statement of behaviours***, the most important part of the training objective, should always be expressed with a verb that specifies definite, observable actions. The competency elements and performance criteria found in Appendix 2 to Chapter 3 provide useful sources of suitable action verbs. Action verbs have also been developed in other learning/training objective taxonomies (Bloom, B.S (1956); Harrow, A. (1972) and Simpson, E. (1972)). Since these classifications were developed for general education purposes, however, they should only be used when a more domain-specific verb, from either the MPL functional/task analysis or other similar flight training task analysis, is not available.

3.6.3 Action verbs can be classified according to the different tasks or skills, knowledge and attitudes they represent, which facilitates the development of an effective and efficient learning path. Training organizations should choose or develop the classification that best suits their own circumstances. As described in Chapter 2, the ICAO course development methodology proposes two basic categories, i.e. *intellectual* and *physical (motor)* skills; intellectual skills can be further broken down into *classifying, discriminating*, *rule-using* and *problem-solving* sub-skills.

3.6.4 Where an action verb has to be used to define a skill to infer a non-observable process, as is often the case when assessing cockpit resource management (CRM) and threat and error management (TEM), an overt or observable synonym should be used as evidence that the process has been carried out. (See also Attachment B to Chapter 3 that describes how evidence of the application of TEM can be collected.)

3.6.5 A training objective should clearly identify the ***conditions*** under which an action must be performed. Conditions consist of the training equipment on which training or assessment is being conducted (e.g. flight simulator training device), the meteorological/environmental factors, aircraft configuration, operational factors and regulatory framework. Simulator training affords an opportunity for instructors and examiners to select and manipulate the conditions under which the training and assessment of competencies take place. Conditions relevant to particular training objectives may be selected for the training or assessment of specific skills, knowledge and attitudes. The conditions included in a training objective at the Advanced level of competency will reflect the range of variables developed by the Licensing Authority.

3.6.6 Training objectives will determine the design of the exercises and other units of training around which an MPL curriculum is constructed. They should be designed to facilitate the training and testing of CRM and TEM behaviours as integral features of each of the phase-of-flight competency units. Training with the aid of flight training devices presents opportunities for structuring training objectives so that the included activities and conditions address the behaviours to be trained and tested.

3.6.7 The training objective ***standard*** contains the criteria against which a student's performance is evaluated. In the case of the terminal objectives, these reflect the performance criteria developed against each of the MPL competency elements. Licensing Authorities should ensure that these performance criteria are used in the preparation of assessment guides or practical test standards for the MPL. The standard will reflect the level of performance expected at each of the competency levels of the MPL training schedule.

3.6.8 Training objective standards may be stated in the form of tolerances, constraints, limits, performance rates or qualitative statements. Where these criteria are contained in approved documents such as regulations, operating manuals, and checklists, only a reference to such documents in the standard section of the objective is needed.

3.6.9 In many instances, the action statement or statements of desired performance contained in training objectives established at different levels of competency can be exactly the same. The conditions under which the action is to be performed and/or the standard against which it is to be judged, however, will get increasingly more complex and difficult as the student advances through the different phases of training. This is reflected in the sample training objectives at Attachment B, which all relate to the same behaviours — perform take-off roll — but differ in terms of the conditions and standards under which and in accordance with the behaviour or action is to be demonstrated.

3.6.10 Once training objectives have been developed, they must be sequenced and grouped into the training modules that make up the different phases of the training schedule. A number of principles apply to the sequencing of training objectives. Generally speaking, a logical approach is to follow the order in which the related tasks are carried out in the operational environment. This is, in fact, reflected in the manner in which the phase- of-flight competency units for the MPL have been ordered. Other considerations, however, such as the differences or commonalities between objectives in terms of the tasks involved, their levels of difficulty and the complexity of the conditions under which the actions have to be carried out, also come into play.

3.6.11 A number of rules usually apply, e.g. objectives that are typical/standard/normal come before objectives that are atypical/non-standard/abnormal and, in the learning sequence, objectives that are simple, easy, and with low task loads come before those that are complex, difficult and with high task loads. These rules, in general, govern the design of instructional materials contained in the modules and phases of training of the MPL programme.

3.6.12 After defining the training objectives, the MPL course developer will design the tests that need to be passed by the student at different points in the programme. With respect to the MPL programme, ***mastery tests*** are those tests that correspond to terminal objectives. Additional ***progress tests*** may be developed for the purpose of providing feedback on the student's progress towards achieving both the terminal objectives and the key enabling objectives. The aim of designing the mastery tests at this stage in the

development of the programme, and prior to determining the actual content of the training, is to ensure that the test, and subsequently the content of the training, strictly correspond to the training objectives and to what the student is actually expected to do on the job.

3.6.13 All tests developed for the MPL, whether mastery or progress tests, should be *criterion-referenced* tests; the criteria used to measure competence should be published in assessment guides and/or practical test standards. All tests must be reliable and valid, both in terms of being an appropriate measure of the competency being tested and of obtaining consistent results with different raters and ratings.

3.7 Design of training modules

3.7.1 Upon sequencing and grouping the training objectives and designing the mastery and progress tests, the course developer will design the training units that constitute a training curriculum for the MPL. As defined in the ICAO course development methodology, the basic building block in this process is the ***module***. Each phase of the MPL training scheme, i.e. the Core Flying Skills, Basic, Intermediate and Advanced phases of training, will consist of a number of building blocks of instruction or modules which, in turn, contain the instructional events used for training. In line with the ICAO course development methodology, the module is structured so that the training objectives are presented at the very beginning of the module, and instructional events in respect to the presentation of content, the provision of practice and feedback and the assessment of achievement follow in logical order.

3.7.2 For the purpose of achieving the enabling objectives at the early phases of training, instructional events should be designed as varied and simplified versions of airline operational activities. During later phases of training and corresponding levels of competency, instructional events can then be designed to increasingly reflect the complexity of operational activities.

3.8 Selection of modes of delivery and training techniques

3.8.1 The training objectives will determine the modes of delivery and training techniques that are to be used in the different phases of training. The consistent delivery of training for the MPL demands the use of a mixture of validated, approved training materials. In accordance with Annex 1, 1.2.8, and Appendix 2, all MPL training should be conducted by an approved training organization, and conditions for obtaining the authorization should include having the necessary documentation, manuals and equipment for conducting the course. The approval requirements also cover the employment and training of course developers and instructors. Chapter 4 contains the competency-based requirements for instructors, examiners, inspectors and course developers.

3.8.2 In respect to training techniques, training for the MPL should require both individualized and group instruction depending on the training tasks being carried out. Classroom instruction can be delivered with the aid of group lectures and individualized learning. Practice on part-tasks can be carried out by individual students working with computerized-based training or e-learning programmes. Training activities on flight simulation training devices (FSTDs) will entail the pairing up of two students into “flight crew”, with each student alternately carrying out Pilot Flying and Pilot Not Flying activities.

3.9 Scenario-based training/Event-set-based training

3.9.1 A training technique that has in recent years gained currency in proficiency-based flight training programmes is ***scenario-*** or ***event-set***-based training. In scenario-based training, module lessons and exercises are organized into a number of scenarios. These scenarios provide the context of the lesson or exercise, in terms of a set of cues or occurrences (***events)*** and conditions, specifically designed for training or assessing the training objectives. Typically, designing a scenario takes into consideration factors such as the type of flight training device to be used and the level of its fidelity, type and length of training activity, complexity of meteorological conditions, level of workload and the nature of the events to be introduced.

3.9.2 Each change in the state of a system or in the environment can be termed an event. Events may therefore include any occurrence such as engine start-up, engine failure, a microburst on short final, erroneous steering commands by the flight management system or the sudden incapacitation of the pilot-in-command. An event may be brought about through the actions of the student or by external phenomena to which the student will have to respond. Events can also be designed as triggers that activate situations (such as an ATC clearance or an error in entering navigational coordinates into the flight management computer (FMC)) to which the student has to respond and can include distractors or conditions that deliberately divert the pilot's attention or increase workload. In the context of TEM, events may be benign or threatening and may also result from a failure to effectively manage error.

3.9.3 The use of FSTDs makes possible a wide range of options in respect to the design of the exercises, events and scenarios that go to make up the training modules included in the different phases of training for the MPL. The Course Developer should, however, always ensure that they are designed in such a manner as to effectively meet the specific training objectives that have been set. As training progresses through the different phases, it is also to be expected that scenarios will become increasingly complex and will reflect more closely actual operational conditions and activities.

3.9.4 Scenario-based training has the advantages that it provides:

a) easier and more reliable criterion-referenced evaluations;

b) more effective control over the behaviours that need to be demonstrated through the selection of occurrences and conditions against which the student has to perform; and

c) a structured design process for integrating the training and testing of both CRM and TEM competencies and the technical phase-of-flight competencies.

3.9.5 The design of training scenarios can be very labour-intensive and, as such, it may not be possible for a sufficiently wide range of them to be developed for training and testing purposes. A restricted number of scenarios used repetitively will result in ineffective training and testing. Course Developers may therefore make use of a number of software packages offering tools for the rapid development and reconfiguration of scenarios. One

such package* also allows for specific conditions relating to workload (time pressure) and distractors (e.g. radio chatter) to be programmed into the scenario. Other conditions, such as meteorological factors and runway conditions, can also be programmed.

3.10 Selection of training media

3.10.1 In general, the selection of media, as described in the ICAO course development methodology (Attachment to Chapter 2 refers) depends on its instructional appropriateness, economy, simplicity and availability. All facilities and training media should be considered by the Licensing Authority as being acceptable and appropriate for an MPL training course as part of the process of the approval of a training organization, in accordance with Annex 1, 1.2.8, and Appendix 2.

3.10.2 The range includes e-training and computer-based part-task training (Type I) devices to full motion, Level D (Type IV) flight simulators. The Type III FSTD must permit the progressive introduction of a sophisticated flight environment including ATC, flight guidance systems, EFIS, FMS and TCAS. All FSTDs should be qualified in accordance with State requirements and approved by the Licensing Authority as being appropriate to the task for which they are being used. Specifications to be used for the qualification of simulators are defined in JAR STD 1A (as amended) and in FAA AC 120-40B and the Alternate Means of Compliance (AMOC), as permitted, in AC 120-40B. Guidance on the qualification of simulators is found in the *Manual of Criteria for the Qualification of Flight Simulators* (Doc 9625).

3.10.3 A definition of the different types of FSTDs to be used for training for the MPL is contained in Annex 1, Appendix 3, paragraph 4. Their allocation to the different phases of training is indicated in the MPL training scheme contained in Appendix 1 to Chapter 3 of this document.

3.11 Production, developmental testing, validation, implementation and evaluation

3.11.1 The guidance provided up to this point has addressed the processes outlined for Phases 1 through 5 of the ICAO course development methodology and is specific to a training programme for the MPL. However, the process involved for the remaining Phases 6 through 9 in the development of an MPL training programme presents a few elements that also require attention.

3.11.2 As outlined in the Attachment to Chapter 2, the output of Phase 6 results in all training materials being produced in such a manner as to allow any competent instructor to deliver the course. Consequently, a comprehensive, well-documented and formatted MPL training programme does not differ from any other standardized training package.

3.11.3 Developmental testing is another important feature of Phase 6. In particular, mastery tests should go through developmental testing to ensure that they are valid and reliable.

* The Rapid Reconfigurable Event-Set Based Line-Oriented Evaluations (RRLOE) programme was developed by the University of Central Florida, U.S.A., for the purpose of ensuring valid and reliable flight crew evaluations under the FAA's Advanced Qualification Programme. The software enables the rapid building or reconfiguring of events and scenarios for the purposes of training and testing. Additional information on the RRLOE programme can be found at http://pegasus.cc.ucf.edu/~rrloe.

In the case of the MPL training programme, this would include developmental testing of scenario-based mastery tests to ensure that they actually match the corresponding training objective. Again, this procedure does not differ for the MPL training programme.

3.11.4 The purpose of validation (i.e. ICAO course development Phase 7) is to ensure that the MPL training materials can effectively guide trainees to the successful performance of mastery tests leading to the issuance of an MPL. In respect to the MPL training programme, this procedure does not differ from other ICAO competency-based course materials.

3.11.5 Once the course materials have been validated and revised as necessary, the MPL training programme can be implemented (Phase 8 of the ICAO course development methodology). However, successful implementation will depend on the qualifications of the instructors delivering the material. To this end, approved training organizations should ensure that instructors and examiners for the MPL training programme meet the competencies described in Chapter 4.

3.11.6 Post-training evaluation is the last phase of the ICAO course development methodology. In the Attachment to Chapter 2, four levels of evaluation are described. Trainee reactions to the MPL training programme (Level 1) and trainee mastery of objectives (Level 2) will be recorded as a matter of course, given the provisions described in the *Manual on the Approval of Flight Crew Training Organizations* (Doc 9841) and the use of the ISD approach in training development. Evaluation at Level 3 calls for the description of the on-the-job performance of trainees and how it effectively meets the standard spelled out during task analysis. This particular level of evaluation will normally be carried out during the IOE phase that MPL holders will have to go through upon completion of the MPL training programme. The purpose of evaluation at Level 4 is to determine the effects of the training programme at an organizational level. This level of evaluation could be used to determine the extent to which the adoption of an MPL training programme has actually resolved organizational issues (shortage of pilots, economies of time, cost benefits, etc.) and to determine and review an organization's strategic planning accordingly.

— — — — — — — —

Attachment B to Chapter 3
MULTI-CREW PILOT LICENCE
SAMPLE TRAINING OBJECTIVES

1. Sample Training Objective, *Perform take-off roll*, established at the Core Flying Skills Level of the MPL Training Scheme

	Condition	Behaviour	Standard
Terminal Objective	Single-engine aeroplane Single-pilot operation Normal procedures Day VFR operations below 10 000 feet AMSL VMC crosswind/headwind/tailwind within aeroplane limits	Perform take-off roll	Flight Manual/take-off charts/approved checklists HF Training Manual/ threat and error countermeasures Assessment Guide* AIP/National regulations/legislation
Enabling Objective 1	As above	Apply take-off power	As above
Enabling Objective 2		Maintain aeroplane direction	
Enabling Objective 3		Control yaw	
Enabling Objective 4		Check engine instruments	
Enabling Objective 5		Manage threats and errors	

* Sample Assessment Guides are provided for each training objective.

Assessment Guide

Element	Evidence	TEM Countermeasures
Perform take-off roll	➢ Line-up checks are completed ➢ Brakes are released ➢ Take-off power is smoothly and fully applied ➢ Aeroplane direction is maintained on runway ➢ Flight and engine instruments are checked and responded to during the take-off roll	➢ Aircraft position and settings are verified ➢ Airport and taxiway charts are used (if applicable) ➢ Clearances are understood and accurately read back ➢ Into wind aileron is raised (as applicable to crosswind) ➢ Excessive pressure on nose wheel is avoided ➢ Yaw is controlled ➢ Task fixation is avoided; tasks are effectively prioritized

Threat and Error Management

Example — Line-up checks completed

Threat: ATC call to give clearance interrupted checklist
Error: Pilot skipped checklist items — Line-up check is not completed
Undesired Aircraft State: Aircraft is lined up for take-off roll with pitot heat off

Examples of use of available resources (countermeasures) to manage the threat/undesired aircraft state

- Task fixation avoided (keep finger in checklist item until checklist is re-started)
- Aircraft settings verified (start checklist all over again after clearance read back)
- Effective task prioritization (request ATC to hold clearance until checklist completed)

2. Sample Training Objective, *Perform take-off roll*, established at the Basic Level of the MPL Training Scheme

	Condition	Behaviour	Standard
Terminal Objective	Single-engine aeroplane and/or approved simulator — Type II – III (as applicable to multi-crew operation) VFR operations VMC, light rain, wet runway Crosswind/headwind/tailwind within aeroplane limits Normal procedures	Perform take-off roll	Flight Manual/pilot operating handbook/take-off charts/approved checklists Aircraft Technical Log Operations Manual HF Training Manual/ threat and error countermeasures Assessment Guide AIP/National regulations/legislation NOTAMs, MET forecasts
Enabling Objective 1	As above	Apply take-off power	As above
Enabling Objective 2		Maintain aeroplane direction	
Enabling Objective 3		Control yaw	
Enabling Objective 4		Check engine instruments	
Enabling Objective 5		Manage threats and errors	

Assessment Guide

Element	Evidence	TEM Countermeasures
Perform take-off roll	➢ Line-up checks are completed ➢ Brakes are released ➢ Take-off power is smoothly and fully applied ➢ Aeroplane direction is maintained on runway ➢ Flight and engine instruments are checked and responded to during the take-off roll	➢ Aircraft position, settings and crew actions (as applicable to multi-crew operations) are verified ➢ Airport and taxiway charts are used ➢ Clearances are understood and accurately read back ➢ Into wind aileron is raised (as applicable to crosswind) ➢ Excessive pressure on nose wheel is avoided ➢ Yaw is controlled ➢ Wet runway procedures are applied (as applicable) ➢ Task fixation is avoided; tasks are effectively prioritized ➢ Briefings are concise and not rushed

		➢ Decisions and actions are analysed and openly verified (as applicable to multi-crew operations) ➢ No hesitation in making queries and in speaking up (as applicable to multi-crew operations) ➢ Communicates and acknowledges plans and decisions; good crosstalk, flow of information is fluid (as applicable to multi-crew operations)

Threat and Error Management

Example — Aeroplane direction is maintained on the runway

Threat: Crosswind take-off
Error: PF did not turn aileron into the wind
Undesired Aircraft State: Aircraft starts take-off roll with flight controls incorrectly configured

Examples of use of available resources (countermeasures) to manage the threat/undesired aircraft state

- Aircraft settings and crew actions verified
- Task fixation avoided
- Into wind aileron raised
- Crew briefed
- PNF did not hesitate to query
- Actions openly verified

3. Sample Training Objective, *Perform take-off roll*, established at the Intermediate Level of the MPL Training Scheme

	Condition	Behaviour	Standard
Terminal Objective	Approved simulator (Type III – IV) Multi-crew operation IFR operations IMC, rain, slippery runway Night/high crosswind Low visibility/low ceiling	Perform take-off roll	Flight Manual/take-off charts/approved checklists Aircraft Technical Log Operations Manual HF Training Manual/ threat and error countermeasures Assessment Guide AIP/National regulations/ legislation Departure/approach charts NOTAMs, MET forecasts ATC clearance
Enabling Objective 1	As above	Apply take-off power	As above
Enabling Objective 2		Maintain aeroplane direction	
Enabling Objective 3		Control yaw	
Enabling Objective 4		Check engine instruments	
Enabling Objective 5		Manage threats and errors	

Assessment Guide

Element	Evidence	TEM Countermeasures
Perform take-off roll	➢ Line-up checks are completed ➢ Brakes are released ➢ Take-off power is smoothly and fully applied ➢ Aeroplane direction is maintained on runway ➢ Flight and engine instruments are checked and responded to during the take-off roll ➢ Automation anomalies are effectively captured	➢ Aircraft position, settings and crew actions are verified ➢ Automation setup is briefed to other crew members ➢ Airport and taxiway charts are used ➢ Clearances are understood and accurately read back ➢ Into wind aileron is raised (as applicable to crosswind) ➢ Excessive pressure on nose wheel is avoided ➢ Yaw is controlled ➢ Wet runway procedures are applied (as applicable) ➢ Task fixation is avoided; tasks are effectively prioritized ➢ Briefings are concise and not rushed

		➢ Decisions and actions are analysed and openly verified ➢ No hesitation in making queries and in speaking up ➢ Communicates and acknowledges plans and decisions; good crosstalk, flow of information is fluid

Threat and Error Management

Example — Brakes are released

Threat: ATC instructs to taxi into position and hold due to departing traffic in intersecting runway
Error: When take-off clearance is received, PF forgets to release brakes
Undesired Aircraft State: High-engine thrust is applied before brakes are released

Examples of use of available resources (countermeasures) to manage the threat/undesired aircraft state

- Aircraft settings and crew actions verified
- Task fixation avoided
- Communicated and actions analysed and openly verified
- Decisions and actions openly verified

4. Sample Training Objective, *Perform take-off roll*, established at the Advanced Level of the MPL Training Scheme

	Condition	Behaviour	Standard
Terminal Objective	Approved simulator (Type IV) Multi-crew operation IFR operations IMC, rain, wet runway Night/high crosswind Low visibility/low ceiling Engine failure prior to V_1 Maximum gross weight	Perform take-off roll	Flight Manual/take-off charts/approved checklists Aircraft Technical Log Operations Manual HF Training Manual/ threat and error countermeasures Assessment Guide AIP/National regulations/legislation Departure/approach charts NOTAMs, MET forecasts ATC clearance
Enabling Objective 1	As above	Apply take-off power	As above
Enabling Objective 2		Maintain aeroplane direction	
Enabling Objective 3		Control yaw	
Enabling Objective 4		Check engine instruments	
Enabling Objective 5		Manage threats and errors	

Assessment Guide

Element	Evidence	TEM Countermeasures
Perform take-off roll	➢ Line-up checks are completed ➢ Brakes are released ➢ Take-off power is smoothly and fully applied ➢ Aeroplane direction is maintained on runway ➢ Flight and engine instruments are checked and responded to during the take-off roll ➢ Automation anomalies are effectively captured ➢ Required rejected take-off procedures are followed	➢ Aircraft position, settings and crew actions are verified ➢ Automation setup is briefed to other crew members ➢ Airport and taxiway charts are used ➢ Clearances are understood and accurately read back ➢ Into wind aileron is raised (as applicable to crosswind) ➢ Excessive pressure on nose wheel is avoided ➢ Yaw is controlled ➢ Wet runway procedures are applied (as applicable) ➢ Brake cooling chart is used ➢ Task fixation is avoided; tasks are effectively prioritized ➢ Briefings are concise and not rushed

		➢ Decisions and actions are analysed and openly verified ➢ No hesitation in making queries and in speaking up ➢ Communicates and acknowledges plans and decisions; good crosstalk, flow of information is fluid

Threat and Error Management

Example — Required rejected take-off procedures are followed

Threat: Heavy weight, high speed, rejected take-off
Error: Flight crew taxies into apron following the RTO without checking brake cooling chart
Undesired Aircraft State: Aircraft with overheated brakes taxiing in the vicinity of other aircraft, vehicles and ramp personnel

Examples of use of available resources (countermeasures) to manage the threat/undesired aircraft state

- Briefing
- Use of brake cooling chart
- Aircraft settings and crew actions verified
- Communicated and actions analysed and openly verified
- Decisions and actions openly verified

— — — — — — — —

Attachment C to Chapter 3
THREAT AND ERROR MANAGEMENT (TEM)

1. General

1.1 Threat and error management (TEM) is an overarching safety concept regarding aviation operations and human performance. TEM is not a revolutionary concept; it evolved gradually, as a consequence of the constant drive to improve the margins of safety in aviation operations through the practical integration of Human Factors knowledge.

1.2 TEM developed as a product of the collective industry experience. Such experience fostered the recognition that past studies and, most importantly, operational consideration of human performance in aviation had largely overlooked the most important factor influencing human performance in dynamic work environments: the interaction between people and the operational context (i.e. organizational, regulatory and environmental) within which they discharge their operational duties.

1.3 The recognition of the influence of the operational context in human performance led to the conclusion that study and consideration of human performance in aviation operations must not be an end in itself. In regard to the improvement of margins of safety in aviation operations, the study and consideration of human performance without context address only part of a larger issue. TEM therefore aims to provide a principled approach to the broad examination of the dynamic and challenging complexities of the operational context in human performance, for it is the influence of these complexities that generates consequences directly affecting safety.

2. The Threat and Error Management (TEM) Model

2.1 The Threat and Error Management (TEM) Model is a conceptual framework that assists in understanding, from an operational perspective, the interrelationship between safety and human performance in dynamic and challenging operational contexts.

2.2 The TEM Model focuses simultaneously on the operational context and the people discharging operational duties in such context. The model is descriptive and diagnostic of both human and system performance. It is descriptive because it captures human and system performance in the normal operational context, resulting in realistic descriptions. It is diagnostic because it allows quantifying complexities of the operational context in relation to the description of human performance in that context, and vice versa.

2.3 The TEM Model can be used in several ways:

a) safety analysis tool — can focus on a single event, as is the case with accident/incident analysis, or can be used to understand systemic patterns within a large set of events, as is the case with operational audits.

b) licensing tool — helps clarify human performance needs, strengths and vulnerabilities, allowing the definition of competencies from a broader safety management perspective.

c) training tool — helps an organization improve the effectiveness of its training interventions and, consequently, of its organizational safeguards.

