

Doc 7192
AN/857



Training Manual

Part E-2
Air Traffic Safety Electronics Personnel (ATSEP)

Approved by the Secretary General
and published under his authority

First Edition — 2011

International Civil Aviation Organization

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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

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FOREWORD

During the 30th Assembly of the International Federation of Air Traffic Safety Electronics Associations (IFATSEA), which was held in Montréal in 2000, an exchange of views between members of the International Civil Aviation Organization's (ICAO) Air Navigation Commission, the ICAO Secretariat and members of the IFATSEA highlighted the fact that personnel involved in the maintenance and installation of Communication, Navigation and Surveillance/Air Traffic Management (CNS/ATM) systems were trained to differing standards. Some States had implemented a comprehensive programme of training, certification, and in some cases, licensing while other States were still looking for appropriate guidance. There was, at that time, a lack of universally established principles to govern the exercise of that profession. Subsequently, the 11th Air Navigation Conference, held at ICAO Headquarters in September 2003, expressed the view that the needs related to training, qualification and competency of air traffic safety electronics personnel required further investigation.

Air navigation systems are now implemented and operated globally. Aviation is going beyond geographical boundaries, and personnel involved in the maintenance and installation of CNS/ATM systems should be trained to uniform requirements on a worldwide basis. ICAO therefore decided to develop a new Part of the ICAO *Training Manual* to address the training requirements for this technical group of personnel which is recognized as Air Traffic Safety Electronics Personnel (ATSEP).

This manual is intended to give detailed information on the training and expertise required for personnel involved in the maintenance and installation of CNS/ATM systems. It should be used in conjunction with Annex 10 — *Aeronautical Telecommunications* and associated manuals as well as with the training required for these systems.

The constant evolution of CNS/ATM technology brings new challenges to air navigation. Training requirements have to be adapted regularly. This is why this manual has been developed to be as generic as possible to provide the flexibility needed to address future systems and equipment.

ICAO would like to acknowledge the major contribution made by IFATSEA in the preparation of Part E-2 of the *Training Manual*. This manual is largely based on a document that was developed by IFATSEA. The manual also draws on EUROCONTROL's *Guidelines for a Common Qualification Level of Technical Training for Air Traffic Safety Electronics Personnel* and on the contribution received from States, international organizations and individual experts who have provided support, advice and input.

Comments on this manual would be appreciated from all States and ICAO Technical Assistance field missions. These comments will be taken into account in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
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DEFINITIONS

Air traffic management. The dynamic, integrated management of air traffic and airspace (including air traffic services, airspace management and air traffic flow management) — safely, economically and efficiently — through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

Approved training. Training conducted within an approved training organization under special curricula approved by a Contracting State.

Approved training organization. An organization approved by a Contracting State in accordance with the requirements of Annex 1, paragraph 1.2.8.2 and Appendix 2 to perform training and operating under the supervision of that State.

ATM services personnel. Persons assigned to perform duties directly in connection with the provision of Air Traffic Management Services.

Attitude. Attitude is understood as behaviours that are acceptable or not in a given context. Attitudes are a component part of the trainees' required performance that is described in the intermediate objectives. Attitudes are taught to reflect the values and beliefs that students should hold to behave in an acceptable way.

Basic training. Fundamental knowledge and skills appropriate to the discipline to be pursued in the ATS environment.

Certification. The process of determining competence, qualification or quality on which an aviation document is based.

Competency. The combination of knowledge, skills and attitude to perform a task to the required standards in accordance with the State regulatory requirements.

Domain. A set of elements of a discipline that are studied in the qualification training.

Equipment. Portion of a system that performs a function that contributes to a systems output(s).

Intermediate objectives. What a trainee is expected to accomplish in terms of skills, knowledge and attitude, at specified points in a training course. For example, be able to use a piece of test equipment, or solder a joint. Sometimes also referred to as enabling objectives, as they lead up to, or enable, a specific terminal objective.

Job performance objectives. The desired level of job performance in terms of tasks to be performed and standards to be achieved.

Knowledge. A person's range of information; familiarity gained by experience or repetition; understanding. Knowledge is understood as information stored in the student's mind that can be retrieved when necessary, and the understanding of concepts and performances. Knowledge is a component part of the trainees' expected performance described in the intermediate objectives.