2.4 From a training perspective, the broadest application to date of the TEM Model is in flight crew human performance training, especially in Crew Resource Management (CRM) training, a widely implemented Human Factors-based training intervention. This may lead to questions about the relationship between TEM and CRM, and it is therefore essential to clarify potential confusions from the outset. The *Human Factors Training Manual* (Doc 9683), Part II, Chapter 2, addresses this relationship in more detail.

2.5 TEM is an overarching safety concept with multiple applications in aviation, while CRM is exclusively a training intervention. The basic concepts underlying TEM (threats, errors and undesired aircraft states) have been integrated into existing CRM programmes because TEM countermeasures build in large measure — although not exclusively — upon CRM skills. The combination of TEM concepts with CRM skills thus introduces the opportunity to present the utilization of CRM skills by flight crews anchored in the operational environment and from a purely operational perspective. It is emphasized that TEM training does not replace CRM training but rather complements and enhances it.

2.6 Originally developed for flight deck operations, the TEM Model can nonetheless be used at different levels and in different sectors within an organization, and across different organizations and activities within the aviation industry. It is therefore important, when applying TEM, to keep the user's perspective in the forefront. Depending on "who" is using TEM (front-line personnel, intermediate management, senior management; flight operations, maintenance, air traffic control), slight adjustments to related definitions may be required. This document focuses on the flight crew as "user", and the discussion herein presents the perspective of flight crews' use of TEM.

3. The components of the TEM Model

There are three basic components in the TEM Model, from the perspective of flight crews: threats, errors and undesired aircraft states. The model proposes that threats and errors are part of everyday aviation operations that must be managed by flight crews, since both threats and errors carry the potential to generate undesired aircraft states. Flight crews must also manage undesired aircraft states, since they carry the potential for unsafe outcomes. Undesired state management is an essential component of the TEM Model, as important as threat and error management, because it largely represents the last opportunity to avoid an unsafe outcome and thus maintain safety margins in flight operations.

4. Threats

4.1 Threats are defined as events or errors that occur beyond the influence of the flight crew, increase operational complexity, and must be managed to maintain the margins of safety. During typical flight operations, flight crews have to manage various contextual complexities, for example, adverse meteorological conditions, airports surrounded by high mountains, congested airspace, aircraft malfunctions, and errors committed by other people outside of the cockpit, such as air traffic controllers, flight attendants or maintenance workers. The TEM Model considers these complexities as threats because they all have the potential to negatively affect flight operations by reducing margins of safety.

4.2 Some threats can be anticipated, since they are expected or known to the flight crew. For example, flight crews can anticipate the consequences of a thunderstorm by briefing their response in advance or can prepare for a congested airport, as they execute the approach, by making sure they keep a watchful eye out for other aircraft.

4.3 Some threats can occur unexpectedly and without warning, such as an in-flight aircraft malfunction. In this case, flight crews must apply skills and knowledge acquired through training and operational experience.

4.4 Some threats may not be directly obvious to, or observable by, flight crews immersed in the operational context and may need to be uncovered by safety analysis. These are considered latent threats. Examples include equipment design issues, optical illusions, or shortened turn-around schedules.

4.5 Regardless of whether threats are expected, unexpected, or latent, one measure of the effectiveness of a flight crew's ability to manage threats is whether threats can be anticipated so as to enable the flight crew to respond to them through deployment of appropriate countermeasures.

4.6 Threat management is a building block to error management and undesired aircraft state management. Although the threat-error linkage is not necessarily straightforward (i.e. it may not always be possible to establish a linear relationship or one-to-one mapping between threats, errors and undesired states), archival data demonstrate that mis-managed threats are normally linked to flight crew errors, which in turn are oftentimes linked to undesired aircraft states. Threat management provides the most proactive option to maintain margins of safety in flight operation, by avoiding safety-compromising situations at their roots. As threat managers, flight crews are the last line of defence to keep threats from impacting flight operations.

4.7 Table 1 presents examples of threats, grouped under two basic categories derived from the TEM Model. Some environmental threats can be planned for and some will arise spontaneously, but they all have to be managed by flight crews in real time. Organizational threats, on the other hand, can be controlled (i.e. removed or, at least, minimized) at source by aviation organizations and are usually latent in nature. Flight crews still remain the last line of defence, but there are earlier opportunities for these threats to be mitigated by aviation organizations themselves.

5. Errors

5.1 Errors are defined actions or inactions by the flight crew that lead to deviations from organizational or flight crew intentions or expectations. Unmanaged and/or mismanaged errors frequently lead to undesired aircraft states. Errors in the operational context thus tend to reduce the margins of safety and increase the probability of adverse events.

5.2 Errors can be spontaneous (i.e. without direct linkage to specific, obvious threats), linked to threats, or part of an error chain. Examples of errors would include the inability to maintain stabilized approach parameters, executing a wrong automation mode, failing to give a required call-out, or misinterpreting an ATC clearance.

Table 1. Examples of threats

Environmental threats	Organizational threats
➢ **Weather:** thunderstorms, turbulence, icing, wind shear, cross/tailwind, very low/high temperatures. ➢ **ATC:** traffic congestion, TCAS RA/TA, ATC command, ATC error, ATC language difficulty, ATC non-standard phraseology, ATC runway change, ATIS communication, units of measurement (QFE/meters). ➢ **Airport:** contaminated/short runway; contaminated taxiway, lack of/confusing/faded signage/markings, birds, aids U/S, complex surface navigation procedures, airport constructions. ➢ **Terrain:** High ground, slope, lack of references, "black hole". ➢ **Other:** similar call signs.	➢ **Operational pressure**: delays, late arrivals, equipment changes. ➢ **Aircraft:** aircraft malfunction, automation event/anomaly, MEL/CDL. ➢ **Cabin:** flight attendant error, cabin event distraction, interruption, cabin door security. ➢ **Maintenance:** maintenance event/error. ➢ **Ground:** ground-handling event, de-icing, ground crew error. ➢ **Dispatch:** dispatch paperwork event/error. ➢ **Documentation:** manual error, chart error. ➢ **Other:** crew scheduling event

5.3 Regardless of the type of error, an error's effect on safety depends on whether the flight crew detects and responds to the error before it leads to an undesired aircraft state and to a potential unsafe outcome. This is why one of the objectives of TEM is to understand error management (i.e. detection and response), rather than solely focusing on error causality (i.e. causation and commission). From a safety perspective, operational errors that are detected in a timely manner and promptly responded to (i.e. properly managed) do not lead to undesired aircraft states and do not reduce margins of safety in flight operations, thus becoming operationally inconsequential. In addition to its safety value, proper error management is an example of successful human performance, having both learning and training value.

5.4 Capturing how errors are managed is then as important as, if not more important than, capturing the prevalence of different types of error. It is of interest to capture if and when errors are detected and by whom, the response(s) upon detecting errors, and the outcome of errors. Some errors are quickly detected and resolved, thus becoming operationally inconsequential, while others go undetected or are mismanaged. A mismanaged error is defined as an error that is linked to or induces an additional error or undesired aircraft state.

5.5 Table 2 presents examples of errors, grouped under three basic categories derived from the TEM Model. In the TEM concept, errors have to be "observable"; therefore, the TEM Model uses the "primary interaction" as the point of reference for defining the error categories.

5.6 The TEM Model classifies errors based upon the primary interaction of the pilot or flight crew at the moment the error is committed. Thus, in order to be classified as an aircraft-handling error, the pilot or flight crew must be interacting with the aircraft (e.g. through its controls, automation or systems). In order to be classified as a procedural error, the pilot or flight crew must be interacting with a procedure (e.g. checklists and SOPs). In order to be classified as a communication error, the pilot or flight crew must be interacting with people (e.g. ATC, ground crew, and other crew members).

5.7 Aircraft-handling errors, procedural errors and communication errors may be unintentional or may involve intentional non-compliance. Similarly, proficiency considerations (i.e. skill or knowledge deficiencies and training system deficiencies) may underlie all three categories of error. In order to keep the approach simple and avoid confusion, the TEM Model does not consider intentional non-compliance and proficiency as separate categories of error but rather as subsets of the three major categories of error.

6. Undesired aircraft states

6.1 Undesired aircraft states are flight crew-induced aircraft position or speed deviations, misapplication of flight controls, or incorrect systems configuration, associated with a reduction in margins of safety. Undesired aircraft states that result from ineffective threat and/or error management may lead to compromising situations and reduce margins of safety in flight operations. Often considered at the cusp of becoming an incident or accident, undesired aircraft states must be managed by flight crews.

6.2 Examples of undesired aircraft states would include lining up for the incorrect runway during approach to landing, exceeding ATC speed restrictions during an approach, or landing long on a short runway requiring maximum braking. Events such as equipment malfunctions or ATC controller errors can also reduce margins of safety in flight operations, but these would be considered threats.

Table 2. Examples of errors

Aircraft-handling errors	➢ Manual handling/flight controls: vertical/lateral and/or speed deviations, incorrect flaps/speed brakes, thrust reverser or power settings. ➢ Automation: incorrect altitude, speed, heading, autothrottle settings, incorrect mode executed, or incorrect entries. ➢ Systems/radio/instruments: incorrect packs, incorrect anti-icing, incorrect altimeter, incorrect fuel switches settings, incorrect speed bug, incorrect radio frequency dialled. ➢ Ground navigation: attempting to turn down wrong taxiway/runway, taxi too fast, failure to hold short, missed taxiway/runway.
Procedural errors	➢ SOPs: failure to cross-verify automation inputs. ➢ Checklists: wrong challenge and response; items missed, checklist performed late or at the wrong time. ➢ Call-outs: omitted/incorrect call-outs. ➢ Briefings: omitted briefings; items missed. ➢ Documentation: wrong weight and balance, fuel information, ATIS, or clearance information recorded, misinterpreted items on paperwork; incorrect logbook entries, incorrect application of MEL procedures.
Communication errors	➢ Crew to external: missed calls, misinterpretations of instructions, incorrect readback, wrong clearance, taxiway, gate or runway communicated. ➢ Pilot to pilot: within crew miscommunication or misinterpretation.

6.3 Undesired states can be managed effectively, restoring margins of safety, or flight crew response(s) can induce an additional error, incident, or accident.

6.4 Table 3 presents examples of undesired aircraft states, grouped under three basic categories derived from the TEM Model.

6.5 An important learning and training point for flight crews is the timely switching from error management to undesired aircraft state management. An example would be as follows: a flight crew selects a wrong approach in the Flight Management Computer (FMC). The flight crew subsequently identifies the error during a cross-check prior to the Final Approach Fix (FAF). However, instead of using a basic mode (e.g. heading) or manually flying the desired track, both flight crew members become involved in attempting to reprogramme the correct approach prior to reaching the FAF. As a result, the aircraft "stitches" through the localizer, descends late, and goes into an unstable approach. This would be an example of the flight crew getting "locked in" to error management, rather than switching to undesired aircraft state management. The use of the TEM Model assists in educating flight crews that, when the aircraft is in an undesired state, their basic task is undesired aircraft state management instead of error management. It also illustrates how easy it is to get locked in to the error management phase.

6.6 Also from a learning and training perspective, it is important to establish a clear differentiation between *undesired aircraft states* and *outcomes*. *Undesired aircraft states* are transitional states between a normal operational state (i.e. a stabilized approach) and an outcome. *Outcomes*, on the other hand, are end states, most notably reportable occurrences (i.e. incidents and accidents). An example would be as follows: a stabilized approach (normal operational state) turns into an unstabilized approach (undesired aircraft state) that results in a runway excursion (outcome).

Table 3. Examples of undesired aircraft states

Aircraft handling	➢ Aircraft control (attitude). ➢ Vertical, lateral or speed deviations. ➢ Unnecessary weather penetration. ➢ Unauthorized airspace penetration. ➢ Operation outside aircraft limitations. ➢ Unstable approach. ➢ Continued landing after unstable approach. ➢ Long, floated, firm or off-centre line landing.
Ground navigation	➢ Proceeding towards wrong taxiway/runway. ➢ Wrong taxiway, ramp, gate or hold spot.
Incorrect aircraft configurations	➢ Incorrect systems configuration. ➢ Incorrect flight controls configuration. ➢ Incorrect automation configuration. ➢ Incorrect engine configuration. ➢ Incorrect weight and balance configuration.

6.7 The training and remedial implications of this differentiation are significant. While at the undesired aircraft state stage, the flight crew has the possibility, through appropriate TEM, of recovering the situation and returning to a normal operational state, thus restoring margins of safety. Once the undesired aircraft state becomes an outcome, recovery of the situation, return to a normal operational state, and restoration of margins of safety are not possible.

7. Countermeasures

7.1 As part of the normal discharge of their operational duties, flight crews must employ countermeasures to keep threats, errors and undesired aircraft states from reducing margins of safety in flight operations. Examples of countermeasures would include checklists, briefings, call-outs and SOPs, as well as personal strategies and tactics. Flight crews dedicate significant amounts of time and energy to the application of countermeasures to ensure margins of safety during flight operations. Empirical observations during training and checking suggest that as much as 70 per cent of flight crew activities may be countermeasure-related activities.

7.2 All countermeasures are necessarily flight crew actions. However, some countermeasures to threats, errors and undesired aircraft states that flight crews employ build upon "hard" resources provided by the aviation system. These resources are already in place in the system before flight crews report for duty and are therefore considered as systemic-based countermeasures. These include:

- Airborne Collision Avoidance System (ACAS);
- Ground Proximity Warning System (GPWS),
- Standard Operating Procedures (SOPs);
- Checklists;
- Briefings;
- Training.

7.3 Other countermeasures are more directly related to the human contribution to the safety of flight operations. These are personal strategies and tactics, and individual and team countermeasures, that typically include canvassed skills, knowledge and attitudes developed by human performance training, most notably, by Crew Resource Management (CRM) training. There are basically three categories of individual and team countermeasures:

- Planning countermeasures: essential for managing anticipated and unexpected threats;
- Execution countermeasures: essential for error detection and error response;
- Review countermeasures: essential for managing the changing conditions of a flight.

7.4 Enhanced TEM is the product of the combined use of systemic-based and individual and team countermeasures. Table 4 presents detailed examples of individual and team countermeasures. Further guidance on countermeasures can be found in the sample assessment guides for terminal training objectives (Attachment B to Chapter 3) as well as in the manual *Line Operations Safety Audit (LOSA)* (Doc 9803).

Table 4. Examples of individual and team countermeasures

Planning countermeasures		
SOP BRIEFING	The required briefing was interactive and operationally thorough	— Concise, not rushed, and met SOP requirements — Bottom lines were established
PLANS STATED	Operational plans and decisions were communicated and acknowledged	— Shared understanding about plans – "Everybody on the same page"
WORKLOAD ASSIGNMENT	Roles and responsibilities were defined for normal and non-normal situations	— Workload assignments were communicated and acknowledged
CONTINGENCY MANAGEMENT	Crew members developed effective strategies to manage threats to safety	— Threats and their consequences were anticipated — Used all available resources to manage threats
Execution countermeasures		
MONITOR / CROSS-CHECK	Crew members actively monitored and cross-checked systems and other crew members	— Aircraft position, settings, and crew actions were verified
WORKLOAD MANAGEMENT	Operational tasks were prioritized and properly managed to handle primary flight duties	— Avoided task fixation — Did not allow work overload
AUTOMATION MANAGEMENT	Automation was properly managed to balance situational and/or workload requirements	— Automation setup was briefed to other members — Effective recovery techniques from automation anomalies
Review countermeasures		
EVALUATION/ MODIFICATION OF PLANS	Existing plans were reviewed and modified when necessary	— Crew decisions and actions were openly analysed to make sure the existing plan was the best plan
INQUIRY	Crew members asked questions to investigate and/or clarify current plans of action	— Crew members not afraid to express a lack of knowledge – "Nothing taken for granted" attitude
ASSERTIVENESS	Crew members stated critical information and/or solutions with appropriate persistence	— Crew members spoke up without hesitation

Chapter 4. COMPETENCY-BASED TRAINING AND ASSESSMENT FOR AIRCRAFT MAINTENANCE PERSONNEL

4.1 Introduction

This chapter provides material on the implementation of an optional competency-based approach to training and assessment of personnel working in aircraft maintenance, including those with certification privileges. This material will be useful to Licensing Authorities responsible for approving training courses, to Approved Maintenance Organizations (AMOs) that should ensure that their personnel demonstrate the competencies appropriate to their individual functions, and to Approved Maintenance Training Organizations (AMTOs) that should implement training programmes complying with the requirements of the Licensing Authorities and fulfilling the needs of AMOs.

4.2 Existing aircraft maintenance licences and training programmes

4.2.1 Aircraft maintenance work covers a wide range of activities. Therefore, aircraft maintenance personnel require a wide range of competencies that depends on:

a) the type and scope of work they do;

b) the type and structure of the maintenance organization in which they work; and

c) the environment in which they work.

4.2.2 In most States, maintenance functions have been grouped, and national Licensing Authorities issue aircraft maintenance licences in accordance with these groups. Typically, these licences are issued in accordance with one of the following groups:

a) technology groups: licences covering a certain technology range (e.g. aircraft system, airframe, engines, avionics, hydraulic components, aircraft seats); and

b) groups defining the kind of tasks: licences covering a certain maintenance environment (e.g. line maintenance, base maintenance, shop maintenance and their special processes);

and within these groups there are additional subsets like:

a) aircraft maintenance mechanic/technician/engineer licences with or without specialty-rating endorsements; and

b) licences rated to a certain level or complexity of work (e.g. Level 1-2-3 / Level A-B-C).

4.2.3 Where maintenance personnel are required to hold a licence, training programmes shall follow the licensing requirements. Where maintenance personnel are not required to hold

licences, training programmes are required to comply with the minimum requirements of Annex 1 and follow the maintenance organization's requirements for particular maintenance functions and/or maintenance authorizations.

4.3 The link between competency-based training and assessment and privileges

4.3.1 Holders of licences and/or authorizations are granted privileges to perform defined maintenance tasks and are accountable for them. Therefore, the competencies required to perform these maintenance tasks should form the basis of training, examinations and assessments. The Licensing Authority or organization (as described in 4.4) shall ensure that a candidate for a particular licence and/or authorization demonstrates the required set of competencies in relation to the privileges granted.

4.3.2 The issuing organization (see 4.4) shall ensure that a candidate for a particular licence or authorization demonstrates the required set of competencies in relation to the given privileges.

4.4 Issue of Licences and Authorizations

Licensing Authorities set the standards for the issue of licences in terms of contents, training and experience requirements, examinations and assessments, and administrative procedures. They may delegate some or all of these functions to designated personnel of AMTOs or AMOs, or they allow AMOs to substitute or complement licences with in-house issued authorizations, which then will grant maintenance and certification privileges on behalf of the AMO. In the latter case, the system which controls the issue of authorizations has to be described in the AMO's procedures manual, which is subject to Civil Aviation Authority approval.

4.4.1 Involvement of the Licensing Authority in competency-based training and assessment

4.4.1.1 In States introducing competency-based training and assessment for maintenance personnel, Licensing Authorities should issue an AMMTE licence without specialty-rating endorsements. The scope of privileges of these licences should follow the contents of generic (non-specialty-rated) Standard Practices Manuals, in which the standard practices to perform individual maintenance tasks are stipulated.

4.4.1.2 The licence will refer to a specified set of standard practices and indicate that the holder of the licence is competent to perform them. A modular licence system should be established to cover the broad range of maintenance of aircraft structure (or airframe), aircraft (or engine) systems, avionic systems and components. This modular approach will allow individuals to build up their competencies as required.

4.4.1.3 The Licensing Authority may delegate certain functions leading to the issuance of specialty-rating licence endorsements to designated personnel of AMOs under its jurisdiction and shall exercise oversight over the designees' performance of delegated functions. AMOs would then issue those authorizations which reflect the scope of maintenance work that the organization performs. The criteria for the issuance of these authorizations shall be stipulated in the AMO's quality management documentation, which is approved by the Civil Aviation Authority.

4.4.1.4 The scope and privileges of the authorizations as well as the prerequisites for their issuance, extension, currency, revocation, cancellation and renewal are subject to the approval of the Licensing Authority.

4.4.1.5 The scope, requirements and privileges of the AMMTE licence issued, its ratings and/or authorizations shall be stipulated in the State's regulations and, in the case of authorizations, expanded in the AMO quality management documentation.

4.4.2 Involvement of AMTOs in competency-based training and assessment

4.4.2.1 A candidate to obtain a licence or authorization shall demonstrate that the required competencies associated with the licence/authorization have been attained. These competencies can be acquired through formal training, practical experience, self-study or a combination of these methods.

4.4.2.2 All competency-based maintenance training programmes shall be conducted by an approved maintenance training organization or an AMO in accordance with paragraph 4.4.3.2. The programmes and their revisions shall be evaluated and approved by the Licensing Authority. Conditions for obtaining the approval shall include having the necessary documentation, manuals and equipment for conducting the course.

4.4.2.3 One role of the AMTOs is to deliver optional training programmes (including theoretical and practical training) as appropriate in relation to the competencies required for a licence or an authorization. In addition, designated personnel of AMTOs should carry out competency-based exams and assessments for licences under delegation received from the Licensing Authority, or for authorizations by delegated authority from the AMO, under its responsibility. The Licensing Authority shall specify all requirements for competency-based exams and assessments including contents, delivery and achievement standards and shall maintain oversight of the training and assessment processes.

4.4.3 Involvement of AMOs in competency-based training and assessment

4.4.3.1 Candidates for licences without specialty-rating endorsement may work in AMOs to gain practical experience under the supervision of licensed/authorized personnel. In conjunction with self-study, distance learning, or formal training, these candidates should acquire the required competency to pass the examinations/assessments for the licence.

4.4.3.2 Should an AMO seek to provide training that will allow an alternate means of compliance with the experience requirements established by Annex 1, the training programme, instructors and facilities shall meet the requirements of an approved aircraft maintenance training organization. Furthermore, the training shall be conducted in accordance with the approved aircraft maintenance training organization requirements. The AMO training programmes and their revisions shall be evaluated and approved by the Licensing Authority.

4.4.3.3 For specialty-rating endorsements, the AMO shall specify an authorization system which reflects its requirements in relation to the scope of the work performed in the AMO and the degree of specialization required by its personnel. The contents and privileges granted by the authorizations shall be based on criteria given in approved maintenance

instructions. The Civil Aviation Authority shall approve the instructions governing how the competency-based examinations/assessments are performed to ensure that authorizations are granted only to personnel who can execute the attached privileges to the defined standards.

4.5 Assessment

Licensing Authorities, AMTOs and AMOs may use the competency units, competency elements and performance criteria in approving and developing their own assessment and training programmes for the licensing and/or authorization of maintenance personnel, as contained in the competency-based frameworks of Appendix 2 to this chapter. Licensing Authorities, AMTOs and AMOs shall develop the range of variables and the evidence and assessment guide and/or practical test standards required for assessing applicants for aircraft maintenance licences in accordance with Annex 1, and for authorizations by an AMO, respectively.

4.6 Training

4.6.1 Competency-based training programmes for aircraft maintenance personnel shall be developed with the use of an ISD methodology.

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 the Attachment to Chapter 2.

4.6.2 Each phase of a maintenance training programme shall integrate instruction in underpinning knowledge and in practical training segments. Training in the underpinning knowledge requirements and skill requirements should be fully integrated or harmonized for any maintenance training programme.

Note.— Guidelines for the implementation of aircraft maintenance personnel competency-based training and assessment can be found in Appendix 1 to this chapter.

4.6.3 Training courses for maintenance personnel shall include continuous evaluation of the effectiveness of the training programme and of the performance of individual students attending the programme. The process of continuous evaluation shall be acceptable to the Authority. This evaluation shall ensure that:

a) the competencies and related assessment are relevant to the task of maintenance personnel acting in a particular function; and

b) the students acquire the necessary competencies in a progressive and satisfactory manner.

4.6.4 Corrective action shall be taken if in-training or post-training evaluation indicates a need to do so.

— — — — — — — —

Appendix 1 to Chapter 4
GUIDELINES FOR THE IMPLEMENTATION OF COMPETENCY-BASED TRAINING AND ASSESSMENT FOR AIRCRAFT MAINTENANCE PERSONNEL

1. Introduction

1.1 The introduction of competency-based training and assessment for aircraft maintenance personnel presents several safety and efficiency benefits, not only for the licence holders, who certify the aircraft or parts of the aircraft as airworthy, but also for all those non-licensed personnel undertaking work that will lead to airworthiness certification.

1.2 The Quality Management System of an AMO depends on the competency of its maintenance personnel. Competency standards therefore play a key role in harmonizing task performance, thereby upholding and potentially improving safety standards in aircraft maintenance. Whether the work is performed by licensed/authorized personnel or not, all personnel inspect their own work. Only in exceptional cases is a duplicated inspection (four-eye-inspection) deemed necessary. Since the risk associated with a poorly performed task rests to a large extent with the individual, it is essential to ensure that personnel authorized to sign for their own work performance be adequately trained and assessed against the corresponding competency standards.