Level of complexity. Refers to the taxonomy of verbs used to describe the trainees' expected performance in a training objective.

Licensing authority. The authority designated by a Contracting State responsible for the licensing of personnel.

Qualification training. Job-category-related knowledge, attitude and skills appropriate to the discipline to be pursued in the ATS environment.

Rated ATSEP. An ATSEP holding the qualification appropriate to the privileges to be exercised.

Service. A function and/or data critical to the system or user, provided directly or indirectly, either individually, or as part of an overall function or output.

Skill. Practical or intellectual ability; ease in doing something; dexterity. Skills are classified as either intellectual or physical. Intellectual skills are those related to the use of intellect, like the abilities of classifying, rule-using, discriminating, problem-solving or cognitive strategy (the most complex of all). Physical skills are those that enable a person to make coordinated movements, perform manual tasks, and carry out physical activities. The skills are a component part of the expected trainees' performance that is described in the intermediate objective.

System. In this context, one or more types of electronic equipment and ancillary devices functioning to provide a service.

System and equipment rating training. System and equipment knowledge, attitude and skills leading to recognized competency.

Terminal objectives. What a trainee is expected to accomplish upon completion of training. For example, "when the trainee completes training, he¹ will be able to troubleshoot and repair a piece of XYZ equipment in twenty minutes, using standard tools and test equipment." Objectives are best stated in terms of accomplishments. Also called end-of-course performance objectives or behavioural objectives.

¹ Throughout this manual, the use of the male gender should be understood to include male and female persons.

GLOSSARY

2DRMS	2 distances root mean square
2F	2 frequency

A

AAIM	Aircraft autonomous integrity monitoring
ABAS	Aircraft based augmentation system
ABI	Advance boundary information
ACARS	Aircraft communications addressing and reporting system
ACAS	Airborne collision avoidance system
ACC	Area control centre
ACT	ACTivation (OLDI message)
ACT	Activation message designator
A/D	Analog-to-digital
ADF	Automatic direction finding system
ADS	Automatic dependent surveillance
ADS-B	Automatic dependent surveillance — Broadcast
ADS-C	Automatic dependent surveillance — Contract
AE	Antenna
AFTN	Aeronautical fixed telecommunications network
AGC	Automatic gain control
AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIRAC	Aeronautical information regulation and control
AIRMET	Information concerning en-route weather phenomena which may affect the safety of low-level aircraft operations
AIS	Aeronautical information services
ALARP	As low as reasonably possible
ALRS	Alerting service
AM	Amplitude modulation
AM MSK	Amplitude modulation minimum shift keying
AMSS	Aeronautical mobile satellite service (or system)
AMSS	Automatic message switching system
ANS	Air navigation services
ANSP	Air navigation service provider
APP	Approach
ARINC	Aeronautical Radio Incorporated
ARTAS	ATC radar tracker and server
ASAS	Airborne separation assurance system
ASM	Airspace management
ASM	Airspace system management
ASR	Airport surveillance radar
ASTERIX	All purpose structured Eurocontrol radar information exchange
ATC	Air traffic control

ATCO	Air traffic controller/Air traffic control officer (US/UK)
ATFM	Air traffic flow management
ATIS	Automatic terminal information service
ATM	Air traffic management
ATN	Aeronautical telecommunication network
ATS	Air traffic services
ATS QSIG	Standard for ATC G/G voice communications
ATSEP	Air traffic safety electronics personnel
ATSO	Air traffic service operator

B

BER	Bite error rate
BITE	Built-in test equipment
BIX	Byte information exchange
B-RNAV	Basic area navigation

C

CAA	Civil Aviation Administration (Authority)
CB	Cumulonimbus
CBA	Cost/benefit analysis
CCITT	Comité consultatif international télégraphique et téléphonique
CDI	Course deviation indicator
CDTI	Cockpit display of traffic information
CDU	Control and display unit
CEP	Circular error probable
CFMU	Central flow management unit
CIDIN	Common ICAO data interchange network
CISM	Critical incident stress management
CMS	Central message switch
CNS	Communications, navigation and surveillance
CNS/ATM	Communication, navigation and surveillance/Air traffic management
COM	Communications
CORBA	Common object request broker architecture
COTS	Commercial off-the-shelf equipment
CPDLC	Controller-pilot data link communications
CRT	Cathode ray tube
CSU	Control sector unit
CTR	Controlled zone
CVFR	Controlled VFR
CVOR	Conventional very high frequency omni range