1.3 Airworthiness regulations stipulate the licences and authorizations that personnel shall acquire and maintain valid in order to exercise the certification privileges for different aircraft maintenance tasks. These regulations vary substantially from one State to another in terms of the scope of the privileges, and the requirements for training, experience and examination or assessment. This lack of harmonization hampers the movement of competent personnel amongst Contracting States as well as the outsourcing of maintenance work from one State to another.

1.4 Competency-based training and assessment of aircraft maintenance personnel facilitates the use of a modular approach suited for the wide variety of maintenance tasks. Because generic knowledge-based training programmes are not outcome-driven, their effectiveness in terms of time and resources used can be limited. Competency-based training and assessment programmes can be tailored to specific sets of competencies required to perform defined maintenance operations, with each competency representing a “building block”.

1.5 This modular approach can deliver further efficiencies by taking into account the already acquired competencies that a particular trainee brings into a training programme. Typically, trainees entering a course do not have to meet predetermined entry requirements or undergo a pre-training assessment. For some students, this can result in the repetition of previously attended training and for others in unrealistically demanding course content. To increase the effectiveness and efficiency of the training programmes, the pre-training competencies of trainees should be measured against the competencies to be achieved. Consequently, individual training needs would be identified and training

focused on the identified competency gaps thereby potentially reducing training time and effort.

1.6 The constant introduction of new technology results in a permanent requirement for aircraft maintenance personnel to adopt new methods and processes. Consequently, personnel need to master new knowledge and skills to meet the competencies needed to cope with technological development. Because of its modular approach, a competency-based training programme can easily accommodate the introduction of training activities for new technological applications.

1.7 Finally, competency-based training programmes accommodate the introduction of new, more effective and efficient training methodologies, including but not limited to simulation, e-learning, multi-media-based and self-directed learning.

2. Guidelines for the Civil Aviation Authorities and maintenance organizations

2.1 Aircraft Maintenance Mechanic/Technician/Engineer (AMMTE) training and licensing path

Competency-based training requires continuous evaluation to ensure that it remains effective and relevant to maintenance operations. All relevant Standards related to approved training organization in Annex 1, Appendix 2 shall apply, including those dealing with approval of the curriculum and quality assurance system.

2.2 Competency-based training — Non-specialty-rated

2.2.1 At the end of fundamental training, students shall demonstrate the set of competencies associated with the “Standard Practices”, as described in “Standard Practices Manuals”, that they will eventually use on the job. In order to demonstrate these competencies, underlying knowledge and skills shall be acquired. These “Standard Practices” are applicable to all types of aeronautical equipment and all existing environments.

2.2.2 As all personnel involved in aircraft maintenance should undergo fundamental training, it is essential that Civil Aviation Authorities closely monitor these training programmes and oversee the final examinations and assessments to ensure that trainees meet the standards associated with the set of competencies that they will use on the job (“Standard Practices”). Civil Aviation Authorities shall therefore approve fundamental competency-based training programmes.

2.2.3 Conditional to trainees successfully passing the final fundamental training examinations and assessments, Licensing Authorities may issue aircraft maintenance licences without specialty-rated endorsement giving clear statements about which competencies the licence holder can demonstrate.

2.3 Competency-based training — Specialty-rated (aircraft systems and structures or components)

2.3.1 At the end of competency-based training for specialty-rating, students shall demonstrate the set of competencies they require to perform maintenance tasks on specific equipment and in specific environments. These specialty-rated maintenance tasks are described in maintenance instructions found in a variety of manuals such as the “Aircraft Maintenance

Manual (AMM)", "Component Maintenance Manual (CMM)", "Structural Repair Manual (SRM)", "Fault Isolation Manual (FIM)", and other authorized maintenance instructions which describe how these tasks are executed and to which standards.

2.3.2 In order to perform work in accordance with maintenance instructions, an AMMTE needs to apply the relevant "Standard Practices" learned in fundamental training to the specific equipment on which work is to be performed. To achieve this, additional training on the specific type of equipment is required.

2.3.3 Competency-based training for specialty-rating shall address the features that are unique to the aircraft type or component to be worked on and were not included in fundamental training. Competency-based training for specialty-rating may include but is not limited to the following features:

- location and identification of systems and components;
- operation and monitoring of systems and components;
- analysis of system or component functions;
- removal and installation of units;
- performance of adjustments and tests; and
- use of tools, equipment and materials.

2.3.4 Because of the wide variety in the scope of work undertaken by different maintenance organizations and their personnel, AMOs and/or AMTOs shall be responsible for the contents of training programmes for specialty-rating required for the various maintenance functions personnel carry out.

2.3.5 The Civil Aviation Authority shall closely monitor competency-based training programmes for specialty-rating and approve them. These programmes shall be described in the Maintenance Organizations Procedures Manual (MOPM). The evaluation of the effectiveness of the training programmes is the responsibility of the Maintenance Organization and shall be included in the auditing and monitoring activities performed by the Civil Aviation Authority on that organization.

2.3.6 Examiners designated by the Licensing Authority in AMTOs or appointed by the AMOs are responsible for the final competency-based examinations and assessments of the students in courses for specialty-rating. These examinations and assessments should not only examine the attained knowledge but also ensure that the students demonstrate competencies to perform maintenance tasks to defined standards as per the maintenance instructions. Based on the successful completion of these examinations and assessments, the AMO shall issue aircraft maintenance authorizations which clearly indicate the competencies that the holder of the authorization has demonstrated.

2.3.7 The procedures to conduct examinations and assessments, as well as the requirements to be met for the issuance of authorizations shall be described in the MOPM. The Civil Aviation Authority shall approve these procedures and exercise oversight.

2.4 Competency-based training flowcharts of existing licensing and training paths

2.4.1 The competency-based approach can be introduced in different ways in the existing licensing and training paths. The flowcharts in Figures 4-App 1-1 to 4-App 1-6 illustrate how this can be accommodated. All start with the student attending fundamentals/basic training.

2.4.1.1 Example 1.— Person attending fundamentals/basic training and receiving a Basic Licence after a successful examination/assessment by the Licensing Authority.

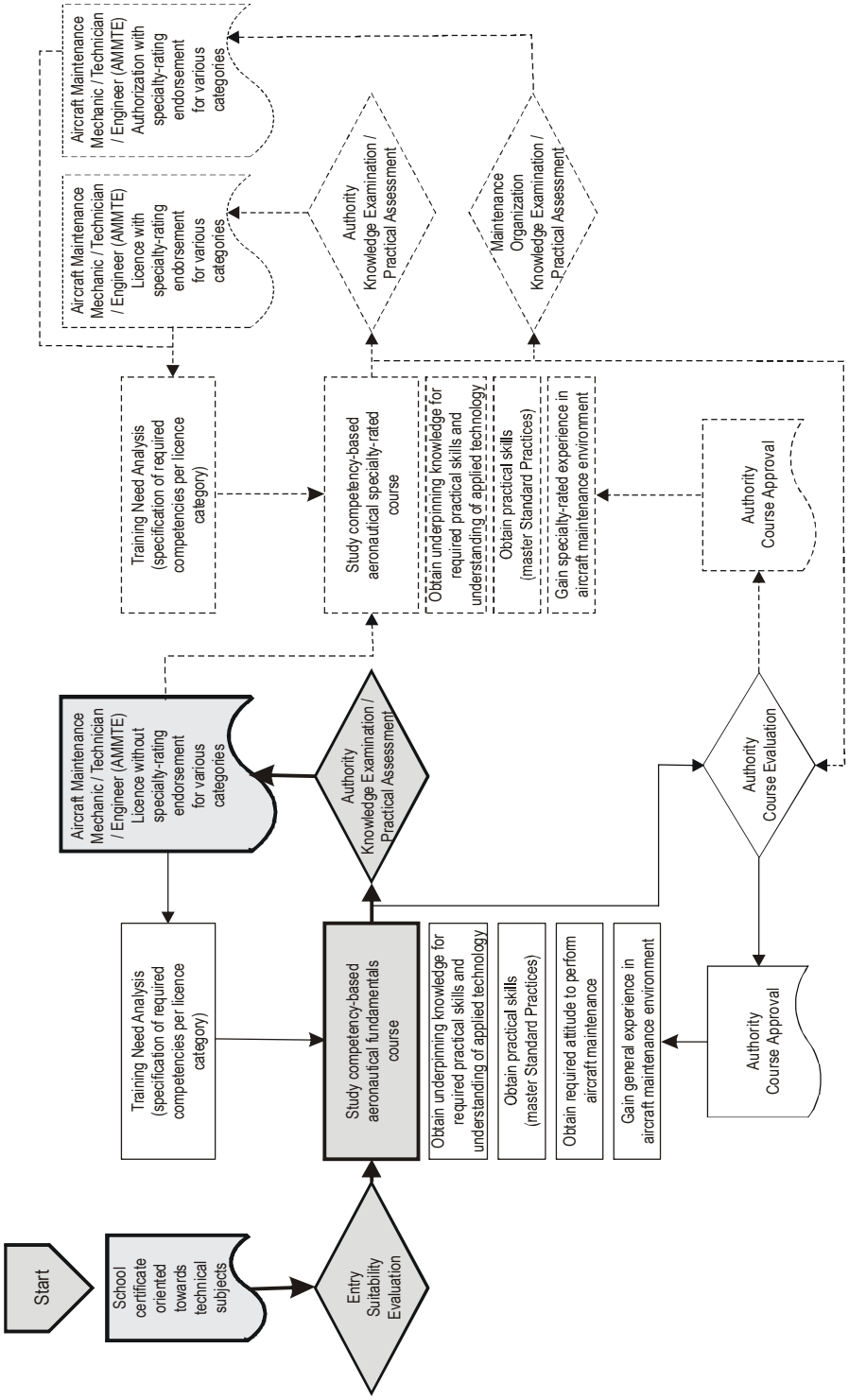


Figure 4-App 1-1. AMMTE training and licensing path (Example 1)

2.4.1.2 Example 2.— Person attending fundamentals/basic training and receiving a Basic Licence, then attending training for specialty-rating and receiving a specialty-rated endorsement on the licence after a successful examination/assessment by the Licensing Authority.

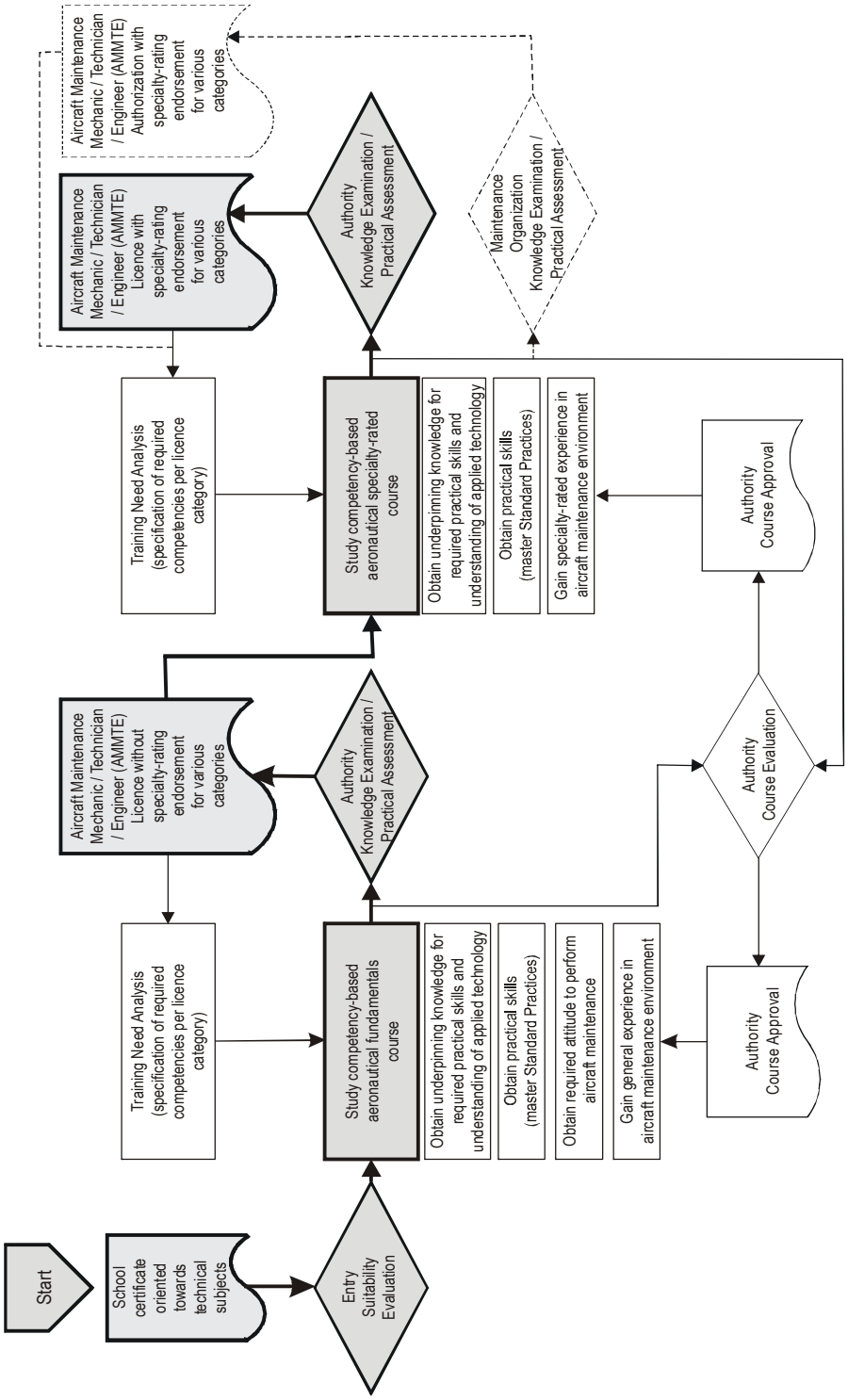


Figure 4-App 1-2. AMMTE training and licensing path (Example 2)

2.4.1.3 Example 3.— Person attending fundamentals/basic training and receiving a Basic Licence, then attending training for specialty-rating and receiving a specialty-rated AMO authorization after a successful AMO examination/assessment.

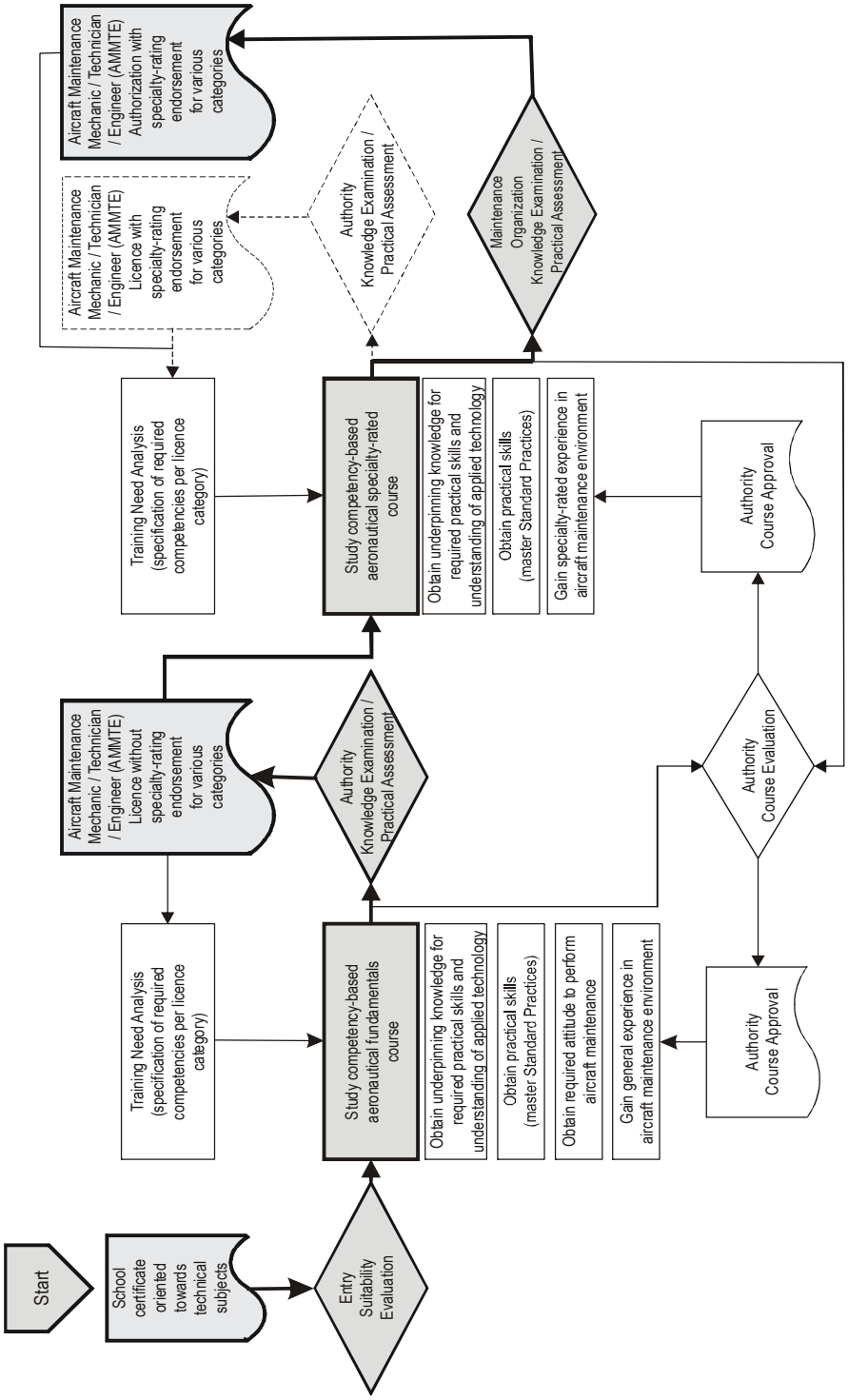


Figure 4-App 1-3. AMMTE training and licensing path (Example 3)

2.4.1.4 Example 4.— Person attending fundamentals/basic training and receiving a Basic Licence, then attending training for specialty-rating and receiving a specialty-rated endorsement on the licence after a successful examination/assessment by the Licensing Authority as a pre-requisite for an additional specialty-rated AMO authorization after a successful AMO examination/assessment.

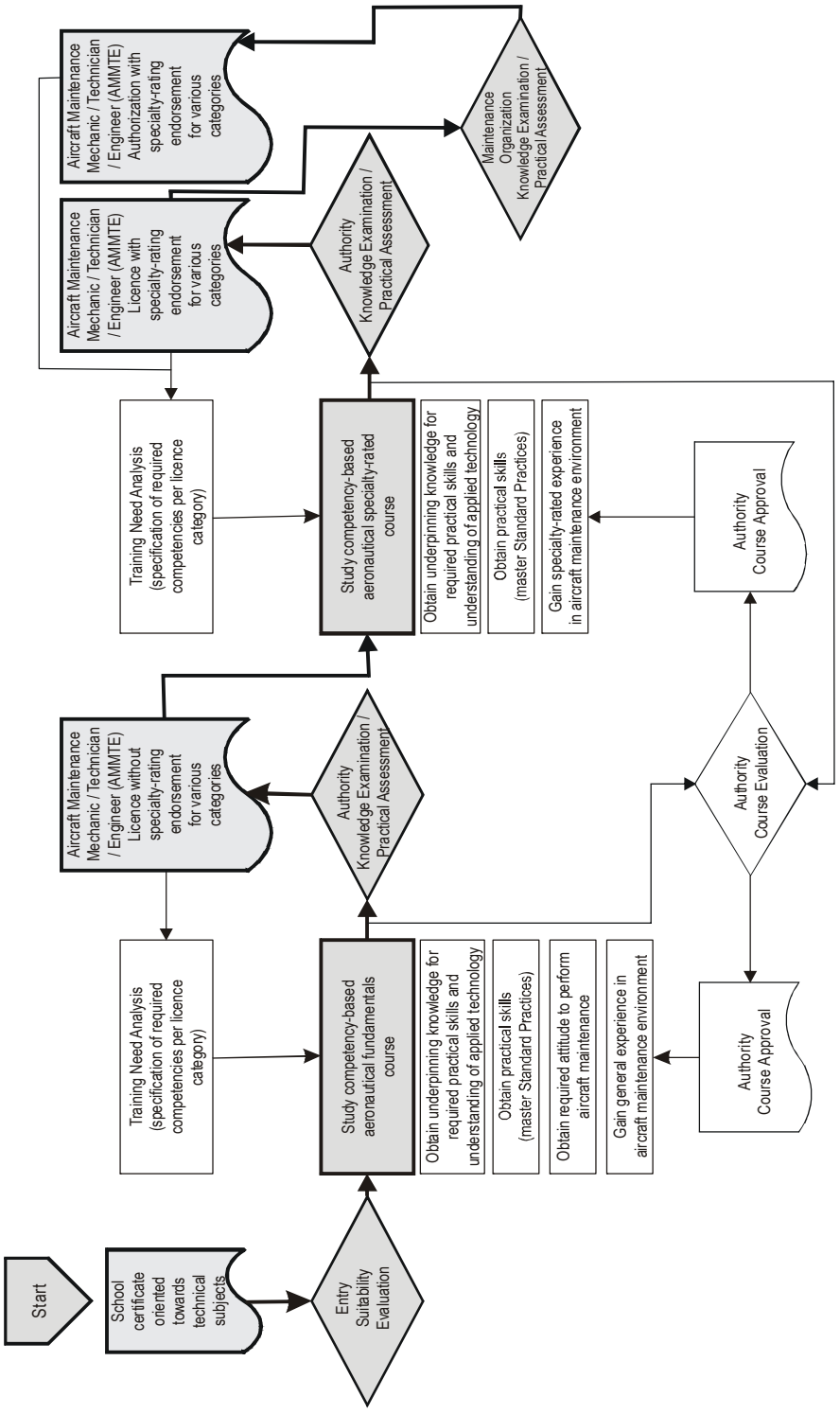


Figure 4-App 1-4. AMMTE training and licensing path (Example 4)

2.4.1.5 Example 5.— Person attending fundamentals/basic training, then attending training for specialty-rating and receiving a specialty-rated AMO authorization after a successful AMO examination/ assessment.

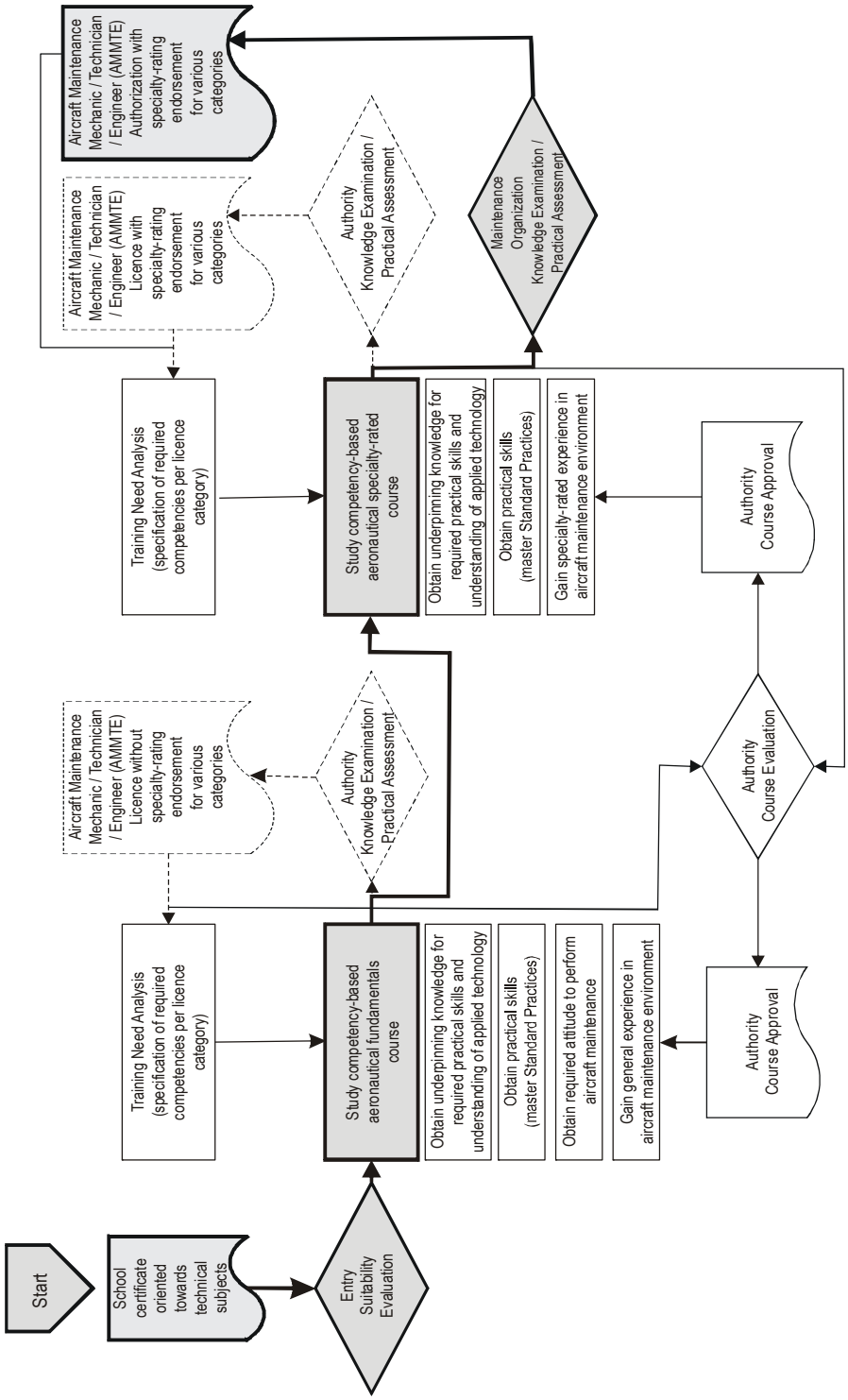


Figure 4-App 1-5. AMMTE training and licensing path (Example 5)

2.4.1.6 Example 6.— Person attending fundamentals/basic training, then attending an equipment technology group training and receiving an equipment technology group AMO authorization after a successful AMO examination/assessment.

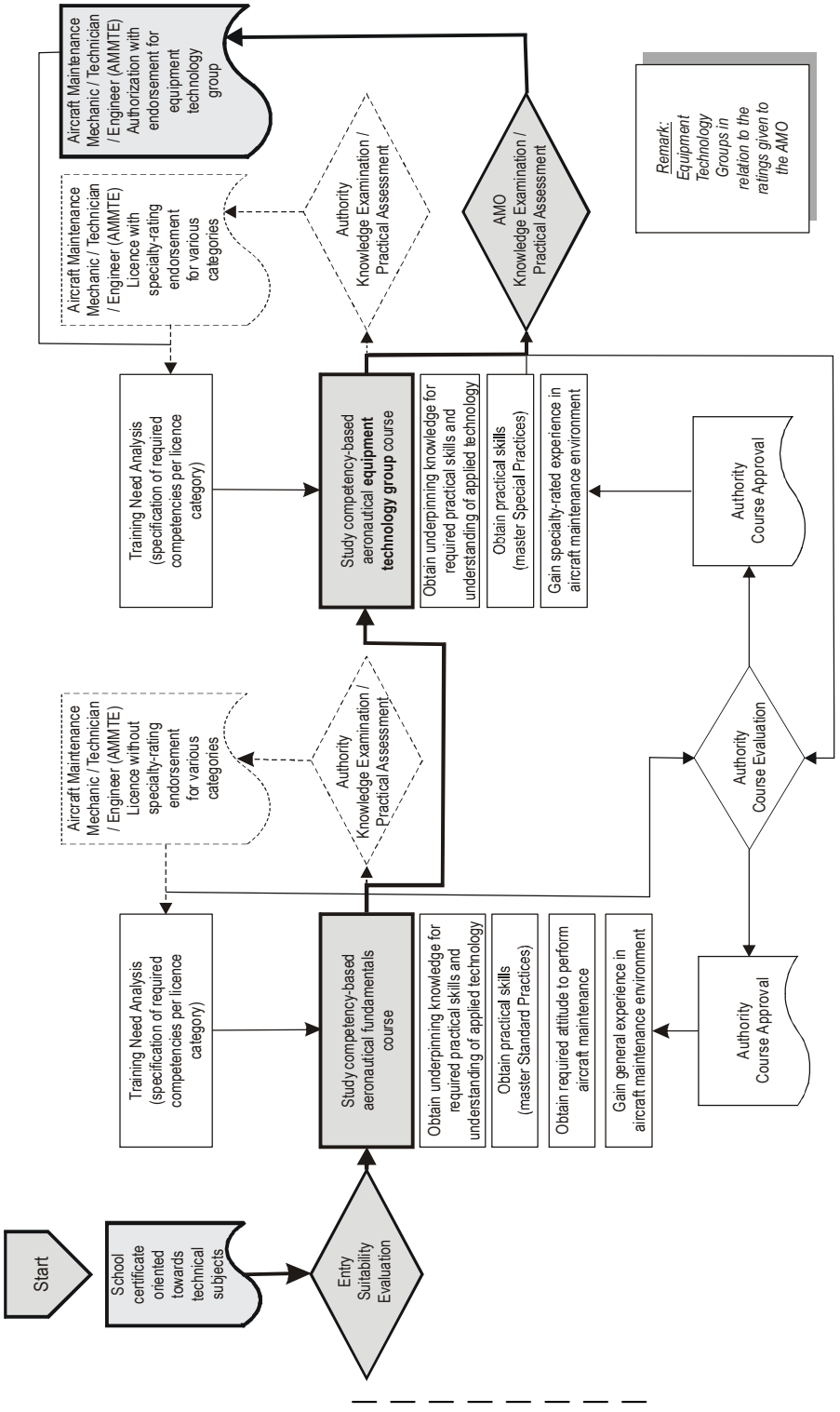


Figure 4-App 1-6. AMMTE training and licensing path (Example 6)

Appendix 2 to Chapter 4
AIRCRAFT MAINTENANCE COMPETENCY UNITS — COMPETENCY ELEMENTS AND PERFORMANCE CRITERIA

1. Introduction

1.1 Aircraft maintenance involves a wide range of tasks performed in maintenance organizations whose scope of work varies broadly. Some maintenance organizations perform the full range of aircraft and component maintenance while others are specialized. Depending on the type of maintenance organization, personnel will require different sets of competencies.

1.2 The following competency frameworks were developed to accommodate the different types of maintenance tasks and organizations. The frameworks list the competencies for three domains: aircraft systems maintenance, aircraft structures maintenance and aircraft components maintenance. The frameworks were developed by combining the existing generic information found in aircraft and engine maintenance manuals, structural repair manuals, component maintenance manuals and the actions described in standard practices documentation. Figure 4-App 2-1, aircraft maintenance domains, illustrates the basis on which the competency frameworks were developed.

1.3 It is not envisaged that one person should achieve all competencies listed in the frameworks. Students shall achieve the competencies selected by the Licensing Authority and/or approved maintenance organization for a specific function.

1.4 The competency frameworks were developed with the following assumptions:

- they are targeted to aircraft maintenance mechanics/technicians/engineers and/or aircraft component maintenance mechanics/technicians/engineers, working within the scope of aircraft and engine maintenance manuals, structural repair manuals and component maintenance manuals;
- they are applicable in aircraft line, base and workshop maintenance; and
- they apply to large aeroplanes (> 5 700 kg) powered by turbine engines and components thereof.

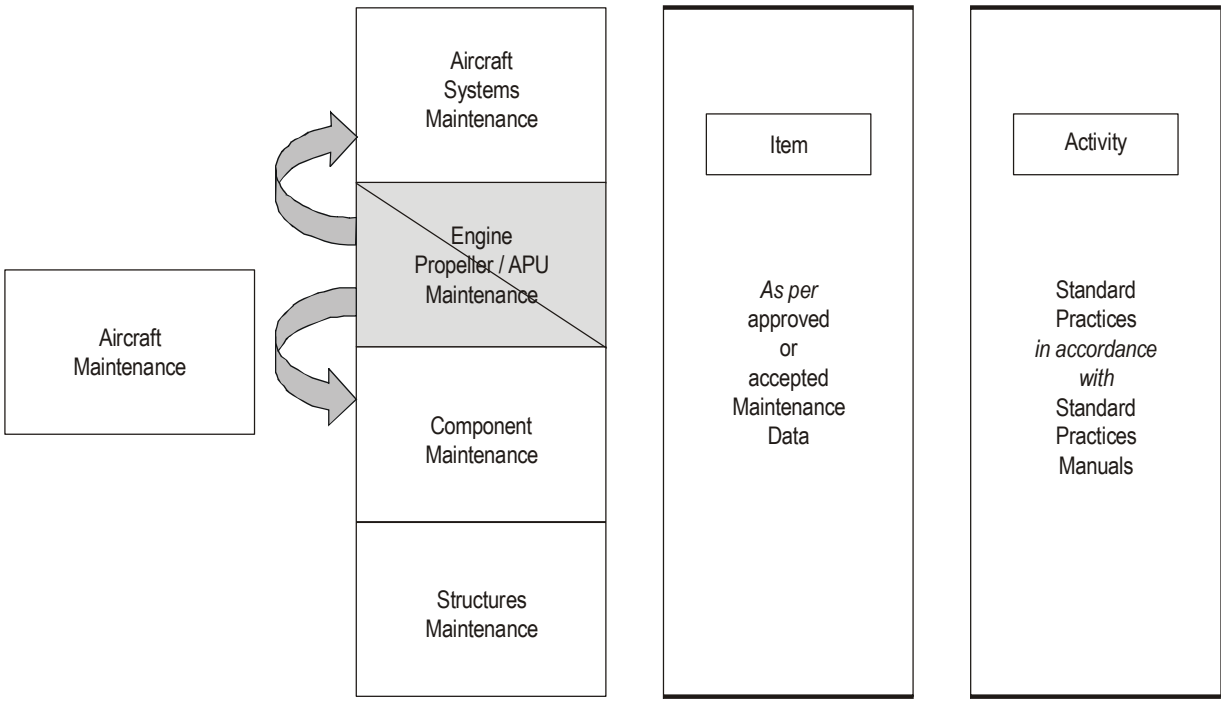


Figure 4-App 2-1. Aircraft maintenance domains

Note.— Depending on the scope of work, the engine maintenance, including the propeller or APU maintenance, may be accomplished using either the framework for the airframe systems maintenance domain or the framework for the component maintenance domain.

2. Competency units, competency elements and performance criteria for aircraft systems maintenance personnel

X. X.X X.X.X	**COMPETENCY UNIT** **Competency element** Performance criteria	*Reference*
1.	**PERFORM FAULT ISOLATION**	
1.0	**Recognize and manage potential threats and errors**	
1.1	**Prepare for fault isolation – collect fault data**	
1.1.1	Collect fault data from relevant aircraft technical logs (printed or electronic) of pilot or maintenance reports – if available	MOPM
1.1.2	Collect data from aircraft recorders/in-flight transmitted records (maintenance messages)	
1.1.3	Collect fault data from Maintenance Defect Reporting Sheet	MOPM
1.2	**Verify fault data**	
1.2.1	Perform inspection to verify physical status	MM
1.2.2	Perform operational test to verify operational status	MM
1.2.3	Perform functional test to verify functional status	MM
1.2.4	Perform check to verify to what degree the fault hampers the designed task fulfilment of the faulty system components	MM
1.2.5	Record all fault findings	MOPM
1.3	**Develop fault isolation procedure**	
1.3.1	Consult the fault isolation section of the Maintenance Manual (MM) for fault isolation procedure availability	MM
1.3.2	Select fault isolation procedure if available	MOPM
1.3.3	If fault isolation procedure not available, perform fault isolation in accordance with generic standard practices, if possible	MOPM
1.3.4	If fault isolation procedure not available and cannot be performed in accordance with generic practice, contact the engineering department for development of the fault isolation procedure	MOPM
1.4	**Perform fault isolation procedure**	
1.4.1	Perform fault isolation procedure step by step	MM
1.4.2	Record results of each step of fault isolation procedure	MOPM
1.4.3	Continue fault isolation procedure until fault cause has been identified	MM
1.5	**Define fault rectification procedure**	
1.5.1	Consult Minimum Equipment List (MEL) to determine whether operation with existing fault is still possible	MEL
1.5.2	Consult Configuration Deviation List (CDL)/Dispatch Deviation Procedures Guide (DDPG) to determine whether operation with existing fault is still possible	CDL

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	1.5.3 Determine whether operation may be continued without immediate fault rectification, if allowed by the MEL. If yes – perform, if required: Operational and/or maintenance procedure as per MEL Operational and/or maintenance procedure as per CDL/DDPG Continue Operation – go to next step **If no – go to next step**	MOPM
	1.5.4 Prepare fault rectification order	MOPM
1.6	**Complete fault isolation**	
	1.6.1 Establish and sign maintenance records	MOPM
2.	**PERFORM MAINTENANCE PRACTICES**	
2.0	**Recognize and manage potential threats and errors**	
2.1	**Identify the need for maintenance practice**	
	2.1.1 Identify whether any step in a maintenance task procedure requires either: • Generic Standard Practices Manual (SPM) application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM; or • Special maintenance practice application – as per Special Maintenance Procedure Manual (SMPM) (e.g. Non-destructive testing (NDT), welding, etc.)	MM
2.2	**Perform maintenance procedure**	
	2.2.1 Perform standard practice – should be possible to be performed without necessity of consulting a manual (competence has been acquired through study/ experience and been successfully assessed within the AMO by which the performing person is employed)	SPM
	2.2.2 Perform maintenance practice as per MM procedure	MM
	2.2.3 Perform special maintenance procedure as per Special Maintenance Practice Manual	SMPM
2.3	**Complete maintenance practice**	
	2.3.1 Establish and sign maintenance records	MOPM

X. X.X.	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
3.	**PERFORM SERVICE**	
3.0	**Recognize and manage potential threats and errors**	
3.1	**Prepare for service**	
3.1.1	Read related maintenance instruction	MM
3.1.2	Prepare required tools	MM
3.1.3	Prepare required equipment	MM
3 1.4	Prepare maintenance records	MOPM
3.1.5	Instruct supporting staff	MOPM
3.1.6	Get access to component/assembly	MM
3.1.7	Locate component/assembly	MM
3.2	**Apply safety precautions/maintenance practices**	
3.2.1	Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
3.2.2	Identify whether any safety precautions are required for the maintenance task and apply them	
3.2.3	Tag all flight deck and external control devices which are involved in the safety precautions	MM
3.3	**Perform service of component/assembly/system**	
3.3.1	Check for required medium to be serviced (e.g. fluid specifications)	MM
3.3.2	Check fill status of component/assembly/system	MM
3.3.3	Record fill status of component/assembly/system	MOPM
3.3.4	Identify required fill status of component/assembly/system	MM
3.3.5	Calculate required refill quantity to add	MOPM
3.3.6	Connect fill equipment to fill openings/ports	MM
3.3.7	Operate fill/overfill valves	MM
3.3.8	Add required refill quantity	MM
3.3.9	Record refill quantity	MOPM
3.3.10	Disconnect fill equipment – close and secure fill openings/ports	MM
3.4	**Apply safety precautions in service area**	
3.4.1	Clean fill area	MOPM
3.4.2	Perform visual inspection	MOPM
3.4.3	Remove all tools and equipment, check work area for leftover objects	MOPM
3.4.4	Re-check fill status	MOPM

X. X.X.	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
3.5	**Complete service**	
	3.5.1 Restore aircraft to Normal status Close service area, un-tag all flight and external control devices involved in the safety precautions and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	3.5.2 Establish and sign maintenance records	MOPM
4.	**REMOVE COMPONENT/ASSEMBLY**	
4.0	**Recognize and manage potential threats and errors**	MOPM
4.1	**Prepare for removal**	
	4.1.1 Read related maintenance instruction	MM
	4.1.2 Prepare required tools	MM
	4.1.3 Prepare required equipment	MM
	4.1.4 Prepare maintenance records	MOPM
	4.1.5 Instruct supporting staff	MOPM
	4.1.6 Get access to component/assembly	MM
	4.1.7 Locate component/assembly	MM
	4.1.8 Take and record any required measurements	MM
4.2	**Apply safety precautions/maintenance practices**	
	4.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	4.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
4.3	**Disconnect all connections to the system(s)**	
	4.3.1 Disconnect electrical connectors (be aware of remaining voltage – capacitors)	MM
	4.3.2 Disconnect hydraulic lines (be aware of leakage and remaining pressure)	MM
	4.3.3 Disconnect pneumatic ducts and lines (be aware of remaining pressure)	MM
	4.3.4 Disconnect all other supply lines (fuel, water, oxygen, etc.) (be aware of leakage and remaining pressure)	MM