D

DAIW	Danger area infringement warning
DDF	Doppler direction finder
DDM	Data display monitor
DF	Direction finding



DGPS	Differential global positioning system
DIS	Director(ate) infrastructure, ATC systems and support (EUROCONTROL Headquarters, SDE)
DL	Data link
DLC	Data link communication
DME	Distance measuring equipment
DME/N	DME/Normal
DME/P	Precise DME
DP	Data processing
DPC	Data processing chain
DRC	Dynamic route change
DSP	Domain specific part
DTMF	Dual tone multi-frequency
DTU	Data terminal unit
DVOR	Doppler very high frequency omni range (Doppler VOR)

E

E1	Digital channel 64-kbps for voice or data
EAD	European AIS database or European aeronautical database
EATCHIP	European Air Traffic Control Harmonization and Integration Programme (now EATMP)
EATMP	European Air Traffic Management Programme (formerly EATCHIP)
ECAC	European Civil Aviation Conference
EDP	Electronic data processing
EGNOS	European global navigation overlay service
EGPWS	Enhanced ground proximity warning system
EHT	Extremely high tension
EJB	Enterprise java beans
ELT	Emergency locator transmitter
EMI	Electromagnetic interference
ENP	Environment data processing
EOIG	EGNOS operators and infrastructure group (Investor group)
ESARR	Eurocontrol safety regulatory requirements
ESD	Electrostatic discharge
ESDS	Electrostatic discharge sensitive
ESTB	EGNOS system test bed
ET	Executive task (EATCHIP)
ETG	European GNSS tripartite group
EU	European Union
EUROCONTROL	European Organization for the Safety of Air Navigation

F

FAA	Federal Aviation Administration
FANS	Future air navigation systems
FAT	Factory acceptance test
FDDI	Fibre distributed data interface
FDP	Flight data processing
FDPS	Flight data processing system



FFM	Far field monitor
FIC	Flight information centre
FIR	Flight information region
FIS	Flight information service
FMS	Flight management system
FoM	Figure of merit
FPL	(Filed) Flight plan
FRUIT	False replies unsynchronized in time
FSS	Fixed satellite services
FSS	Flight service station

G

G/G	Ground/ground
GAMET	Area forecast for low-level flights
GBAS	Ground based augmentation system
GLONASS	Global orbiting navigation satellite system
GNSS	Global navigation satellite system
GPS	Global positioning system
GPWS	Ground proximity warning system
GRAS	GPS (or GNSS) regional augmentation system
GS	Glideslope
GS	Ground speed

H

HCM	High capacity multiplexing
HCP	Hard copy printer
HDL	High frequency data link
HDLC	High level data link communication
HF	Human Factors
HF	High frequency
HHI	Human human interface
HIS	Horizontal situation indicator
HMI	Human machine interface
HRS	Human resources programme (EATMP, HUM)
HRT	Human resources team (EACHIP/EATMP, HUM)
HSI	Horizontal situation indicator
HUM	Human Factors
HUM	Human resources (Domain) (EATCHIP/EATMP)
HUM Unit	Human Factors and Manpower Unit (EUROCONTROL Headquarters, SDE, DIS; formerly know as the "ATM Human Resources Unit"; also known as DIS/HUM)
HV	High voltage
HW	Hardware
Hz	Hertz



I

IACA	International Air Carrier Association
IANs	Institute of Air Navigation Services (EUROCONTROL, Luxembourg)
IAOPA	International Council of Aircraft Owner and Pilot Associations
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDF	Instantaneous direction finding
IEA	International Energy Agency
IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate fix
IF	Intermediate frequency
IFALPA	International Federation of Air Line Pilot Association
IFATCA	International Federation of Air Traffic Controller Association
IFATSEA	International Federation of Air Traffic Safety Electronics Associations
IFPS	Integrated initial flight plan processing system
IFPS	Interactive flight plan service
IFR	Instrument flight rules
II codes	Interrogator identifier code
IISLS	Improved interrogate sidelobe suppression
ILS	Instrument landing system
INS	Inertial navigation system
IP	Internet protocol
I/Q	In-phase and quadrature channels
ISA	International standard atmosphere
ISDN	Integrated services digital network
ISLS	Interrogation side lobe suppression
ISO	International Standards Organization
ITU	International Telecommunication Union