X. **X.X.**	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	4.3.5 Disconnect mechanical control linkages, cables and rods (be aware of spring loaded linkages and attached dampers)	MM
	4.3.6 Disconnect bonding jumpers	MM
4.4	**Secure component/assembly before removal**	
	4.4.1 Hoist component/assembly to structure	MM
	4.4.2 Support component/assembly	MOPM
4.5	**Loosen and remove connecting elements from support structure**	
	4.5.1 Loosen and remove all attachment nuts and bolts	MM
	4.5.2 Loosen and remove all attachment fasteners	MM
	4.5.3 Loosen and remove all attachment clamps and Quick Attach-Detach devices	MM
4.6	**Move component/assembly out of installation area**	
	4.6.1 Use hoist to lower component/assembly from installation area	MM
	4.6.2 Lift component/assembly out of installation area	MOPM
4.7	**Apply safety precautions in removal area**	
	4.7.1 Clean removal area	MOPM
	4.7.2 Perform visual inspection	MOPM
	4.7.3 Remove all tools and equipment, check work area for leftover objects	MOPM
4.8	**Complete removal**	
	4.8.1 Remove and discard seals and gaskets	MOPM
	4.8.2 Drain component/assembly	MM
	4.8.3 Store component/assembly in cradle, container or shelf, stack	MM
	4.8.4 Install covers on electrical connectors, lines, ducts and openings to keep out unwanted materials	MOPM
	4.8.5 Restore aircraft Close removal area, un-tag all flight and external control devices involved in the safety precautions and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	4.8.6 Establish and sign maintenance records	MOPM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
5.	**INSTALL COMPONENT/ASSEMBLY**	
5.0	**Recognize and manage potential threats and errors**	MOPM
5.1	**Prepare for installation**	
	5.1.1 Read related maintenance instruction	MM
	5.1.2 Prepare required tools	MM
	5.1.3 Prepare required equipment	MM
	5.1.4 Prepare maintenance records	MOPM
	5.1.5 Assign required duplicated inspections	MOPM
	5.1.6 Instruct supporting staff	MOPM
	5.1.7 Get access to component/assembly installation area	MM
	5.1.8 Locate component/assembly installation position	MM
5.2	**Apply safety precautions/maintenance practices**	
	5.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	5.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	5.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
5.3	**Perform pre-installation activities**	
	5.3.1 Get component/assembly out cradle, container, shelf or stack	MOPM
	5.3.2 Check Certificate of Release to Service of component/assembly and perform visual inspection	MOPM
	5.3.3 Remove covers from electrical connectors, lines, ducts and openings	MOPM
	5.3.4 Install seals and gaskets and apply grease and sealing	MM
	5.3.5 Fill or pre-charge component/assembly with oil, hydraulic fluid, fuel, nitrogen	MM
5.4	**Move component/assembly into installation area**	
	5.4.1 Use hoist to lift component/assembly into installation area	MM
	5.4.2 Lift component/assembly into installation area	
5.5	**Insert, attach, tighten/torque/fasten and secure connecting elements to support structure**	
	5.5.1 Insert, tighten/torque and secure all attachment nuts and bolts	MM
	5.5.2 Insert, fasten and secure all attachment fasteners	MM
	5.5.3 Attach, tighten/torque and secure all attachment clamps and QAD devices	MM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
5.6	**Connect all connections to the system(s)**	
	5.6.1 Connect electrical connectors (be aware of remaining voltage – capacitors)	MM
	5.6.2 Connect hydraulic lines (be aware of leakage and remaining pressure)	MM
	5.6.3 Connect pneumatic ducts and lines (be aware of remaining pressure)	MM
	5.6.4 Connect all other supply lines (fuel, water, oxygen, etc.) (be aware of leakage and remaining pressure)	MM
	5.6.6 Connect bonding jumpers	MM
5.7	**Perform adjustments (see 7)**	
	5.7.1 Perform adjustments	MM
	5.7.2 Take and record measurements	MM
5.8	**Apply safety precautions in installation area**	
	5.8.1 Clean installation area	MOPM
	5.8.2 Perform visual inspection	MOPM
	5.8.3 Remove all tools and equipment, check work area for leftover objects	MOPM
	5.8.4 Perform required duplicated inspections	MOPM
5.9	**Apply safety precautions in flight deck/Activation**	
	5.9.1 Unlock mechanical control devices	MM
	5.9.2 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
5.10	**Complete installation**	
	5.10.1 Perform leak test (see 7)	MM
	5.10.2 Perform operational test (see 7)	MM
	5.10.3 Perform functional test (see 7)	MM
	5.10.4 Restore aircraft to Normal status – Close installation area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	5.10.5 Establish and sign maintenance records	MOPM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
6.	**ADJUST**	
6.0	**Recognize and manage potential threats and errors**	MOPM
6.1	**Prepare for adjustment**	
	6.1.1 Read related maintenance instruction	MM
	6.1.2 Prepare required tools	MM
	6.1.3 Prepare required equipment	MM
	6.1.4 Prepare maintenance records	MOPM
	6.1.5 Assign required duplicated inspections	
	6.1.6 Instruct supporting staff	MOPM
	6.1.7 Get access to component/assembly	MM
	6.1.8 Locate component/assembly	MM
6.2	**Apply safety precautions/maintenance practices**	
	6.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	6.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	6.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
6.3.	**Perform adjustment**	
	6.3.1 Install measuring devices (gages, fixtures, templates, etc.)	MM
	6.3.2 Take and record existing measurements/parameters. Perform Test (see 7– Operate component/assembly as required)	MM
	6.3.3 Compare measurements/parameters taken with measurements specified for operational efficiency and integrity of system, sub-system, assembly or component	MM
	6.3.4 In case of measurement/parameter deviations from specified tolerances perform adjustment to be in compliance with specification	MM
6.4	**Apply safety precautions in adjustment area and flight deck**	
	6.4.1 Clean adjustment area	MOPM
	6.4.2 Perform visual inspection	MOPM
	6.4.3 Perform required duplicated inspections	MOPM
	6.4.4 Remove all tools and equipment, check work area for leftover objects	MOPM
	6.4.5 Unlock mechanical control devices	MM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	6.4.6 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
6.5	**Complete adjustment**	
	6.5.1 Restore aircraft to Normal status – Close adjustment area and restore normal power supply to system/sub-system/assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	6.5.2 Establish and sign maintenance records	MOPM
7.	**TEST**	
7.0	**Recognize and manage potential threats and errors**	MOPM
7.1	**Prepare for operational test**	
	7.1.1 Read related maintenance instruction	MM
	7.1.2 Prepare maintenance records	MOPM
	7.1.3 Instruct supporting staff	MOPM
	7.1.4 Get access to control and monitoring devices of system/sub-system/ assembly/component	MM
	7.1.5 Identify whether any step in a maintenance task procedure requires maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
7.2	**Perform operational test**	
	7.2.1 Establish power supply to system/sub-system/assembly/component (electric, hydraulic, pneumatic)	MM
	7.2.2 Operate system/sub-system/assembly/component through its various positions and conditions using on-board control devices	MM
	7.2.3 Monitor system/sub-system/assembly/component positions and conditions using on-board monitoring devices	MM
	7.2.4 Compare monitored system/sub-system/assembly/component positions and conditions with normal specified operational positions and conditions and record any deviations	MM
7.3	**Complete operational test**	
	7.3.1 Restore aircraft to Normal status – Deactivate power supply to system/sub-system/assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	7.3.2 Establish and sign maintenance records	MOPM
7.4	**Prepare for functional/system test**	
	7.4.1 Read related maintenance instruction	MM
	7.4.2 Prepare required tools	MM
	7.4.3 Prepare required equipment	MM
	7.4.4 Prepare maintenance records	MOPM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	7.4.5 Assign required duplicated inspections	MOPM
	7.4.6 Instruct supporting staff	MOPM
	7.4.7 Get access to component/assembly	MM
	7.4.8 Locate component/assembly	MM
7.5	**Apply safety precautions/maintenance practices**	
	7.5.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	7.5.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	7.5.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
7.6	**Perform functional/system test**	
	7.6.1 Install measuring devices and test equipment (gages, fixtures, templates, testers, etc.)	MM
	7.6.2 Establish power supply to system/sub-system/assembly/component (electric, hydraulic, pneumatic)	MM
	7.6.3 Operate system/sub-system/assembly/component through the various positions and conditions of the functional test programme using on-board control devices and/or supplemental test equipment	MM
	7.6.4 Monitor system/sub-system/assembly/component positions and conditions using on-board monitoring devices and/or supplemental test equipment	MM
	7.6.5 Compare monitored system/sub-system/assembly/component positions and conditions with minimum acceptable system or unit design specifications and record any deviations	MM
7.7	**Apply safety precautions in test area and flight deck**	
	7.7.1 Perform visual inspection	MOPM
	7.7.2 Remove all tools and equipment, check work area for leftover objects	MOPM
	7.7.3 Unlock mechanical control devices	MM
	7.7.4 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
7.8	**Complete functional/system test**	
	7.8.1 Restore aircraft to Normal status – Close test area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	7.8.2 Establish and sign maintenance records	MOPM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
8.	**INSPECT**	
8.0	**Recognize and manage potential threats and errors**	MOPM
8.1	**Prepare for inspection**	
	8.1.1 Read related maintenance instruction	MM
	8.1.2 Prepare required tools	MM
	8.1.3 Prepare required equipment	MM
	8.1.4 Prepare maintenance records	MOPM
	8.1.5 Instruct supporting staff	MOPM
	8.1.6 Get access to inspection area	MM
	8.1.7 Locate inspection items	MOPM
8.2	**Apply safety precautions/deactivation**	
	8.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	8.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	8.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
8.3	**Perform inspection**	
	8.3.1 Clean inspection area	MM
	8.3.2 Remove paint as required	MM
	8.3.3 Identify inspection criteria per inspection item	MOPM
	8.3.4 Prepare record sheet for inspection results (including limits and tolerances)	MM
	8.3.5 Identify items which need to be removed from aircraft for inspection	MM
	8.3.6 Remove items from aircraft which require “bench” inspection	MM
	8.3.7 Perform general visual inspection – examine for signs of physical damage, corrosion, leaks, correct installation, missing items – use judgement for deviation from normal condition	MOPM
	8.3.8 Perform detailed visual inspection – use inspection tools for examination of wear, play, leaks, corrosion and compare measurements with specified limits and tolerances (permitted wear dimensions)	MM
	8.3.9 Record inspection results/deviations/defects	MOPM
8.4	**Apply safety precautions in adjustment area and flight deck**	
	8.4.1 Remove all tools and equipment, check work area for leftover objects	MOPM
	8.4.2 Unlock mechanical control devices	MM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	8.4.3 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
8.5	**Complete inspection**	
	8.5.1 Re-install items that had been removed from the aircraft for inspection	MM
	8.5.2 Restore aircraft to Normal status – Close inspection area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	8.5.3 Establish and sign maintenance records	MOPM
9.	**CHECK**	
9.0	**Recognize and manage potential threats and errors**	MOPM
9.1	**Prepare for the check**	
	9.1.1 Read related maintenance instruction	MM
	9.1.2 Prepare required tools	MM
	9.1.3 Prepare required equipment	MM
	9.1.4 Prepare maintenance records	MOPM
	9.1.5 Instruct supporting staff	MOPM
	9.1.6 Get access to component/assembly	MM
	9.1.7 Locate component/assembly	MM
9.2	**Apply safety precautions/maintenance practices**	
	9.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	9.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	9.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
9.3	**Perform check**	
	9.3.1 Identify check criteria	MOPM
	9.3.2 Prepare record sheet for check results (including check procedure, limits and tolerances)	MM
	9.3.3 Verify that the condition and installation of the item to be checked is within specified limits and tolerances (check service indicators, filters, visual indicators, BITE indicators, torque values, etc.)	MM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	9.3.4 Check as per MM instruction that the item to be checked performs its designed specific tasks within the specified limits and tolerances (operate the item/set the item into certain conditions and monitor its positions and functions)	MM
	9.3.5 Record check results/deviations	MOPM
9.4	**Apply safety precautions in check area and flight deck**	
	9.4.1 Clean check area	MOPM
	9.4.2 Perform visual inspection	MOPM
	9.4.3 Remove all tools and equipment, check work area for leftover objects	MOPM
	9.4.4 Unlock mechanical control devices	MM
	9.4.5 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
9.5	**Complete check**	
	9.5.1 Restore aircraft to Normal status – Close inspection area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	9.5.2 Establish and sign maintenance records	MOPM
10.	**CLEAN**	
10.0	**Recognize and manage potential threats and errors**	MOPM
10.1	**Prepare for cleaning**	
	10.1.1 Read related maintenance instruction	MM
	10.1.2 Prepare required tools	MM
	10.1.3 Prepare required equipment	MM
	10.1.4 Prepare maintenance records	MOPM
	10.1.5 Instruct supporting staff	MOPM
	10.1.6 Get access to area/component/assembly	MM
	10.1.7 Locate component/assembly	MM
10.2	**Apply safety precautions/maintenance practices**	
	10.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	10.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	10.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
10.3	**Perform cleaning**	
	10.3.1 Identify materials located in cleaning area	MM
	10.3.2 Protect items which should not get into contact with cleaning agent	MOPM
	10.3.3 Identify and select which required and allowed cleaning agents are to be used in relation to the material of the item to be cleaned	MM
	10.3.4 Identify and select required and allowed cleaning method (manual cleaning, machine cleaning)	MM
	10.3.5 Verify whether paint has to be removed before cleaning – if required, remove paint	MM
	10.3.6 Perform cleaning process – remove contamination	MM
	10.3.7 Dry the cleaned area immediately following cleaning process	MOPM
	10.3.8 Re-lubricate and protect cleaned area as required (after any required inspection)	MM
10.4	**Apply safety precautions in cleaning area**	
	10.4.1 Perform visual inspection	MOPM
	10.4.2 Remove all tools and equipment, check work area for leftover objects	MOPM
	10.4.3 Unlock mechanical control devices	MM
	10.4.4 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
10.5	**Complete cleaning**	
	10.5.1 Restore aircraft to Normal status − Close cleaning area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	10.5.2 Establish and sign maintenance records	MOPM
11.	**PAINT**	
11.0	**Recognize and manage potential threats and errors**	MOPM
11.1	**Prepare for painting**	
	11.1.1 Read related maintenance instruction	MM
	11.1.2 Prepare required tools	MM
	11.1.3 Prepare required equipment	MM
	11.1.4 Prepare maintenance records	MOPM
	11.1.5 Instruct supporting staff	MOPM
	11.1.6 Get access to area/component/assembly	MM
	11.1.7 Locate component/assembly	MM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
11.2	**Apply safety precautions/maintenance practices**	
	11.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	11.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	11.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
11.3	**Perform painting**	
	11.3.1 Identify materials located in stripping/painting area	MM
	11.3.2 Attach stencils/mask items to protect items which should not get into contact with stripper/primer/paint	MOPM
	11.3.3 Identify and select required and allowed stripper/primer/paint in relation to material of item to be stripped/painted	MM
	11.3.4 Identify and select required and allowed stripping/painting method (manual, spray, machine method)	MM
	11.3.5 Verify whether paint has to be removed before painting	MM
	11.3.6 Perform stripping/mechanical paint removal process, as required	MM
	11.3.7 Clean and dry stripping/paint removal area	MOPM
	11.3.8 Check that temperature and humidity are suitable for priming/painting process	MM
	11.3.9 Perform priming/painting process	MM
	11.3.10 Dry priming/painting area	MM
	11.3.11 Verify whether finish/coating for painted area is required – if required, apply finish/coating	MM
11.4	**Apply safety precautions in painting area**	
	11.4.1 Perform visual inspection	MOPM
	11.4.2 Remove all tools and equipment, check work area for leftover objects	MOPM
	11.4.3 Unlock mechanical control devices	MM
	11.4.4 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
11.5	**Complete painting**	
	11.5.1 Restore aircraft to Normal status − Close painting area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	11.5.2 Establish and sign maintenance records	MOPM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
12.	**REPAIR**	
12.0	**Recognize and manage potential threats and errors**	MOPM
12.1	**Prepare for repair**	
	12.1.1 Read related fault report	MOPM
	12.1.2 Verify fault and add information to fault report if it is incomplete	MOPM
	12.1.3 Read related maintenance instruction	MM
	12.1.4 Prepare repair scheme as per maintenance instruction	MOPM
	12.1.5 Procure required materials	MM
	12.1.6 Prepare required tools	MM
	12.1.7 Prepare required equipment	MM
	12.1.8 Prepare maintenance records	MOPM
	12.1.9 Instruct supporting staff	MOPM
	12.1.10 Get access to component/assembly	MM
	12.1.11 Locate component/assembly	MM
12.2	**Apply safety precautions/maintenance practices**	
	12.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM
	12.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	
	12.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM
12.3	**Perform repair**	
	12.3.1 Identify areas/component that can be adversely affected during the performance of the repair process	MOPM
	12.3.2 Protect areas/components which can be adversely affected during the performance of the repair process	MOPM
	12.3.3 Perform repair scheme step by step and verify during the process that no limit/ tolerance is exceeded	MM
	12.3.4 Clean the repair area	MOPM
	12.3.5 Verify at the end of the repair process that the physical integrity of the repaired parts is in an airworthy condition (in specified permitted dimensions) and that the parts fulfil their designed specific tasks	MM
12.4	**Apply safety precautions in repair area**	
	12.4.1 Perform visual inspection	MOPM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	12.4.2 Remove all tools and equipment, check work area for leftover objects	MOPM
	12.4.3 Unlock mechanical control devices	MM
	12.4.4 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
12.5	**Complete repair**	
	12.5.1 Restore aircraft to Normal status − Close repair area and restore normal power supply to system/sub-system/ assembly/component (electric, hydraulic, pneumatic) – set control devices into their Normal position	MM
	12.5.2 Establish and sign maintenance records	MOPM
13. PERFORM MEL AND CDL/DDPG PROCEDURES (Minimum Equipment List (MEL)/Configuration Deviation List (CDL)/Dispatch Deviation Procedures Guide (DDPG))		
13.0	**Recognize and manage potential threats and errors**	MOPM
13.1	**Prepare for procedure performance**	
	13.1.1 Read related fault report	MOPM
	13.1.2 Verify fault and add information to fault report if it is incomplete	MOPM
	13.1.3 Identify system/sub-system/assembly/component which cause(s) the fault as per fault isolation process	MM
	13.1.4 Consult with the flight crew for details about experienced fault (if possible) and details about the planned flight mission	MOPM
	13.1.5 Consult MEL to determine whether the flight mission can be performed with existing fault	MMEL MEL
	13.1.6 Consult CDL/DDPG to determine whether the flight mission can be performed with missing assembly/component	DDPG
	13.1.7 Remove faulty assembly/component when necessary	MM
	13.1.8 Ensure that application of MEL/CDL/DDPG repair deferral in addition to other existing deferred fault rectifications is not affecting the aircraft's airworthiness	Tech Log
	13.1.9 Consult with flight crew to confirm they will accept application of MEL/ CDL/DDPG – to defer fault rectification – for the planned flight mission	MOPM
	13.1.10 Check whether MEL/DDPG operational or maintenance procedure has to be performed	MEL DDPG
	13.1.11 Ensure that the flight crew is aware of and understand the need to perform the MEL/CDL/DDPG operational procedure	MOPM
	13.1.12 Read related maintenance instruction	MM
	13.1.13 Prepare required tools	MM
	13.1.14 Prepare required equipment	MM
	13.1.15 Prepare maintenance records	MOPM
	13.1.16 Instruct supporting staff	MOPM
	13.1.17 Get access to component/assembly	MM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	13.1.18 Locate component/assembly	MM
13.2	**Perform MEL or CDL/DDPG maintenance procedure**	
	13.2.1 Perform MEL maintenance procedure	MM
	13.2.2 Perform CDL/DDPG maintenance procedure	MM
13.3	**Apply safety precautions in repair area**	
	13.3.1 Perform visual inspection	MOPM
	13.3.2 Remove all tools and equipment, check work area for leftover objects	MOPM
	13.3.3 Unlock mechanical control devices which have not been installed as part of any MMEL/CDL/DDPG - lock-out procedure	MM
	13.3.4 Un-tag all flight deck and external control devices which were involved in the safety precautions and which have not been installed as part of any MMEL/ CDL/DDPG lock-out procedure	MM
13.4	**Complete MEL/CDL/DDPG procedure**	
	13.4.1 Restore aircraft to acceptable status in accordance with MEL/CDL/DDPG conditions and limitations Close work area and set control devices into MEL/CDL/DDPG required position. (set those which are not related to the MEL/CDL/DDPG procedure into their Normal position)	MM
	13.4.2 Establish and sign maintenance records	MOPM Tech Log

3. Competency units, competency elements and performance criteria for aircraft structure maintenance personnel.

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
1.	**PERFORM AIRCRAFT STRUCTURAL REPAIR INSPECTION**	
1.0	**Recognize and manage potential threats and errors**	MOPM
1.1	**Prepare for inspection**	
	1.1.1 Read related aircraft structural repair inspection instruction	SRM
	1.1.2 Prepare required tools	MM/SRM
	1.1.3 Prepare required equipment	MM/SRM
	1.1.4 Prepare maintenance records	MOPM
	1.1.5 Instruct supporting staff	MOPM
	1.1.6 Gain access to inspection area	MM/SRM
	1.1.7 Locate inspection items	MOPM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
1.2	**Apply safety precautions/Deactivation**	
	1.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM Chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM/SRM
	1.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	MM/SRM
	1.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM/SRM
1.3	**Perform aircraft structural repair inspection**	MM/SRM
	1.3.1 Clean area to be inspected, e.g. doors, skin plates, fairings, floor structure, stringers, stiffeners, flaps	MM/SRM
	1.3.2 Remove paint and other finishing materials as required	MM/SRM
	1.3.3 Identify inspection criteria for the structural component or area, and apply aerodynamic smoothness measurement criteria to all surfaces being inspected	SRM
	1.3.4 Refer to the appropriate ATA chapter for specific instructions related to the area to be inspected, e.g. doors, fuselage, nacelles/pylons, stabilizers, windows, wings	SRM
	1.3.5 Prepare record sheet for inspection results (including limits and tolerances)	MM/SRM
	1.3.6 Identify items which need to be removed from aircraft for inspection	MM/SRM
	1.3.7 Remove items from aircraft which require bench inspection	MM/SRM
	1.3.8 Perform general visual inspection – examine for signs of physical damage, heat, corrosion, leaks, correct installation, missing items – use judgement for deviation from normal condition	MOPM
	1.3.9 Perform detailed visual inspection – use inspection tools for examination of wear, play, leaks, corrosion and compare measurements with given limits and tolerances (permitted wear dimensions)	MM
	1.3.10 Where applicable, perform non destructive testing (NDT) inspection	SRM
	1.3.11 Apply applicable maintenance instruction for inspection type and reference inspection instructions at Page Blocks 101/102	SRM
	1.3.12 Record inspection results including observations, deviations, and defects	MOPM
1.4	**Apply safety precautions in structural repair and flight deck areas**	
	1.4.1 Remove all tools and equipment and check work area for leftover objects	MOPM
	1.4.2 If applicable, unlock mechanical control devices	MM
	1.4.3 If applicable, un-tag all flight deck and external control devices which were involved in the safety precautions	MM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
1.5	**Complete aircraft structural repair inspection**	
	1.5.1 Re-install items that have been removed from the aircraft for inspection	MM
	1.5.2 Restore aircraft to Normal status and close inspection area	MM
	1.5.3 Establish and sign maintenance records	MOPM
2.	**PERFORM STRUCTURAL DAMAGE INVESTIGATION, CLEANUP, AND AERODYNAMIC SMOOTHNESS CHECK**	
2.0	**Recognize and manage potential threats and errors**	MOPM
2.1	**Prepare to perform damage investigation, cleanup, and aerodynamic smoothness check**	
	2.1.1 Read related maintenance instruction	MM/SRM
	2.1.2 Prepare required tools	MM/SRM
	2.1.3 Prepare required equipment	MM/SRM
	2 1.4 Prepare maintenance records	MOPM
	2.1.5 Instruct supporting staff	MOPM
	2.1.6 Gain access to structural area to be investigated	MM
	2.1.7 Locate structural area or component	MM/SRM
	2.1.8 Where necessary, remove structural part from aircraft before performing damage investigation	MM/SRM
2.2	**Apply safety precautions/maintenance practices**	
	2.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 51, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM/SRM
	2.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	MM/SRM
	2.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM/SRM
2.3	**Determine structural damage classification**	SRM
	2.3.1 Using the ATA chapter index, locate the chapter, section, and table of contents that refers to the damaged part	SRM
	2.3.2 Refer to the topic addressing allowable damage limits/Page Block 101, and determine applicability for part/structure in question	SRM
	2.3.3 Examine the part/structural component for damage tolerance/limits and record findings/observations	MOPM/SRM
2.4	**Determine damage repair applicability**	SRM
	2.4.1 Refer to the *identification* page for the damaged structural part affected, and determine the *action* or *repair* for the damaged area under review	SRM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	2.4.2 Determine if part has a reference to a repair within the manual, either in the chapter concerned or in another chapter and record damage classification	SRM
	2.4.3 Use the applied classification to determine repair procedure	SRM
	2.4.4 Document and record structural damage details: include length, width, diameter, orientation and any additional dimensions defining the damage or repair geometry (if applicable – depth of dent, etc.)	SRM
	2.4.5 Use data or defect recording form to register damage findings and observations	MOPM
2.5	**Perform structural surface cleanup**	
	2.5.1 Refer to the specific section of the ATA chapter that applies to the area to be cleaned	SRM
	2.5.2 Access area to be cleaned and set up for cleaning activity with necessary tools and equipment	SRM
	2.5.3 Isolate and prepare area to be cleaned and protect adjacent structural parts and components from cleaning solvents, chemicals, or other specified cleaning materials/solutions	SRM
	2.5.4 Perform cleanup process as detailed in the referenced ATA chapter for the type of material being cleaned	SRM
	2.5.5 Follow step-by-step procedures for cleaning application and respect applicable warning and caution related to application	SRM
	2.5.6 Apply cleaning materials to structural area being cleaned and remove any excess from surface being cleaned	SRM
	2.5.7 Remove cleaning material once application time period has been reached	SRM
	2.5.8 Neutralize solvent, chemicals, or other cleaning materials with appropriate neutralizing materials as specified in the ATA chapter for the structural component	SRM
2.6	**Perform aerodynamic smoothness check**	
	2.6.1 Ensure that surface area has been properly cleaned and is free of contaminants	SRM
	2.6.2 Refer to applicable section of the ATA chapter to determine applicable limitations for the structural area being checked	SRM
	2.6.3 Prepare for surface measurement by selecting tools and equipment to measure the structural surface area	SRM
	2.6.4 Perform measurement over entire structural area to check for degree of smoothness against allowable limitations listed in the reference tables located in the applicable ATA chapter	SRM
	2.6.5 Check for loose rivets, fasteners, or other attachment hardware	SRM
	2.6.6 Record any data that is found to be beyond limits such as: dents, depressions, heat deformation, pitting, cracks, delamination, or other structural anomalies that fall outside of the smoothness limits	SRM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	2.6.7 Close-up area and remove any tools or equipment used in the aerodynamic smoothness check	SRM
2.7	**Apply safety precautions in activity area**	
	2.7.1 Re-install items that have been removed from the aircraft to accommodate performance of damage investigation	MM
	2.7.2 Perform visual inspection	SRM
	2.7.3 Remove all tools and equipment; check that work area is clean and free of objects	SRM
2.8	**Complete structural damage investigation, cleanup, and aerodynamic smoothness check**	
	2.8.1 Restore aircraft to Normal status and close out the area if no further activities are required	SRM
	2.8.2 Complete and sign maintenance records where necessary	MOPM
3.	**PERFORM SPECIAL PROCESS APPLICATION**	
3.0	**Recognize and manage potential threats and errors**	MOPM
3.1	**Apply safety precautions/maintenance practices**	
	3.1.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 51, 60 or 70; • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM; or • Special maintenance practice application – as per Special Maintenance Procedure Manual (e.g. NDT, welding)	MM/SRM
	3.1.2 Identify and apply safety precautions required for the maintenance/inspection task	MM/SRM
	3.1.3 Where necessary, tag all flight deck and external control devices which are involved in the safety precautions	MM/SRM
	3.1.4 Perform Special Maintenance Procedure as per Special Maintenance Practice Manual	SMPM
3.2	**Identify type and form of special process to be applied**	SRM
	3.2.1 Refer to applicable section of ATA chapter, Structures – General and identify process to be applied	SRM
	3.2.2 Review pertinent data, procedures, tables, and application process associated with the selected process (e.g. protective treatment; corrosion prevention; special coatings; paint coatings; sealing; or other selected special process)	SRM
3.3	**Apply special process**	SRM
	3.3.1 Where necessary, remove structural part from aircraft before proceeding with process application	SRM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	3.3.2 Refer to Page Block 201 in ATA chapter to address specific structural element to be processed, review applicability status, and special tools/equipment requirements	SRM
	3.3.3 Confirm process applicability and effectivity for aircraft or structure to be processed	SRM
	3.3.4 Observe all cautions and warnings related to the use of chemicals and cleaning materials, sealants and adhesives	SRM
	3.3.5 Become familiar with specific data references, and application limitations for the selected process/activity	SRM
	3.3.6 Apply the special process to the affected area as detailed in the application instructions for: protective treatment; corrosion prevention; special coatings; paint coatings; sealing; or other selected special process	SRM
3.4	**Complete application of special process**	
	3.4.1 Re-install items that have been removed from the aircraft to accommodate application of special process	MM
	3.4.2 Remove all tools and special equipment used to support the special process activity	SRM
	3.4.3 Clean and close out area; remove all tools and equipment from reworked area	SRM
	3.4.4 Complete and sign maintenance records	MOPM
4.	**PERFORM METAL REWORK/TESTING**	
4.0	**Recognize and manage threats and errors**	MOPM
4.1	**Apply safety precautions/maintenance practices**	
	4.1.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 51, 60 or 70; • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM; or • Special maintenance practice application – as per Special Maintenance Procedure Manual (e.g. NDT, welding)	MM/SRM
	4.1.2 Identify whether any safety precautions required are for the maintenance/ inspection task and apply them	MM/SRM
	4.1.3 Where necessary, tag all flight deck and external control devices which are involved in the safety precautions	MM/SRM
	4.1.4 Perform Special Maintenance Procedure as per Special Maintenance Practice Manual	SMPM
4.2	**Prepare for metal rework and testing**	SRM
	4.2.1 Identify metal rework or testing to be performed	SRM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	4.2.2 Refer to applicable section of ATA chapter, Structures – General – and identify rework activity to be applied	SRM
	4.2.3 Review pertinent data, procedures, tables, and application process associated with the selected metal re-work process (e.g. heat treatment, forming, bending, joggling, cutting, heat damage evaluation, hardness and conductivity testing, prestressing of components, or flap peening)	SRM
	4.2.4 Clean and prepare area for rework or testing activity	
	4.2.5 If structural component needs to be removed from the aircraft to facilitate rework or testing activity – refer to applicable ATA chapter maintenance procedures before removing structural part	MM/SRM
4.3	**Perform metal rework or testing**	
	4.3.1 Refer to Page Block 201 in ATA chapter to address specific structural element to be processed, and review aircraft applicability status	SRM
	4.3.2 Confirm process applicability and effectivity for aircraft or structure to be processed	SRM
	4.3.3 Become familiar with step-by-step procedure for process application and observe all safety precautions, data references, and application limitations	SRM
	4.3.4 Select tools and special equipment required to perform rework or testing activity	SRM
	4.3.5 Perform NDT inspection before starting any repair to confirm absence of cracks or deformities	SRM
	4.3.6 Perform NDT inspection before and after applying forming techniques to sheet metal repairs	SRM
	4.3.7 Perform metal rework or testing activity as detailed in the applicable section of the ATA chapter associated with the metal rework activity (e.g. heat treatment, forming, bending, joggling, cutting, heat damage evaluation, hardness and conductivity testing, prestressing of components, and flap peening)	SRM
4.4	**Apply safety precautions in activity area**	
	4.4.1 Remove all tools and equipment; clean area	SRM
	4.4.2 Perform visual inspection for remaining objects	SRM
4.5	**Complete metal rework and testing activities**	
	4.5.1 Re-install items that have been removed from the aircraft to accommodate metal rework or testing activities	MM
	4.5.2 Complete maintenance records and documentation	MOPM/SRM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
5.	**PERFORM STRUCTURAL REPAIR**	
5.0	**Recognize and manage potential threats and errors**	MOPM
5.1	**Prepare for structural repair**	
	5.1.1 Read related maintenance instruction including relevant ATA chapter Page Blocks 101/201	SRM
	5.1.2 Prepare required tools	SRM
	5.1.3 Prepare required equipment	SRM
	5.1.4 Prepare maintenance records	MOPM
	5.1.5 Instruct supporting staff	MOPM
	5.1.6 Gain access and locate structural component to be repaired	SRM
	5.1.7 Take and record any required measurements	SRM
5.2	**Apply safety precautions/maintenance practices**	MM/SRM
	5.2.1 Identify whether any step in a maintenance task procedure requires either: • Generic SPM application; • Specialty-rated standard maintenance practice application – as per MM chapters 20, 60 or 70; or • Maintenance practice application – as per Page Block 200 in each ATA chapter of the MM	MM/SRM
	5.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	MM/SRM
	5.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MM/SRM
5.3	**Determine structural repair effectivity**	
	5.3.1 Consult applicable section of the ATA chapter and Page Blocks 101 and 201 to determine repair eligibility status	SRM
	5.3.2 Apply damage category data, e.g. allowable, repairable or replaceable	SRM
	5.3.3 Determine aircraft effectivity status applicable to the structural area to be repaired by making reference to weight variant lists (aircraft modifications, service bulletin, identification, coverage, exclusion, and airplane allocation lists)	SRM
	5.3.4 Identify allowable repair scheme options and select appropriate repair for the type of structure, such as sheet metal, honeycomb or composites	SRM
	5.3.5 Become familiar with all special processes or procedures applicable to the type of material being repaired, such as metal or composite	SRM
	5.3.6 Identify and select replacement parts and materials to be used in the repair process	SRM
	5.3.7 Identify areas/component that can be adversely affected during the performance of the repair process	SRM

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
	5.3.8 Protect areas/components which can be adversely affected during the performance of the repair process	SRM
5.4	**Perform structural repair**	
	5.4.1 If a structural component is to be removed, refer to appropriate section of ATA chapter for removal and installation procedures	SRM
	5.4.2 Access and apply repair scheme specification data per Page Block 201 and other applicable chapter references (data, tables, etc.)	SRM
	5.4.3 Perform the selected repair scheme – step-by-step and verify during the repair process that no limit/tolerance is exceeded	SRM
	5.4.4 Where repairs are performed on honeycomb panels, graphite aramid, fibreglass, polyimide glass fabric and other composite materials, be mindful of safety procedures while handling toxic or hazardous materials	SRM
	5.4.5 Verify at the end of the repair process that the physical integrity of the repaired area meets structural integrity specifications	SRM
	5.4.6 Perform balancing of structural component, if applicable (e.g. aileron, elevator, rudder)	SRM
5.5	**Apply finishing to structural repair**	
	5.5.1 Clean the repaired area	SRM
	5.5.2 Refer to repair specification and apply finishing, sealing, or paint protection as detailed in the repair specification for metal or composite surface to be finished	SRM
	5.5.3 Maintain aerodynamic smoothness/limitations called for in the repair specification; e.g. application of fasteners, rivets	SRM
	5.5.4 Reference applicable ATA chapters (52-57) when applying finishes to composite materials, such as glassfiber reinforced plastic, carbonfiber reinforced plastic, or aramidfiber reinforced plastic	SRM
5.6	**Apply safety precautions in repair area**	
	5.6.1 Re-install items that have been removed from the aircraft to accommodate performance of structural repair activities	MM
	5.6.2 Perform visual inspection	MOPM
	5.6.3 Remove all tools and equipment, check work area for leftover objects	MOPM
	5.6.4 Unlock mechanical control devices	MM
	5.6.5 Un-tag all flight deck and external control devices which were involved in the safety precautions	MM
5.7	**Complete structural repair**	
	5.7.1 Clean and close out area	SRM
	5.7.2 Complete and sign maintenance records	MOPM

4. Competency units, competency elements and performance criteria for aircraft component maintenance personnel

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
1.	**PERFORM TESTING FAULT ISOLATION**	
1.0	**Recognize and manage potential threats and errors**	
1.1	**Prepare for testing and fault isolation – collect fault data**	
1.1.1	Collect fault data from relevant aircraft technical logs (printed or electronic) of pilot or maintenance reports – if available	MOPM
1.1.2	Collect data from aircraft recorders/in-flight transmitted records (maintenance messages) – if available	MOPM
1.1.3	Collect fault data from maintenance defect sheet – if available	MOPM
1.1.4	Collect fault data from repair order	MOPM
1.2	**Verify fault data**	
1.2.1	Perform inspection to verify physical status of the component	MOPM
1.2.2	Identify available component-specific tests and test procedures	CMM
1.2.3	Select component-specific tests and test procedures appropriate to the available fault data – if necessary identify progressive levels of testing (manual tests and automatic tests)	CMM
1.2.4	Consult maintenance instructions for the relevant test procedures, including diagrams and schematics	CMM
1.2.5	Identify test equipment and material required to perform planned tests	CMM
1.2.6	Prepare test set-up data, test input and output parameters, and parameter limits; prepare test record	CMM
1.2.7	Progressively perform the return-to-service test to verify or identify/isolate the fault(s) of the complete component and its individual subassemblies, and to identify the required maintenance actions to restore the component into a serviceable condition	CMM
1.2.7.a	If built-in-test equipment (BITE) is provided for a component, perform this test first. Determine whether the component needs further test (detailed performance test) or repair Erase BITE memory after test, if applicable	CMM
1.2.8	Record all test results and fault findings	MOPM
1.3	**Define fault rectification procedure**	
1.3.1	Make decision whether operation can be continued without additional fault rectification	MOPM
1.3.1.a	If yes – Return component back to service • Issue component tag with certificate of return to service (CRS) – Serviceable tag	
1.3.1.b	If no – Prepare fault rectification order	

X. X.X	COMPETENCY UNIT Competency element X.X.X Performance criteria	*Reference*
2.	**PERFORM DISASSEMBLY**	
2.0	**Recognize and manage potential threats and errors**	
2.1	**Identify the extent of necessary disassembly**	
	2.1.1 Identify the extent of disassembly necessary to get access to any faulty subassembly	CMM
2.2	**Prepare for disassembly**	
	2.2.1 Consult disassembly instructions	CMM
	2.2.2 Prepare tools, fixtures, equipment, and consumable items as required per disassembly instruction	CMM
	2.2.3 Review special tool procedures, if applicable	CMM
2.3	**Apply safety precautions/maintenance practices**	
	2.3.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Shop Practices Manual application • Special procedures application – as per CMM	MOPM
	2.3.2 Identify whether any safety precautions are required for the maintenance task and apply them	MOPM
2.4	**Perform disassembly**	
	2.4.1 Perform disassembly as per CMM procedure – step-by-step instructions in a logical sequence to the extend required, with minimum disturbance of other serviceable parts in the component	CMM
	2.4.2 Keep parts in matched sets where required	CMM
	2.4.3 Document the maintenance records for references during re-assembly – items like shims and spacer location or wiring routing	MOPM
2.5	**Complete disassembly**	
	2.5.1 Complete and sign maintenance records	MOPM
3	**CLEAN**	
3.0	**Recognize and manage potential threats and errors**	
3.1	**Prepare for cleaning**	
	3.1.1 Consult the cleaning instructions or standard cleaning practices for the parts involved in the process	CMM
	3.1.2 Prepare any tools, fixtures, equipment and consumable items as required per the cleaning instructions	CMM
	3.1.3 Review special tool procedures, if applicable	CMM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
3.2	**Apply safety precautions/maintenance practices**	
	3.2.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Shop Practices Manual application • Special procedures application – as per CMM	MOPM
	3.2.2 Identify whether any safety precautions are required for the maintenance task and ensure they are applied	MOPM
3.3	**Perform cleaning**	
	3.3.1 Identify materials located in cleaning area and of those parts to be cleaned	CMM
	3.3.2 Protect items which should not get into contact with cleaning agent	MOPM
	3.3.3 Identify and select required and allowed cleaning agents in relation to material of items to be cleaned	CMM
	3.3.4 Identify and select required and allowed cleaning method (manual cleaning, machine cleaning)	CMM
	3.3.5 Verify whether paint has to be removed before cleaning – if required: remove paint	CMM
	3.3.6 Perform cleaning process – remove contamination	CMM
	3.3.7 Dry cleaning area immediately following cleaning process	MOPM
3.4	**Complete cleaning**	
	3.4.1 Establish and sign maintenance records	MOPM
4.	**PERFORM INSPECTION/CHECK**	
4.0	**Recognize and manage potential threats and errors**	MOPM
4.1	**Prepare for inspection/check**	
	4.1.1 Consult inspection/check instructions or standard inspection/check practices for the parts involved in the process	CMM
	4.1.2 Prepare any tools, fixtures, equipment, and consumable items as required per inspection/check instructions	CMM
	4.1.3 Review special tool procedures, if applicable	CMM
4.2	**Apply safety precautions/maintenance practices**	
	4.2.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Shop Practices Manual application • Special procedures application – as per CMM	MOPM
	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	CMM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
4.3	**Perform inspection/check**	
	4.3.1 Identify inspection criteria per inspection item as: • serviceability of parts and subassemblies • reparability of parts (because of technical or economical reason) • specific inter-relationships between parts that perform a functional operation	MOPM
	4.3.2 Prepare record sheet for inspection results (including limits and tolerances for fits and clearances, nature and maximal allowable extent of defects)	CMM
	4.3.3 Identify items which need special inspection procedures like non-destructive-testing (NDT)	CMM
	4.3.4 Perform general visual inspection – examine for signs of physical damage, corrosion, leaks, correct installation, missing items – use judgement for deviation from normal condition	CMM
	4.3.5 Perform detailed visual inspection – use inspection tools for examination of wear, play, leaks, corrosion and compare measurements with given limits and tolerances (permitted wear dimensions)	CMM
	4.3.6 Record inspection results/deviations/defects	MOPM
4.4	**Complete Inspection**	
	4.4.1 Record and scrap all parts which are not serviceable or repairable	MOPM
	4.4.3 Complete and sign maintenance records	MOPM
5.	**REPAIR**	
5.0	**Recognize and manage potential threats and errors**	MOPM
5.1	**Prepare for repair**	
	5.1.1 Consult repair instructions or repair practices for the parts involved in the process	CMM
	5.1.2 Prepare any tools, fixtures, equipment, material and consumable items as required per repair instructions	CMM
	5.1.3 Review special tool procedures, if applicable	CMM
5.2	**Apply safety precautions/maintenance practices**	
	5.2.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Shop Practices Manual application • Special procedures application – as per CMM	MOPM
	5.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	CMM
5.3	**Perform repair**	
	5.3.1 Identify areas of possible restoration	CMM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
	5.3.2 Identify machining instructions and specifications like: • surface finish • concentricity • squareness • parallelism • heat treatment range • chamfers • edge break radius tolerances • shot peening • plating	CMM
	5.3.3 Identify areas/parts that can be adversely affected during the performance of the repair process	MOPM
	5.3.4 Protect areas/parts which can be adversely affected during the performance of the repair process	MOPM
	5.3.5 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	CMM
	5.3.6 Clean the repair area	MOPM
	5.3.7 Verify at the end of the repair process that the physical integrity of the repaired parts is such that the parts are in an airworthy condition (in permitted dimensions) and that the parts fulfil their designed specific tasks	CMM
5.4	**Complete repair**	
	5.4.1 Complete and sign maintenance records	MOPM
6.	**PERFORM ASSEMBLY**	
6.0	**Recognize and manage potential threats and errors**	MOPM
6.1	**Prepare for repair**	
	6.1.1 Consult assembly instructions or standard assembly practices for the parts involved in the process	CMM
	6.1.2 Prepare any tools, fixtures, equipment, material and consumable items as required per assembly instructions	CMM
	6.1.3 Review special tool procedures, if applicable	CMM
6.2	**Apply safety precautions/maintenance practices**	
	6.2.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Shop Practices Manual application • Special procedures application – as per CMM	MOPM
	6.2.2 Identify whether any safety precautions are required for the maintenance task and apply them	CMM

X. X.X	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
6.3	**Perform assembly**	
	6.3.1 Perform assembly in accordance with step-by-step assembly instructions in a logical sequence: • Comply with any notes which have been recorded during disassembly for proper installation of parts • Comply with assembly fits and clearances as found in the page block “Fits and Clearances” • Perform required adjustments • Use proper torque values for all fasteners • Comply with special requirements like parts in matched sets or wiring requirements (routing and connections) • Perform procedures for sealing, cementing, lubricating, etc. • Perform as required intermediate calibrations during the assembly process if they cannot be performed after final assembly and record calibration data • Perform as required intermediate tests during the assembly process if they cannot be performed after final assembly and record test data	CMM
	6.3.2 Perform servicing of component through: • Identifying required media to be serviced (e.g. fluid or gas specifications) • Identifying required fill status of component/assembly • Connecting fill equipment to fill openings/ports and refilling with required fill quantity	CMM
	6.3.3 Perform final calibration after completion of final assembly	CMM
	6.3.4 Record final calibration data	
	6.3.5 Perform final test after completion of final assembly	CMM
	6.3.6 Record final test data	
6.4	**Complete assembly**	
	6.4.1 Complete and sign maintenance records	MOPM
	6.4.2 Issue component tag with certificate of return to service (CRS) – Serviceable tag	MOPM
7.	**PERFORM STORAGE (TRANSPORTATION)**	
7.0	**Recognize and manage potential threats and errors**	MOPM
7.1	**Prepare for storage**	
	7.1.1 Consult storage instructions or standard storage practices for the parts involved in the process	CMM
	7.1.2 Prepare any tools, fixtures, equipment, material and consumable items as required per storage instructions	CMM
	7.1.3 Get familiarized with special tool procedures, if applicable	CMM

X. **X.X**	**COMPETENCY UNIT** **Competency element** X.X.X Performance criteria	*Reference*
7.2	**Apply safety precautions/maintenance practices**	
	7.2.1 Identify the proper application to follow for all steps in the maintenance task procedure: • Generic Standard Storage Practices Manual application • Special procedures application – as per CMM	MOPM
	7.2.2 Identify whether any safety precautions are required for the storage procedure and apply them	CMM

Attachment A to Chapter 4
COMPETENCY-BASED TRAINING FOR AIRCRAFT MAINTENANCE — GUIDANCE ON THE DESIGN AND DEVELOPMENT OF A COMPETENCY-BASED TRAINING PROGRAMME FOR MAINTENANCE PERSONNEL

1. Introduction

This Attachment to Chapter 4 describes how the principles and procedures of the ICAO course development methodology can be applied in the development of an aircraft maintenance personnel training programme.

2. Design and development of an aircraft maintenance training programme through ICAO course development methodology

2.1 The ICAO course development methodology

The generic ICAO course development process is described in the Attachment to Chapter 2 of this document. For each phase of development, guidelines are provided for the development of aircraft maintenance training programmes.

2.2 Preliminary analysis

2.2.1 In October 2007, the IATA Training and Qualifications Initiative (ITQI) was launched. During that meeting, the issue of a human resource shortage for aircraft maintenance mechanics/engineers/technicians was raised. It was envisaged that this issue would be especially critical in emerging economies. It was therefore necessary to respond to a high training demand without sacrificing quality or impacting safety.

2.2.2 The preliminary study was pursued during the ITQI Engineering and Maintenance Kick-off meeting conducted in January 2008. It was concluded during this meeting that ICAO licensing and training standards as well as associated national regulations had not kept up with developments in training methodologies and new aircraft technologies. A need to harmonize regulatory frameworks was also identified. It was agreed that the use of a competency-based approach would support harmonization and that it should be accommodated in Annex 1.

2.3 Functional/task analysis

2.3.1 The aim of aircraft maintenance competency-based training is to ensure that personnel perform maintenance tasks to defined standards. In order to derive the competencies to be achieved, a functional/task analysis was carried out for several generic maintenance functions.

2.3.2 Regardless of aircraft type, today's aircraft design requires a set of generic competencies. Standard Practices Manuals (SPM), issued by the manufacturers and suppliers of aeronautical equipment, describe the methods to be applied, tools and equipment to be used, and the standards to which these tasks have to be performed. These basic generic competencies have been organized in three categories: aircraft (and engine) systems maintenance, aircraft structure maintenance, and component maintenance.

2.3.3 In addition to these Standard Practices, there are core competencies that apply throughout maintenance work and that shall be trained and evaluated. These core competencies are related to:

- Maintenance resource management and threat and error management in maintenance
- Work health and safety
- Adherence to industrial standards and regulatory and company procedures.

2.3.4 The performance of specialty-rated maintenance tasks requires the application of generic competencies acquired during fundamental training on specific aircraft and equipment. Assuming that generic competencies have been achieved, aircraft maintenance licence holders, after training on the specificities of the aircraft type and given appropriate maintenance instructions, shall be able to perform tasks within the scope of their licence/authorization privileges to given standards. This assumption is valid only if generic competencies have been properly examined and assessed.

2.3.5 If new Maintenance Practices or Special Maintenance Practices need to be applied, then additional competencies have to be acquired. These practices, which are specific to a type of equipment, are found in the appropriate Maintenance Instructions.

2.3.6 Beyond formal practical training, trainees will be required to undergo on-the-job training (OJT) under the supervision of qualified personnel in a maintenance environment for a certain time period. Only after successfully completing OJT can an authorization be issued to a candidate to perform specified maintenance work autonomously.

2.4 Population analysis

2.4.1 The target population for basic aircraft maintenance training is varied. Students bring a wide range of skills and abilities to aircraft maintenance. In order to ensure that fundamental maintenance training is effective, it is essential to determine whether potential trainees meet entry requirements and are well suited for the job. In this regard, Maintenance Organizations, in collaboration with AMTOs, may wish to establish entry requirements and selection criteria.

2.4.2 A competency-based approach to training for specialty-rating will also be useful, as it will allow maintenance organizations to compare the competencies that their personnel already hold against those that they should have to perform on specific aircraft or equipment. Personnel can then undergo training targeted to fill the competency gap identified by AMOs. This method can then increase efficiency in terms of training time and effort.

2.5 Curriculum design

2.5.1 Competency-based training and assessment of aircraft maintenance personnel is conducted in two steps: fundamental training and assessment (and licensing) conducted once; and training for specialty-rating and related assessments conducted multiple times as required. Recurrent training and assessment is also conducted to ensure that competencies of licence or authorization holders remain valid.

2.5.2 Competency-based training requires the integration of knowledge and practical skill training. Typically, knowledge and practical training have been designed and delivered independently. For example, knowledge training is delivered by a different set of instructors, in different training locations, and sometimes organizations, than practical skills training. Operational restrictions and resource constraints limit the extent to which knowledge and practical training can be conducted at the same location, at the same time, by the same instructional personnel. Therefore the design of a training programme for aircraft maintenance personnel should take these restrictions into account and specify how knowledge and practical training can be integrated in an effective and efficient manner.

2.5.3 In any case, competency-based examinations and assessments shall verify that candidates combine the knowledge and practical skills necessary to perform maintenance tasks for which the training was designed. A candidate's successful completion of these examinations and assessments depends on a well thought-out integrated training programme.

2.5.4 The competency frameworks found in Appendix 2 to Chapter 4 provide the basis from which training objectives should be derived for fundamental training and for training for specialty-rating. Curriculum design starts with the formulation of training objectives which correspond to the competency elements and performance criteria identified in the framework. (See Chapter 2, paragraph 5.2 and section 2.6 below).

2.5.5 Whether for fundamental training or training for specialty-rating, the terminal and enabling objectives should define what the student needs to demonstrate in terms of skills, knowledge and attitude (SKAs) for aircraft (and engine) systems maintenance, aircraft structure maintenance, and component maintenance. The terminal objectives shall reflect what must be accomplished at the end of the training programme for the issuance of a licence and/or authorization. The difference between training objectives of fundamental training and of training for specialty-rating will lie in the conditions and standards under which trainees are to perform.

2.5.6 There will be a need to administer key progress tests to ensure that students acquire the necessary SKAs. Students who fail a progress test should receive remedial training until such time as they have mastered that particular module.

2.6 Developing training objectives for aircraft maintenance training

2.6.1 As described in Chapter 2, a training objective states the (observable) ***desired action*** or ***behaviours***, the (measurable) ***standard*** and the ***conditions*** relevant to what must be accomplished by the student during each phase of training prior to reaching the desired level of competency.

2.6.2 The ***action statement*** or the ***statement of behaviours***, the most important part of the training objective, should always be expressed with a verb that specifies definite, observable actions. The competency elements and performance criteria found in Appendix 2 to Chapter 4 provide useful sources of suitable action verbs. Action verbs have also been developed in other learning/training objective taxonomies (Bloom, B.S (1956); Harrow, A. (1972) and Simpson, E. (1972)). Since these classifications were developed for general education purposes, however, they should only be used when a more domain-specific verb is not available.

2.6.3 Action verbs can be classified according to the different tasks or KSA they represent, which facilitates the development of an effective and efficient learning path. AMTOs should choose or develop the classification that best suits their own circumstances.

2.6.4 Where an action verb has to be used to define a skill to infer a non-observable process, as is often the case when assessing maintenance resource management (MRM), an overt or observable synonym should be used as evidence that the process has been carried out.

2.6.5 A training objective should clearly identify the ***conditions*** under which an action must be performed. Conditions consist of the training equipment on which training or assessment is being conducted (e.g. synthetic training devices), the environmental factors, aircraft and component configuration, situational factors and regulatory framework. Simulator training affords an opportunity for instructors and examiners to select and manipulate the conditions under which the training and assessment of competencies take place. Conditions relevant to particular training objectives may be selected for the training or assessment of specific KSA.

2.6.6 Training objectives will determine the design of the exercises and other units of training around which an aircraft maintenance training curriculum is constructed. They should be designed to facilitate the training and testing of MRM behaviours as integral features of each set of tasks related to competency units. Training with the aid of synthetic training devices or within the work environment will present different opportunities to structure learning activities so that they support the behaviours and conditions outlined by training objectives.

2.6.7 The training objective ***standard*** contains the criteria against which a student's performance is evaluated. In the case of the terminal objectives, these reflect the performance criteria developed against each of the aircraft maintenance competency elements. Licensing Authorities should ensure that these performance criteria are used in the preparation of examination and assessment guides or practical test standards. The standard will reflect the level of performance expected at each of the competency levels of the fundamental training schedule or of the training for specialty-rating schedule.

2.6.8 Training objective standards may be stated in the form of tolerances, constraints, limits, performance rates or qualitative statements. Where these criteria are contained in approved documents such as regulations, maintenance manuals, job cards, checklists or other approved maintenance instructions, only a reference to such documents in the standard section of the objective is needed.

2.6.9 In many instances, the action statement or statements of desired performance contained in training objectives established at different levels of competency can be exactly the same. The difficulty of the action to be performed and/or the standard against which it is

to be judged will be impacted by the conditions under which this action is to be performed. For example, performing “lockwiring” on mock-ups in a well organized training workshop is much easier than performing “lockwiring” at night, at freezing point, on the ramp, in the wheel well.

2.6.10 Once training objectives have been developed, they must be sequenced and grouped into the training modules that make up the different phases of the training schedule. A number of principles apply to the sequencing of training objectives. Generally speaking, a logical approach is to follow the order in which the related tasks are carried out in the maintenance environment. Other considerations, however, such as the differences or commonalities between objectives in terms of the tasks involved, their levels of difficulty and the complexity of the conditions under which the actions have to be carried out, also come into play.

2.6.11 The following are examples of sequencing principles that usually apply: objectives that are typical/standard/normal come before objectives that are atypical/non-standard/abnormal and, in the learning sequence, objectives that are simple, easy, and with low task loads come before those that are complex, difficult and with high task loads. These principles, in general, govern the design of instructional materials contained in the modules of a training programme.

2.6.12 After defining the training objectives, the course developer will design the tests that need to be passed by the student at different points in the programme. With respect to a competency-based maintenance training programme, ***mastery tests*** are those tests that correspond to terminal objectives. Additional ***progress tests*** may be developed for the purpose of providing feedback on the student’s progress towards achieving both the terminal objectives and the key enabling objectives. The aim of designing the mastery tests at this stage in the development of the programme, and prior to determining the actual content of the training, is to ensure that the test, and subsequently the content of the training, strictly correspond to the training objectives and to what the student is actually expected to do on the job.

2.6.13 All tests developed for a competency-based maintenance training programme, whether mastery or progress tests, should be ***criterion-referenced*** tests and assessments; the criteria used to measure competence should be published in examination and assessment guides and/or practical test standards. All tests must be reliable and valid, both in terms of being an appropriate measure of the competency being tested and of obtaining consistent results.

2.7 Design of training modules

2.7.1 Upon sequencing and grouping the training objectives and designing the mastery and progress tests, the course developer will design the training units that constitute a training curriculum for a competency-based maintenance training programme. As defined in the ICAO course development methodology, the basic building block in this process is the ***module***. Each phase of a competency-based maintenance training programme will consist of a number of building blocks of instruction or modules which, in turn, contain the instructional events used for training. In line with the ICAO course development methodology, the module is structured so that the training objectives are presented at the very beginning of the module, and instructional events in respect of the presentation of

content, the provision of practice and feedback, and the assessment of achievement follow in logical order.