J

JAA	Joint Aviation Authorities
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K

Kb	Kilo byte
Kbps	Kilobits per second

L

L	Locator
LAM	Logical acknowledgement message
LAN	Local area network
LAPB	Link access procedure
LCD	Liquid crystal display
LF	Low frequency (30 to 300 kHz)

LNTA	Low noise transistor amplifier
LOC	Localizer
LRM	Lowest replaceable module
LRU	Line (or lowest) replaceable unit
LVA	Large vertical aperture

M

MAC	MAC address (Hardware address of device)
MAC	Medium access control
MASPS	Minimum aircraft systems performance specifications
MDS	Minimum detectable signal
METAR	Meteorological aerodrome report
MFC	Multi-frequency coding
MHz	Megahertz
MIB	Management information base
MIME	Multipurpose Internet mail extension
min.	Minute
MLS	Microwave landing system
MLT	Multilateration
MM	Middle marker
MMEL	Master minimum equipment lists
MMR	Multi-mode receiver
MMS	Maintenance management system
MODEM	Modulator demodulator
MODEM	Multiplexer/demultiplexer
Mode S	Mode select
MOPS	Minimum operational performance standards (or specifications) FAA
MOTNE	Meteorological operational telecommunications network Europe
MSAS	MTSAT satellite based augmentation system
MSAS	Multi-functional transport satellite augmentation system
MSAW	Minimum safe altitude warning
MSS	Mobile satellite service
MSSR	Monopulse secondary surveillance radar
MTBF	Mean time between failure
MTCA	Medium term conflict alert
MTD	Moving target detection
MTI	Moving target indicator
MTSAT	Multi-functional transport satellite

N

NAV	Navigation
NAVAID	Navigation(al) aid
ND	Navigation display, Network digit
NDB	Non directional beacon
N-ISDN	Narrow and integrated services digital network
NOTAM	Notice to Airmen



O

OBI	On board indicator
OCM	Oceanic clearance message
OJI	On-the-job instructor
OJM	On-the-job mentor
OJT	On-the-job-training
OJTI	On-the-job training instructor
OLDI	On-line data interchange
OM	Outer marker
OS	Operating system
OSI	Open system interconnection
OTM	Overall transaction manager

P

PABX	Private automatic branch exchange
PAC	Pre-activation message
PANS	Procedures for air navigation services
PAPI	Precision approach path indicator
PAR	Precision approach radar
PC	Personal computer
PCB	Printed circuit board (to be confirmed by originator)
PCM	Pulse code modulation
PCU	Power control unit
PDC	Pre-departure clearance
PD WRT	Probability of detection. With respect to
PFD	Planned flight data
PFD	Probability of failure
PFD	Primary flight display
POP	Proof of performance
PPI	Plan position indicator
PRF	Pulse repetition frequency
PRF-FRUIT	Pulse repetition frequency – false replies unsynchronized in time
PRI	Pulse repetition interval
P-RNAV	Precision area navigation
PSD	Phase sensitive detector
PSR	Primary surveillance radar
PTE	POEMS test environment
PTT	Post, telephone and telegraph

Q

QFE	Pressure at the airport
QFF	Corresponding pressure at sea level
QNE	Pressure at any level higher than sea level
QNH	Pressure reduced to mean sea level
QoS	Quality of Service
QSIG	Symmetrical adaptation of N-ISDN signalling