2.7.2 For the purpose of achieving the enabling objectives at the early phases of training, instructional events should be designed as varied and simplified versions of real aircraft maintenance activities. During later phases of training, instructional events can then be designed to increasingly reflect the complexity of aircraft maintenance activities.

2.8 Selection of modes of delivery, training techniques and training media

2.8.1 The training objectives will determine the modes of delivery and training techniques that are to be used in the different phases of training. The consistent delivery of training for a competency-based maintenance training programme demands the use of a mixture of validated, approved training materials. All competency-based maintenance training programmes should be conducted by an approved maintenance training organization, and conditions for obtaining the authorization should include having the necessary documentation, manuals and equipment for conducting the course. The approval requirements also cover the employment and training of course developers and instructors, including those employed by AMOs for practical skill training.

2.8.2 In respect to training techniques, competency-based maintenance training programmes should require both individualized and group instruction depending on the training tasks being carried out. Classroom instruction can be delivered with the aid of group lectures and individualized learning can be delivered through computer-based training and e-learning.

2.8.3 In general, the selection of media, as described in the ICAO course development methodology (Attachment to Chapter 2 refers) depends on its instructional appropriateness, economy, simplicity and availability. As part of the process of the approval of a maintenance training organization and the training programme, Licensing Authorities should assess whether all facilities and training media are acceptable and appropriate for a competency-based maintenance training programme.

2.9 Production, developmental testing, validation, implementation and evaluation

2.9.1 The guidance provided up to this point has addressed the processes outlined for Phases 1 through 5 of the ICAO course development methodology. However, the process involved for the remaining Phases 6 through 9 in the development of a competency-based maintenance training programme presents a few elements that also require attention.

2.9.2 As outlined in the Attachment to Chapter 2, the output of Phase 6 results in all training materials being produced in such a manner as to allow any competent and suitably trained maintenance personnel to deliver the course. Consequently, a comprehensive, well-documented and formatted training programme does not differ from any other standardized training package.

2.9.3 Developmental testing is another important feature of Phase 6. In particular, mastery tests should go through developmental testing to ensure that they are valid and reliable. In the case of a competency-based maintenance training programme, this would include

developmental testing of scenario-based mastery tests to ensure that they actually match the corresponding training objective.

2.9.4 The purpose of validation (i.e. ICAO course development Phase 7) is to ensure that training materials can effectively guide trainees to the successful performance of mastery tests leading to the issuance of a licence/authorization.

2.9.5 Post-training evaluation is the last phase of the ICAO course development methodology. In the Attachment to Chapter 2, the four levels of evaluation are described.

———————

Attachment B to Chapter 4
DERIVING TRAINING OBJECTIVES FOR AIRCRAFT MAINTENANCE PERSONNEL

1. General

1.1 Training objectives are derived from the job and task analysis used to develop the competency frameworks for aircraft maintenance personnel contained in Appendix 2 to Chapter 4. The tasks to be performed during aircraft maintenance can be classified into generic tasks and specialty-rated tasks. The competency frameworks make an inventory of these generic tasks that can be performed on any kind of aeronautical equipment.

1.2 Some generic tasks, such as installation of nuts and bolts, hydraulic pipes, electrical connectors, etc., are described as “standard practices” in “Standard Practices Manuals” (SPM). These manuals specify what the task is, how it should be carried out and to which standards. These tasks, related to “standard practices”, have a correspondence in the competency framework – e.g. “*4.5.1 Loosen and remove all attachment nuts and bolts*” or “*4.7.2 Perform visual inspection*”.

1.3 Other generic tasks are related directly to “maintenance administrative procedures” – e.g. “*5.1.4 Prepare maintenance records*”. While these tasks can be initially addressed generically, they will need to be reviewed when applied in an actual maintenance organization’s environment operating under specific regulations.

1.4 A third group of generic tasks is listed in the competency framework, consisting of “specialty-rated tasks”. Specialty-rated tasks consist of generic tasks that can only be performed on specific pieces of equipment – e.g. “Perform Functional Test”. Examples of specialty-rated tasks, performed on type-specific equipment, are operation of a system or component, monitoring of the operation, fault isolation, removal and installation of components, operational and functional testing or adjustments. Specialty-rated tasks require underlying knowledge about system and component manufacture, assembly and function as well as cognitive skills. Tasks such as removal and installation, adjustments, repair, cleaning and painting consist of a set of standard practices (generic tasks) applied to a specific piece of equipment and therefore require additional psychomotor and cognitive skills.

1.5 To build the competency of a person being trained in aircraft maintenance, a twofold training programme is required consisting of “basic/fundamental training” and “training for specialty-rating”.

1.6 Basic/fundamental training programmes are aimed at ensuring that trainees acquire the underpinning psychomotor skills needed for the performance of standard practices. Additionally, underpinning knowledge about representative aircraft systems, sub-systems and components, their build-up and functional features has to be acquired as a prerequisite for specialty-rating. This is normally done in “Basic/Fundamental Training Programmes“. Training programmes for specialty-rating are aimed at ensuring that trainees can apply generic skills and knowledge in relation to specific equipment and the

acquisition of the necessary knowledge and cognitive and psychomotor skills.

2. Basic/fundamental training objectives

2.1 A two-step approach should be used to derive training objectives for basic/fundamental training programmes. First, basic/fundamental training programmes are designed for a particular maintenance position (normally represented by a certain aircraft maintenance licence category as described in Annex 1, paragraph 4.2.2). Based on the scope of the licence to be obtained, corresponding groups of generic tasks (standard practices) are selected out of the appropriate "Standard Practices Manual". All these groups of tasks have been documented in the competency frameworks of Appendix 2 to Chapter 4 as competency units. For example, the standard practice "*Electrical connective devices repair"* corresponds to the competency unit "*12. Repair*".

2.2 From the various individual tasks ("competency elements") belonging to a competency unit, terminal training objectives can be derived. A sample would be "*circular connectors repair*". Then for each individual task, several sub-tasks are performed. These are described in the performance criteria. Enabling objectives can be derived from the performance criteria. Refer to Example 1 below.

2.3. In developing the basic/fundamental training programmes, it will be important to specify the underpinning knowledge and cognitive skills required for successful achievement of the terminal and enabling training objectives. For training purposes, representative aircraft systems, sub-systems and their related components should be used and composed of those elements which are found in currently operated aircraft. These generic elements will be used to elaborate the generic knowledge and cognitive skill elements an aircraft maintenance person needs to master to support the performance of generic tasks and as a prerequisite for training for specialty-rating.

3. Objectives of a training programme for specialty-rating

3.1 Training objectives for a training programme for specialty-rating are based on the maintenance instructions for the particular piece of equipment concerned (e.g. aircraft maintenance manual, structural repair manual, component maintenance manual). A person holding a specialty-rated endorsement on his/her "aircraft maintenance licence or authorization" has to be competent to perform the tasks described in the instructions. All maintenance tasks listed in the maintenance instructions have therefore to be analysed for their particular training requirements and the derivation of corresponding training objectives.

3.2 A sample task is shown below: "Removal and installation of a flow control and shutoff valve of a certain aircraft".

The task in this sample is described in the aircraft's maintenance manual and is composed of two competency units:

- Remove component/assembly
- Install component /assembly

3.3 The various sub-tasks as described in the aircraft maintenance manual and their correspondence to competency elements are listed in Example 2. These sub-tasks again contain a series of steps (performance criteria).

3.4 Each of these specialty-rated "performance criteria" can be related to a generic one in the competency framework. If it relates to a standard practice, then no training objective needs to be defined since this objective would have been covered during basic/fundamental training. For those items which cannot be related to standard practices, training objectives have to be defined as they are specific to training for specialty-rating.

Example 1.
Competency-based training for aircraft maintenance personnel — Samples of training objectives for a competency unit in relation to generic (i.e. non-specialty-rated) standard practices: "Repair of a Wiring Circular Connector"

The competency standards for the various task elements are found in approved maintenance instructions. The training requirements are different depending on the specific manual (see listing below):

SPM – Standard practices manual	requires basic/fundamental training
SMPM – Special maintenance procedures manual	requires basic/fundamental training
SWPM – Standard wiring practices manual	requires basic/fundamental training
MM – Specialty-rated maintenance manual	requires training for specialty-rating
MOPM – Maintenance organization procedures manual	requires AMO organizational training

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the SPM		**Sequence as per SPM**	**Correspondence to competency framework**	
	➢ Repair of a wiring circular connector ➢ Task performance on a maintenance practical training mock-up	**Repair wiring circular connector**	**12. Repair**	SWPM
Terminal objective 1	As above	**Prepare for task**	**2.1 Identify the need for maintenance practice**	
Enabling objective 1	As above	Read related fault report	12.1.1 Read related fault report	Training task instruction
Enabling objective 2	As above	Verify fault and add information to fault report if it is incomplete	12.1.2 Verify fault and add information to fault report if it is incomplete	Training task instruction

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the SPM		**Sequence as per SPM**	**Correspondence to competency framework**	
Enabling objective 3	As above	Identify part number of circular connector	12.1.3 Read related maintenance instruction	SWPM
Enabling objective 4	As above	Consult reference tables	12.1.3 Read related maintenance instruction	SWPM
Enabling objective 5	As above	Read circular connector chapters	12.1.3 Read related maintenance instruction	SWPM
Terminal objective 2	As above	Disconnect circular connector	**4.3 Disconnect all connection to system(s)**	
Enabling objective 1	As above	Disconnect and open circular connector	4.3.1 Disconnect electrical connectors (be aware of remaining voltage – capacitors)	SWPM
Terminal objective 3	As above	Inspect circular connector	**8.3 Perform inspection**	
Enabling objective 1	As above	Visually inspect circular connector	8.3.7 Perform general visual inspection – examine for signs of physical damage, corrosion, leaks, correct installation, missing items – use judgement for deviation from normal condition	SWPM
Terminal objective 4	As above	Prepare for repair	**12.1 Prepare for Repair**	
Enabling objective 1	As above	Select proper repair procedure from maintenance instruction	12.1.4 Prepare repair scheme as per maintenance instruction	SWPM
Enabling objective 2	As above	Select proper material for repair	12.1.5 Procure required materials	SWPM
Enabling objective 3	As above	Select proper tools for repair	12.1.6 Prepare required tools	SWPM
Terminal objective 5	As above	Perform repair	**12.3 Perform repair**	
Enabling objective 1	As above	Perform all steps of repair procedure	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the SPM		**Sequence as per SPM**	**Correspondence to competency framework**	
Enabling objective 2	As above	Perform circular connector backshell maintenance	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM
Enabling objective 3	As above	Extract circular connector contacts	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM
Enabling objective 4	As above	Crimp circular connector contacts	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM
Enabling objective 5	As above	Insert circular connector contacts	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM
Enabling objective 6	As above	Assemble circular connector and relief strain on wires	12.3.3 Perform repair scheme step by step – verify during the process that no limit/ tolerance is exceeded	SWPM
Enabling objective 7	As above	Confirm the correct repair	12.3.5 Verify at the end of the repair process that the physical integrity of the repaired parts is in an airworthy condition (in permitted dimensions) and that the parts fulfill their designed specific tasks	SWPM
Terminal objective 6		Install circular connector	**5.6 Connect all connections to system(s)**	
Enabling objective 1		Install circular connector in training mockup	5.6.1 Connect electrical connectors (be aware of remaining voltage – capacitors)	SWPM
Enabling objective 2		Lockwire circular connector	5.6.1 Connect electrical connectors	SWPM

Example 2.
Competency-based training for aircraft maintenance personnel — Samples of training objectives in relation to specialty-rating for Competency Unit: 4. Remove Component/ Assembly

The following is an example of a competency unit applied to a task in a training programme for specialty-rating.

The competency standards for the various task elements are found in approved maintenance instructions. The training requirements are different depending on the specific manual (see listing below):

SPM – Standard practices manual	requires basic/fundamental training
SMPM – Special maintenance procedures manual	requires basic/fundamental training
SWPM – Standard wiring practices manual	requires basic/fundamental training
MM – Specialty-rated maintenance manual	requires training for specialty-rating
MOPM – Maintenance organization procedures manual	requires AMO organizational training

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the MM		**Sequence as per MM**	**Correspondence to competency framework**	
	➢ Flow control and shutoff valve – removal. Sample of a particular aircraft ➢ Task performance during "A-Check" in maintenance hangar	**Remove component/ assembly**	**4. Remove component/ assembly**	SPM SMPM (e.g.SWPM) MM MOPM
Terminal objective 1	As above	Prepare for removal	4.1 Prepare for removal	MM
Enabling objective 1	As above	Get access to the flow control and shutoff valve: Open air conditioning access door	4.1.6 Get access to component/ assembly	MM
Terminal objective 2	As above	Apply safety precautions/ maintenance practices	4.2 Apply Safety Precautions/ Maintenance Practices	MM

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the MM		**Sequence as per MM**	**Correspondence to competency framework**	
Enabling objective 1	As above	Remove pressure from the pneumatic system	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them 2.2.2 Perform maintenance practice as per MM procedure	MM
Enabling objective 2	As above	Set the L and R PACK switches to the OFF position	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them 2.2.2 Perform maintenance practice as per MM procedure	MM
Enabling objective 3	As above	Set the BLEED 1 and 2 switches to the OFF position	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them 2.2.2 Perform maintenance practice as per MM procedure	MM
Enabling objective 4	As above	Set the BLEED APU switch to the OFF position	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them 2.2.2 Perform maintenance practice as per MM procedure	MM
Enabling objective 5	As above	Open P6-4 circuit breaker on F/O electrical system panel	4.2.2 Identify whether any safety precautions are required for the maintenance task and apply them 2.2.2 Perform maintenance practice as per MM procedure	MM
Enabling objective 6	As above	Attach DO-NOT-OPERATE tags	4.2.3 Tag all flight deck and external control devices which are involved in the safety precautions	MOPM
Terminal objective 3a	As above	Disconnect all connections to the system(s)	4.3 Disconnect all connections to the system(s)	MM

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the MM		**Sequence as per MM**	**Correspondence to competency framework**	
Enabling objective 1	As above	Remove the air supply duct clamps	4.3.3 Disconnect pneumatic ducts and lines	SPM
Terminal objective 5a		Loosen and remove connecting elements from support structure	4.5 Loosen and remove connecting elements from support structure	MM
Enabling objective 1	As above	Remove the air supply duct nut, washer, and bolt	4.5.1 Loosen and remove all attachment nuts and bolts	SPM
Enabling objective 2	As above	Remove the washer between the tie rod and the flange of the air supply duct	4.5.1 Loosen and remove all attachment nuts and bolts	SPM
Terminal objective 6a	As above	Move component / assembly out of installation area	4.6 Move component / assembly out of installation area	MM
Enabling objective 1	As above	Remove the air supply duct	4.6.2 Lift component / assembly out of installation area	MOMP
Terminal objective 3b	As above	Disconnect all connections to the system(s)	4.3 Disconnect all connections to the system(s)	MM
Enabling objective 1	As above	Remove the 358 F duct clamps	4.3.3 Disconnect pneumatic ducts and lines	SPM
Terminal objective 6b	As above	Move component / assembly out of installation area	4.6 Move component / assembly out of installation area	MM
Enabling objective 1	As above	Remove the 358 F duct	4.6.2 Lift component / assembly out of installation area	MOMP
Terminal objective 3c	As above	Disconnect all connections to the system(s)	4.3 Disconnect all connections to the system(s)	MM
Enabling objective 1	As above	Remove the electrical connectors from the flow control and shutoff valve	4.3.1 Disconnect electrical connectors (be aware of remaining voltage – capacitors)	SWPM
Enabling objective 2	As above	Loosen the b-nut on the sense line	4.3.3 Disconnect pneumatic ducts and lines	SPM

	Condition	Behaviour		Standard
Terminal objectives are sequenced according to the MM		**Sequence as per MM**	**Correspondence to competency framework**	
Enabling objective 3	As above	Remove the screw and washer that connect the bonding jumper to the structure	4.3.6 Disconnect bonding jumpers	SWPM
Terminal objective 4	As above	Secure component / assembly before removal	4.4 Secure component/assembly before removal	MM MOPM
Enabling objective 1	As above	Hold the valve as you remove the clamp	4.4.2 Support component/assembly	MOPM
Terminal objective 3d	As above	Disconnect all connections to the system(s)	4.3 Disconnect all connections to the system(s)	MM
Enabling objective 1	As above	Remove the flow control and shutoff valve clamp	4.3.3 Disconnect pneumatic ducts and lines	SPM
Terminal objective 6c	As above	Move component / assembly out of installation area	4.6 Move component/ assembly out of installation area	MM
Enabling objective 1	As above	Remove the flow control and shutoff valve	4.6 Move component/ assembly out of installation area	MM
Terminal objective 8	As above	Complete removal	4.8 Complete removal	MOPM
Enabling objective 1	As above	Put covers on the duct openings to keep out unwanted materials	4.8.4 Install covers on electrical connectors, lines, ducts and openings to keep out unwanted materials	MOPM

Chapter 5. EVIDENCE-BASED TRAINING (EBT)

5.1 Applicability

5.1.1 This Chapter, supported by Doc 9995, the *Manual of Evidence-based Training*, is intended to provide guidance to Civil Aviation Authorities, operators and approved training organizations in the recurrent assessment and training of pilots referred to in Annex 6 to the Convention on International Civil Aviation, *Operation of Aircraft*, Part I, *International Commercial Air Transport — Aeroplanes*, 9.3 — Flight crew member training programmes and 9.4.4 — Pilot proficiency checks.

5.1.2 It may also provide guidance for training organizations engaged in the recurrent assessment and training of flight crew engaged in the operations of large or turbojet aeroplanes in accordance with Annex 6, Part II — *International General Aviation — Aeroplanes* (Section 3 refers).

5.1.3 The EBT programme and philosophy are intended as a means of assessing and training key areas of flight crew performance in a recurrent training system.

5.1.4 EBT is optional. When choosing to implement EBT in their regulatory framework, States shall ensure that operators and training organizations apply the principles of Doc 9995 when developing and implementing such recurrent training programmes.

5.2 Background

5.2.1 The EBT development project arose from an industry-wide consensus that, in order to reduce the aircraft hull loss and fatal accident rates, a strategic review of recurrent training for airline pilots was necessary. Existing airline pilot training regulation is largely based on the evidence of hull losses from early generation jets and a simple view that in order to mitigate a risk, simply repeating an event in a training programme was sufficient. Over time, many new events occurred, and the subsequent addition of these events saturated recurrent training programmes and created an inventory or “tick box” approach to training.

5.2.2 It is impossible to foresee all accident scenarios, especially in today’s aviation system where the system’s complexity and high reliability mean that the next accident may be something completely unexpected. EBT addresses this by moving from pure scenario-based training to prioritizing the development and assessment of key competencies, leading to a better training outcome. The scenarios recommended in EBT are merely a vehicle and a means to develop and evaluate competence. Mastering a finite number of key competencies should allow a pilot to manage unforeseen situations in flight.

5.2.3 The key competencies identified in EBT encompass what were previously termed both technical and non-technical KSA, aligning the training content with the actual competencies necessary in contemporary aviation context. These competencies are embedded in the threat and error management (TEM) concept.

5.2.4 The availability of useful data covering both flight operations and the training activity has improved substantially over the last 20 years. Data sources like flight data analysis, flight observation (e.g. line operations safety audit (LOSA)) and air safety reports give a detailed insight into the threats, errors and risks in flight operations and their relation to unwanted consequences. An enhanced monitoring of training results demonstrates important differences in training needs between different manoeuvres and aircraft generations. Availability of such data has both established the need for the EBT effort and supported the definition of the resulting training concept and curriculum.

5.3 EBT philosophy

5.3.1 EBT recognizes the need to develop and evaluate crew performance according to a set of competencies and the related KSA without necessarily distinguishing between the "non-technical" (e.g. CRM) and the technical competencies needed in order to operate safely. Any area of competence assessed not to meet the required level of performance shall also be associated with an observable behaviour that could lead to an unacceptable reduction in safety margin.

5.3.2 The aim of EBT is to identify, develop and evaluate the competencies and the related KSA required to operate safely, effectively and efficiently in a commercial air transport environment, while addressing the most relevant threats according to evidence collected in accidents, incidents, flight operations and training. The guidance contained in Doc 9995 is intended to enable and support the implementation of more effective training to improve operational safety. Recognizing the criticality of competent instructors in any training programme, the manual also provides specific additional guidance on the required qualifications of instructors delivering EBT.

5.3.3 Representing the essences of TEM is a set of competencies, competency descriptions, corresponding taxonomy and behavioural indicators encompassing the technical and non-technical KSA to operate safely, effectively and efficiently in a commercial air transport environment. To this set of competencies must be added a statement (developed by the operator or relevant training provider) to define the standard of competencies and related KSA to achieve the task to the required level of proficiency. The competencies and the related KSA should be used as a means to guide and develop competency levels appropriate to the type of operation and aircraft, within the training syllabus.

Note.— An example set of competencies is contained in Doc 9995.

5.3.4 The EBT programme proposes a paradigm shift, not simply to replace a sometimes outdated set of critical events by a new set, but to use the events as a vehicle to develop and assess crew performance across a range of necessary competencies (and related KSA). In addition, EBT refocuses instructors on the analysis of root causes of errors in order to correct inappropriate actions, rather than simply asking a pilot to repeat a manoeuvre without really understanding why it was not successfully flown at first.

5.3.5 Finally, it is recognized that in today's very high-fidelity simulator environment, there are very powerful training tools and yet regulation is much more biased towards testing and checking. EBT seeks to redress the balance between training and checking, recognizing that an assessment of competence is necessary, but once completed, pilots learn most effectively when not under pure test conditions. Appropriate input by competent

instructors will enable pilots to be trained to a given set of performance criteria for performing tasks and managing events effectively.

5.3.6 The defined programme includes outlined guidance for the development of training programmes and the evaluation of trainee flight crew and pilot performance, in addition to information for instructors conducting the training. This chapter does not formally consider training media but will assume that the training and evaluation described will be conducted in an FSTD qualified to an appropriate level in accordance with Civil Aviation Authority (CAA) rules (*Manual of Criteria for the Qualification of Flight Simulation Training Devices* (Doc 9625) refers).

Chapter 6. COMPETENCIES FOR FLIGHT CREW TRAINING, COURSE DEVELOPER AND INSTRUCTOR, AND MPL EXAMINER AND INSPECTOR

6.1 Course developer and instructor qualifications

6.1.1 Course developer qualifications

Course developers shall have demonstrated that they possess the competencies described in the Attachment to this chapter and that they have successfully achieved the ability to develop training in accordance with the features of a competency-based approach to training, as outlined in 2.2 of Chapter 2.

6.1.2 Instructor qualifications

6.1.2.1 Prior to the issue of a flight crew instructor certificate, rating or authorization, all instructors shall hold or have held a licence, rating or authorization equivalent to that for which the privilege to instruct is being sought.

Note.— The above requirement does not preclude a non-licensed technical specialist from being authorized by the Licensing Authority to instruct on subject matters that deal with systems operation or procedural requirements in a traditional classroom or FSTD.

6.1.2.2 Qualified and authorized instructors may be assigned to carry out specific assessment, checking, testing and/or auditing duties to determine that all required performance standards have been satisfactorily achieved. These performance standards may be obligated as being a final objective or required to be met on a continuous basis. In either case, the instructor is responsible for making a determination of the actual standards attained and any recommendation for immediate remediation if necessary.

6.1.2.3 Instructors shall meet the requirements as specified in Annex 1, 2.1.8 and 2.8, as appropriate. In addition, for the Intermediate and Advanced phases of the MPL training programme, the instructor shall have experience, acceptable to the Licensing Authority, in multi-crew operations.

6.1.2.4 Prior to an organization authorizing the provision of instruction within holistic competency-based training environments, such as MPL or EBT programmes, instructors should undergo a selection process designed to ensure the individual's motivation and disposition are suitable for the instructor's role.

6.1.2.5 In addition, selection of an instructor should be based on criteria intended to define a proven capability in the piloting function that he/she intends to instruct, in accordance with the competencies and the related KSA described in 5.3.3.

Note.— An example set of competencies is contained in Doc 9995.

6.1.2.6 Training programmes for the instructor role should focus on development of the competencies listed in the Attachment to Chapter 6, in the following areas:

a) manage safety;
b) prepare the training environment;
c) manage the trainee;
d) conduct training;
e) perform trainee assessment;
f) perform course evaluation; and
g) continuously improve performance.

6.1.2.7 Additionally, instructors providing training for the multi-pilot operations should:

a) have suitable experience in multi-pilot operations; or

b) with the exception of instructors providing instruction in the intermediate and advanced phases of the MPL licence, receive training as an alternative means of compliance with the experience prerequisite for instruction in multi-pilot operations. This training should include but may not be limited to the following elements:

1) multi-crew cooperation training in a suitable multi-pilot FSTD;
2) observations of multi-pilot line operations with a suitable operator;
3) observations of subsequent multi-pilot training where applicable; and
4) completion of multi-pilot CRM training.

6.1.2.8 Prior to the issue of an instructor certificate, rating or authorization, all instructors should successfully complete a formal instructor competency assessment during the conduct of practical training. The final assessment of instructor competence should be made against the competency framework contained in the Attachment to Chapter 6.

6.1.2.9 All instructors should receive refresher training, and be reassessed according to 6.1.2.8 using a documented training and assessment process acceptable to the Licensing Authority, implemented by a certificated or approved organization, or at intervals established by the Licensing Authority. Such refresher training and reassessment intervals shall not be greater than three years.

6.2 MPL examiner and inspector qualifications

6.2.1 MPL examiner qualifications

6.2.1.1 MPL examiners shall meet at least the following requirements:

a) have demonstrated that they possess the competencies for MPL examiners described in the Attachment to this chapter;

b) hold the qualifications to provide instruction at the Advanced phase of MPL training; and

c) meet the experience requirements of an instructor for the MPL as specified in 6.1.2.

6.2.1.2 The Licensing Authority shall authorize an MPL examiner for periods not exceeding three years.

6.2.2 MPL inspector qualifications

Inspectors of MPL training programmes shall have demonstrated that they possess the competencies described in the Attachment to this chapter.

— — — — — — — —

Attachment to Chapter 6
COMPETENCIES OF INSTRUCTORS, MPL EXAMINERS AND INSPECTORS, AND COURSE DEVELOPERS

THE INSTRUCTOR COMPETENCY FRAMEWORK

The competency framework consists of competency units, competency elements and performance criteria. The competency framework for instructors of flight crew should be based on the following competency units:

1. Unit 1 — Manage safety

The competent instructor must ensure a safe training/evaluation environment at all times. The competent instructor must ensure the safety of trainees in his/her care.

1.1 Ensures a safe training environment

a) ensures that required equipment meets safety requirements;
b) communicates evacuation procedures;
c) ensures a safe operating environment (e.g. for aircraft: weather, fuel);
d) identifies hazards and manages them;
e) creates an appropriate safe learning environment; and
f) identifies and takes appropriate action to prevent physical or mental stress.

1.2 Intervenes when required for safety

a) transfers control of aircraft or equipment safely;
b) intervenes, when required for safety, appropriately at the correct time and level (e.g. verbally or by taking control); and
c) recommences training as soon as practicable (after any safety intervention).

2. Unit 2 — Prepare the training environment

Recognizing that the training organization is the controlling agency in providing the required environment, the competent instructor should ensure, to the extent possible, that the training environment provides for effective learning. The training environment includes facilities, equipment and instructional materials. The following elements should be adapted to the size and processes of the organization. The instructor should consider the following subelements as essential to a successful outcome.

2.1 Follows approved training syllabus

a) explains that the training is needed;
b) ensures that the training is logically structured (where there is a need for the instructor to influence the flow of the training programme);

c) ensures that the training is realistic and relevant;
d) ensures that there are specific and measurable objectives; and
e) ensures realism in the choice of scenarios.

2.2 Ensures adequate facilities and equipment

a) ensures that the facilities are scheduled and adequate to meet the learning outcomes objectives;
b) ensures that the physical environment is suitable for learning;
c) ensures that the environment and conditions exist for the training objectives;
d) ensures that the equipment is suitable, adequate and serviceable; and
e) arranges appropriate airspace for the required training, if applicable.

3. Unit 3 — Manage the trainee

The competent instructor should ensure that the training is appropriate to the trainees and their needs.

3.1 Understands trainees

a) identifies and demonstrates awareness of trainee characteristics (experience, language, culture);
b) determines learning needs;
c) demonstrates awareness of learning styles; and
d) selects or modifies instructional materials and methods as appropriate.

3.2 Coaches trainees

a) demonstrates awareness of any measurable indicators of trainee readiness for training (as far as possible);
b) is flexible and supportive to trainees' performance and needs;
c) develops appropriate relationship with trainees; and
d) develops and sustains trainees' motivation.

4. Unit 4 — Conduct training

The competent instructor must demonstrate a variety of instructional methods as required for the training.

4.1 Establishes and maintains credibility

a) demonstrates exemplary behaviour as a role model (i.e. the instructor demonstrates the expected behaviour in the technical role for which trainees are being trained, according to the competencies and related KSA);
b) establishes credentials;
c) demonstrates respect for organizational goals and requirements (SOPs, dress codes, appearance, acceptable personal conduct, etc.);
d) states clear objectives and clarifies roles for the training or evaluation being undertaken; and
e) establishes and maintains an atmosphere of mutual respect.

4.2 Demonstrates effective presentation skills

a) stimulates and sustains trainees' interest;
b) sequences and paces instruction appropriately;
c) uses the voice effectively;
d) uses eye contact effectively;
e) uses gestures, silence, movement and training aids effectively; and
f) demonstrates effective questioning skills.

4.3 Demonstrates effective instruction and facilitation

a) communicates effectively both verbally and non-verbally;
b) listens actively and reads non-verbal messages correctly;
c) asks appropriate questions to encourage learning or to confirm understanding;
d) answers questions correctly and adequately;
e) generates content by questioning, redirecting, balancing participation, etc.; and
f) provides structure by confirming understanding, paraphrasing, summarizing, etc.

4.4 Creates and sustains realism

a) ensures realism in the choice of scenario administered; and
b) maintains a realistic approach in the conduct of the scenario.

4.5 Manages time

a) allocates time appropriately on activities;
b) adjusts time spent on activities to ensure that objectives are met; and
c) implements contingency plans for situations in which activities must be eliminated, reduced or replaced.

5. Unit 5 — Perform trainee assessment

The competent instructor must assess the trainee appropriately, objectively and correctly.

5.1 Develops assessment methods

a) selects appropriate events and activities through which to observe trainee's performance;
b) clarifies assessment process and rules with trainee; and
c) communicates to trainees the criteria upon which their performance will be assessed.

5.2 Monitors trainee's performance during instruction

a) observes behaviours;
b) interprets observed behaviours and comments correctly;
c) allows trainee to self-correct in a timely manner; and
d) identifies individual differences in learning rates.

5.3 Makes objective assessments

a) compares trainee's performance outcomes to defined objectives;

b) applies performance standards fairly and consistently;
c) ensures a level of knowledge and skill that achieves an appropriate level of safety;
d) observes and encourages self-assessment of performance against performance standards; and
e) confidently makes decisions on outcome of the task.

5.4 Provides understandable and actionable feedback

a) ensures that the applicant fully comprehends the assessment;
b) applies appropriate corrective actions;
c) uses facilitation techniques where appropriate;
d) provides positive reinforcement;
e) encourages mutual support; and
f) develops and seeks agreement on any plan for improvement or remediation.

5.5 Produces training and performance reports

a) keeps appropriate and adequate training and performance records;
b) reports clearly and accurately on trainee's performance using only observed behaviours reflecting KSA;
c) follows up on corrective actions;
d) reports recognized training opportunities within the training system in order to improve the process; and
e) respects confidentiality.

6. Unit 6 — Perform course evaluation

The competent instructor should evaluate the effectiveness of the training system.

6.1 Self-evaluates the effectiveness of his/her own performance as an instructor

a) evaluates his/her own communication skills;
b) evaluates his/her own presentation skills;
c) evaluates his/her own facilitation skills;
d) evaluates his/her own use of training media;
e) evaluates his/her own use of instructional materials; and
f) evaluates his/her own assessment of trainees.

6.2 Evaluates the effectiveness of a course or phase of a course

a) evaluates trainees' feedback on the training process;
b) evaluates trainees' mastery of final course objectives;
c) evaluates the effect of facilities on trainees' performance;
d) evaluates the effect of equipment on trainees' performance;
e) evaluates the effect of training materials on trainees' performance; and
f) evaluates the effect of the management of the training programme on trainees' performance.

Note.— The management of the training programme in 6.2 f) refers to the policies and decisions (or lack of decisions) of the organization's management team regarding the training programme.

6.3 Reports information on course evaluation

a) identifies strengths and/or weaknesses of the training course;
b) identifies systemic safety issues;
c) identifies unexpected outcomes;
d) identifies barriers to the transfer of learning;
e) makes recommendations for improvements to course design;
f) makes recommendations for improvements to course documentation;
g) makes recommendations for improvements to training media and facilities; and
h) shares information with other instructors and management.

7. Unit 7 — Continuously improve performance

7.1 Evaluates effectiveness

a) encourages and welcomes feedback on his/her own performance as an instructor;
b) evaluates his/her own performance as an instructor and learns from the results; and
c) actively seeks feedback on the training course from trainees and peers.

7.2 Sustains personal development

a) maintains required qualifications;
b) strives to increase and update relevant knowledge and skills; and
c) demonstrates continuous improvement of instructor competencies.

MPL EXAMINER

Carry out competency-based assessment

1. Gather evidence

1.1 Establish a working relationship with the candidate
1.2 Interpret competency standards
1.3 Apply assessment techniques and tools

2. Evaluate evidence

2.1 Ensure validity of evidence gathered
2.2 Ensure reliability of evidence gathered
2.3 Establish assessment decision
2.4 Provide constructive feedback to the candidate

3. Report assessment decision

3.1 Record assessment results
3.2 Provide candidate with future training plan, if applicable
3.3 Review assessment process to improve validity and reliability
3.4 Process relevant documentation

MPL INSPECTOR

Inspect competency-based training programmes

1. Assess ATO's application to conduct a competency-based training programme

1.1 Validate background data on Approved Training Organization
1.2 Review application
1.3 Evaluate quality assurance system implementation
1.4 Document findings

2. Evaluate competency-based training programme

2.1 Assess training needs analysis
2.2 Assess curriculum design
2.3 Assess courseware (ground, FSTD and flight)
2.4 Assess evaluation procedures
2.5 Confirm required qualifications and competencies of instructors and designated/delegated MPL examiners
2.6 Document evaluation findings

3. Inspect competency-based training programme

3.1 Inspect ground school facilities
3.2 Inspect FSTD facilities
3.3 Inspect flight training facilities
3.4 Inspect record-keeping system
3.5 Evaluate conduct of training
3.6 Document inspection findings

4. Conduct surveillance

4.1 Carry out a risk assessment
4.2 Establish initial surveillance plan
4.3 Conduct operational review of training programme
4.4 Instigate follow-up rectification/enforcement action
4.5 Document surveillance findings
4.6 Establish ongoing surveillance plan

5. Conduct trend analysis of approval/surveillance activity*

* Depending on the size of the CAA, individual MPL inspectors may or may not be responsible for this competency unit.

COURSE DEVELOPER

Develop competency-based training and assessment

1. Conduct analysis

1.1 Conduct preliminary analysis
1.2 Conduct job and task analysis
1.3 Conduct population analysis

2. Develop training material

2.1 Design curriculum
2.2 Define training objectives
2.3 Design mastery tests
2.4 Design modules
2.5 Determine training strategy
2.6 Select training media
2.7 Produce competency-based training and assessment materials
2.8 Carry out developmental testing of competency-based training and assessment materials

3. Evaluate training material

3.1 Validate competency-based training materials
3.2 Evaluate whether job performance objectives are met
3.3 Evaluate whether organizational and operational objectives are met

Chapter 7. UPSET PREVENTION AND RECOVERY TRAINING (UPRT)

7.1 Applicability

7.1.1 This chapter, supported by the *Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011), is intended to provide procedures to Civil Aviation Authorities, operators and approved training organizations to meet the UPRT requirements for an MPL and UPRT recommendations for a CPL(A) contained in Annex 1. Similarly, the information provided supports the UPRT requirements for type-rating in Annex 1 and for the recurrent training of pilots required by Annex 6, Part I, 9.3 – *Flight crew member training programmes*. The procedures in this chapter are applicable only to aeroplane UPRT.

7.1.2 Although not obligatory, training organizations engaged in the recurrent assessment and training of flight crew engaged in the operations of large or turbojet aeroplanes in accordance with Annex 6, Part II — *International General Aviation — Aeroplanes* (Section 3 refers) should also use this information to enhance the scope of their training services being offered.

7.2 Background

7.2.1 The UPRT development project arose from an industry-wide consensus that the hull loss rates and fatalities attributable to LOC-I events warranted a concerted effort in identifying and effectively implementing mitigating strategies. The study of the LOC-I phenomena and, in particular, the determination of any systemic contributing factors quickly became an ICAO priority.

7.2.2 Following an in-depth study involving representatives from numerous CAAs, aviation accident investigative bodies, industry and professional associations, airlines, major approved training organizations and OEMs, it was determined that the flight crews involved in LOC-I accidents had often reacted inappropriately prior to and/or during the event. An effective countermeasure to LOC-I pointed towards the need for improvements to existing training.

7.3 UPRT approach

7.3.1 The UPRT programme and approach are a means of assessing and training critical areas of flight crew performance in conditions of flight during which pilots are likely to be exposed to an increased risk of an in-flight upset. UPRT should be designed and delivered within existing training and regulatory paradigms, which will be focused upon the trainee being “trained to proficiency” based upon achieving pre-determined knowledge and skill performance levels. UPRT for MPL and EBT programmes has to be developed in the same manner as competency-based training, so that they can be seamlessly integrated into those existing programmes. A well-constructed UPRT

programme will better enable individual pilots and flight crews to effectively cope with unexpected and unforeseeable situations, which involve a skill set that, regrettably, has been found lacking in virtually every recorded LOC-I accident.

7.3.2 To realize the full value of UPRT programmes and permit ATOs to focus their attention on ensuring that the trainee achieves the targeted proficiency requirements, CAAs should view UPRT as purely a training programme and not invoke direct testing requirements on the trainee as part of their oversight process. Other regulatory due-diligence processes can be used to ensure that operational safety levels are not compromised and to establish whether the approved training programme is meeting its stated objectives.

7.3.3 The aim of UPRT is to identify and develop the training resources (academic, on-aeroplane, and FSTD-based) and the associated elements of training required to provide pilots with the necessary knowledge and skills required to increase their ability to recognize and avoid situations that may lead to aeroplane upsets and improve their ability to recover control of an aeroplane that has exceeded the normal flight regime. The guidance contained in the *Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011) is intended to enable and support the implementation of more effective training to improve safety levels. Recognizing the criticality of competent instructors in any training programme, the manual also provides specific guidance on the required qualifications of instructors delivering UPRT in addition to those identified in Chapter 6 of PANS-TRG.

7.3.4 This chapter does not formally consider training media, but all FSTD training described should be conducted in an FSTD qualified in accordance with 7.5.5.

7.4 Regulatory requirements

In several instances UPRT is not optional. It is a requirement for the MPL as well as for those pilots receiving type rating training or commercial air transport operator-specific initial and recurrent training. It is also recommended for pilots undergoing training towards the issuance of a CPL(A). When introducing UPRT into their regulatory framework, States shall ensure that operators and training organizations apply the principles of the *Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011), when developing and implementing such a programme.

Note. — Refer to the following provisions in Annex 1, 2.1.5 — Requirements for the issue of class and type ratings*; 2.4* — Commercial pilot licence*; and 2.5* — Multi-crew pilot licence appropriate to the aeroplane category*; and Annex 6, Part I, 9.3* — Flight crew member training programmes.

7.5 Training

7.5.1 UPRT programmes should focus on training to ensure that trainees achieve the required knowledge and skills to effectively manage those conditions of flight that are likely to increase the risk of an upset or those conditions during which an actual upset has occurred so that a safe condition of flight can be restored without undue delay and risk.

7.5.2 UPRT programmes should be developed and introduced in an integrated manner using differing approaches depending on the phase of a pilot's career. Those begin with the

appreciation that learning is best achieved when information is presented in context to current conditions. Hence, the recommended UPRT provided at the CPL(A) licensing level should be commensurate with those requirements deemed appropriate for an entry-level licence for a pilot starting employment with a commercial operator. This is because the expansion of that CPL(A) trainee's knowledge, skill and attitudinal abilities would be subsequently developed during the transition to airline level type-rating and operator-specific initial and recurrent training phases. The UPRT programme for an MPL trainee, on the other hand, shall take into account that an MPL programme includes learning the core set of flying abilities as well as achieving a type rating on an airline's commercial air transport aeroplane. The *Manual on Aeroplane Upset Prevention and Recovery Training* (Doc 10011), addresses the three distinct areas for UPRT in detail under the following headings:

a) single-pilot training on-aeroplane;

b) multi-crew training in an FSTD; and

c) type-specific training in an FSTD.

Note. — The Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011) provides detailed guidance on training topics, training elements and their descriptions to enable ATOs to develop comprehensive programmes for all three areas of UPRT. This information is further supplemented by OEM-supported recommendations in prevention and recovery techniques, as well as suggested training scenarios for the FSTD.*

7.5.3 The logical delivery of the training syllabus is the second part of the programme integration issue. In this regard, the programme should commence with either the creation or confirmation of a solid foundation of baseline knowledge levels. These should then be reinforced by practical exercises that demonstrate the application of those learned principles. Finally, this level of understanding should then be further enhanced by introducing scenarios during flight (actual or simulated, as applicable) that provide the trainees with a comprehensive set of descriptors in order to expand their ability to recognize specific threats to safe conditions of flight and take deliberate and effective avoidance actions. The first emphasis of UPRT shall, therefore, be on awareness, recognition, and avoidance, as part of the prevention equation of UPRT. The second part of UPRT shall involve developing the analytical and manual handling abilities of the trainee to recognize the type of upset event and then effectively apply the correct recovery actions.

Note.— Care must be taken at the early stages of UPRT implementation not to assume the existence of a comprehensive level of UPRT-related knowledge, particularly at the commercial air transport type rating and recurrent training levels, as LOC-I accident data strongly indicates that even highly experienced flight crews exhibited signs of shortcomings in understanding and reacting to their predicament, which indicated potential knowledge deficiencies.

7.5.4 ATOs are required by Appendix 2 to Annex 1 to establish a quality assurance system (QA). The objective of QA is to assure the achievement of results that conform to the standards set out in the ATOs' manuals and in those requirements and documents issued by the Licensing Authority. QA attempts to improve and stabilize the training process and to identify and avoid, or at least minimize, issues that could lead to

problems. It continuously verifies that standards are adhered to throughout the training process by introducing various checkpoints and controls. It further introduces a system of audits to assure that documented policies, processes and procedures are consistently followed. It is the “assurance” part of quality management and its effective operation is crucial to the success of a competency-based training programme. Quality management focuses on the means to achieve product or service quality objectives through the use of four key components: quality planning; quality control; quality assurance; and quality improvement.

7.5.5 A large portion of a fully integrated UPRT programme involves the training of flight crews in a simulated environment. Most FSTDs can be used satisfactorily for a significant portion of upset training, including training close to the critical angle of attack but not involving full aerodynamic stalls. However, ATOs and commercial air transport operators shall take into account the fact that existing FSTD flight models have deficiencies in adequately representing aircraft characteristics outside the valid training envelope, i.e. in conditions which exceed the aeroplane flight envelope data used for the FSTD qualification. Furthermore, many current FSTDs lack enhanced instructor feedback tools to allow for a complete and accurate assessment of the trainee’s performance. These limitations, if not fully appreciated by training programme designers and instructional staff, can have serious and long-term repercussions by which trained flight crews could be left with significant misunderstandings of upset events. While the industry moves towards introducing improvements to FSTD models and instructor operating station design, ATOs shall conduct all FSTD training in an FSTD qualified to an appropriate level in accordance with Civil Aviation Authority rules (Doc 9625, *Manual of Criteria for the Qualification of Flight Simulation Training Devices* refers) and approved for each intended training task. Detailed guidance on the technical requirements and on the instructor operating station functions and tools for UPRT can be found in Doc 9625, Volume I.

Note.— Regarding 7.5.4 and 7.5.5, ATOs are encouraged to establish more robust quality-related processes to optimize their efforts in achieving excellence in the provision of training. The subject of QA and the implementation of quality systems (QS) are detailed in Appendix B to the Manual on the Approval of Training Organizations *(Doc 9841).*

7.5.6 On-aeroplane training shall include special risk mitigation measures. This is particularly true when the training programme involves the development of analytical and handling abilities among pilots with low levels of experience and often under conditions of high stress. Robust instructor training and qualification requirements, aircraft certification and capabilities appropriate for the training tasks, strict operational control involving appropriate minimum dispatch and weather conditions, adhering to minimum safe altitudes, use of collision avoidance equipment and establishing special separation criteria, and contingency considerations are just some proactive examples to marginalize threats to safety levels. The ATOs’ ability to establish robust risk mitigation strategies under the umbrella of a mature safety management system (SMS) is critical to the safe and effective implementation of an on-aeroplane UPRT programme. The primary objective of on-aeroplane UPRT shall be to learn best practices in upset avoidance and recovery in a safe and controlled environment.

Note 1.— The Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011), makes several recommendations for the ATOs’ risk mitigation efforts.*

Note 2.— On-aeroplane UPRT is not to be considered synonymous with aerobatic training. Whilst aerobatic training does provide improved manual handling skills, the primary objective to training aerobatics is proficiency in precision manoeuvring. Aerobatic flight training does not necessarily provide the best medium to develop the full spectrum of analytical reasoning skills required to rapidly and accurately determine the best course of recovery action during periods of high stress.

7.5.7 Regardless of an individual's background, all instructors designated to provide training in a UPRT programme should successfully complete an approved UPRT instructor qualification training course in accordance with the applicable provisions in Chapter 6, 6.1.2. Both initial qualification and recurrent training curriculum for instructors should address training elements appropriate to the level of an instructor's participation in delivering a UPRT programme, as a minimum, to ensure that the designated instructor acquires and maintains the required UPRT knowledge levels and skill sets. The UPRT on-aeroplane environment may be beyond that which is experienced during normal training operations. The unpredictable nature of trainee inputs, reactions, and behaviour requires fluency in response to a wide variety of potential situations requiring a time-constrained and accurate response. This specialized expertise cannot be acquired through routine flight operations alone, but demands that instructor training provides the appropriate degree of exposure necessary to develop complete knowledge and understanding of the entire UPRT operating environment. As part of their QA effort, ATOs shall ensure that all UPRT instructors are qualified, competent, and current in delivering the course material as well as possessing the ability to make accurate performance assessments and recommendations for remediation, whenever necessary.

Note.— Many LOC-I accident investigations have revealed that the affected flight crew had received misleading information from well-meaning training staff or their organizations. Indeed, some existing trained practices were found to be not only ineffective but were also considered a contributory factor, which led to inappropriate responses by some flight crews. For example, in certain cases, the methodologies being applied in training and checking a recovery from an approach to stall condition of flight were based on the pilot being able to achieve recovery with a minimal loss of altitude. This resulted in training practices emphasizing the importance of a rapid application of power with the least amount of reduction in angle of attack to minimize the loss of altitude rather than appreciating the importance of reducing the angle of attack to effectively increase the ability of the wing to restore its capability to generate lift. Action has now been taken by both regulators and training providers to amend such procedures with new training and testing standards emphasizing that effective recovery from an approach to stall requires, foremost, an immediate and deliberate reduction in the angle of attack. This reduction, while operating at high altitude and depending on the aeroplane energy state, might result in a substantial loss in altitude necessary to ensure that an effective recovery from an impending or actual aerodynamic stall condition is achieved.

7.5.8 Training that is delivered under a quality system as described in Appendix B to the *Manual on the Approval of Training Organizations* (Doc 9841) should prevent instances of inappropriate or incomplete training.

7.6 Regulatory oversight

7.6.1 UPRT programmes should be competency-based in their design and delivery in accordance with those principles outlined in Chapter 2 of this document and in

Appendix E to Doc 9841. UPRT shall be treated as purely a training programme, which is outcome-focused and permits trainees to gain the skill sets and confidence to effectively manage conditions that may pose a threat to safety. An individual shall not be considered to have completed the training if the required competency levels are not achieved.

7.6.2 The training shall not be delivered to meet, or be encumbered by, any newly-devised regulatory testing criteria established by the CAA. Rather, the Authority should ensure levels of safety and quality of the training by applying due diligence processes upon the ATO and its QA policies, processes, procedures and observed practices. The application of this form of oversight is particularly conducive to achieving the best results in competency-based training environments. Although not required, CAAs should also consider requiring that training programmes approved under the training criteria outlined in Annex 6, Part I, Chapter 9, 9.3, be similarly conducted within a QA governance structure to assure the maintenance of high delivery standards in UPRT.

Note.— Appendices E, F and G to Doc 9841 as well as Section 6 of the Manual on Aeroplane Upset Prevention and Recovery Training *(Doc 10011), provide detailed guidance on the oversight of ATOs and such specially-designed curricula.*

— END —