R

RA	Resolution advisory
RADAR	Radio detection and ranging
RADNET	Radar network (Benelux-Germany)
RAIM	Receiver autonomous integrity monitoring
RAPNET	Regional aeronautical packet switched network
RCA	Remote client access
RCC	Rescue coordination centre
RCMS	Remote control and monitoring system
RCP	Required communication performance
RDPS	Radar data processing system
REC	Receive or receiver
RES	Radar environment simulator
RF	Radio frequency, Radius to a fix (ARINC 424 path terminator)
RF/IF	Radius to a fix (ARINC 424 path terminator)
RGP	Required global performance
RMCD E	Radar message conversion and distribution equipment
RMI	Radio magnetic indicator
RMS	Root mean square
RNAV	Area navigation
RNP	Required navigation performance
RSL S	Receiver side lobe suppression
RSP	Required surveillance performance
RTF	Radiotelephone or radiotelephony
RUP	Rational unified process
RVR	Runway visual range
RVSM	Reduced vertical separation minimum
RX	Receiver station

S

SA	Selective availability
SADIS	Satellite distribution of world area forecast system
SARPS	Standards and Recommended Practices (ICAO)
SASS	Surveillance analysis support system
SASS-C	Surveillance analysis support system — Centre
SASS-S	Surveillance analysis support system — Sensor
SAT	Site acceptance test
SATCOM	Satellite communications
SBAS	Space/Satellite based augmentation system
SDD	Synthetic data display
SDE	Senior Director, Principal EATMP Directorate or, in short, Senior Director(ate) EATMP (EUROCONTROL Headquarters)
SDM	System definition manual
SDPS	Surveillance data processing system (ICAO)
SEP	Spherical error probable
SID	Standard instrument departure (Route)



SIGMET	Significant meteorological information
SIS	Signal in space
SITA	Société Internationale de Télécommunications Aéronautiques (F)
SLS	Side lobe suppression
SMC	System monitoring and control
SMC	System monitoring and computer/control
SMGCS	Surface movement guidance and control system
SMR	Surface movement radar
S/N	Signal to noise ratio
SNMP	Simple network management protocol
SPECI	Aeronautical special meteorological report
SPI	Special position indicator
SPI	Special pulse (Position) identification (SSR)
SRA	Surveillance radar approach
SRAM	Safety regulation commission (EUROCONTROL)
SSR	Secondary surveillance radar
STC	Sensitivity time control
STCA	Short term conflict alert
SUP	Supervisor
SW	Software
SWC	Significant weather chart (also TEMSI)
SWR	Standing waves ratio

T

TA	Traffic advisory
TACAN	UHF tactical air navigation aid
TAF	Terminal area forecast
TCAS	Traffic alert and collision avoidance system
TCAS	Transponder collision avoidance system
TCP	Transmission control protocol
TCP/IP	Transmission control protocol/Internet protocol
TDG	Training development guideline
TDH Unit	Training Development and Harmonization Unit (EUROCONTROL, IANS)
TDM	Time division multiplex
TEMSI	Significant weather chart (mostly for Europe)
TFCCC	Task force common core content (EATCHIP, HUM, HRT, TSG)
TFI	Technical flight inspector
TL	Transition level
TLS	Target level of safety
TMA	Terminal area
TMG	Training management guideline
TOS	Taux d'onde stationnaire (Standing wave ratio)
TRM	Team resource management
TRSB	Time reference scanning beam
TSG	Training sub-group (EATCHIP/EATMP, HUM, HRT)
TSP	Training sub-programme (EATMP, HUM, HRS)
TSRB	Time reference scanning beam
TTTF	Time to first fix
TWR	Tower
TX	Transmitter

U

UAT	Universal access transceiver
UBSS	Unix basic system software
UDP	User datagram protocol
UHF	Ultra high frequency (300 to 3 000 Mhz)
UML	Unified modeling language
UPS	Uninterrupted power supply
UTC	Universal time coordinate

V

VASIS	Visual approach slope indicator system
VCS	Voice communication system
VDF	VHF direction finding station
VDL	VHF digital/data link
VFR	Visual flight rules
VHF	Very high frequency (30 to 300 Mhz)
VOLMET	Meteorological information for aircraft in flight
VOR	VHF omni-directional radio range
VORTAC	VOR and TACAN combination
VSP	Variable system parameter
VSWR	Voltage standing wave ratio

W

WAAS	Wide area augmentation system (USA)
WAN	Wide area network
WGS	World geodetic system
WGS84	World geodetic standard 1984
WRT	With respect to

X

X25	Packet switched data network protocol
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Chapter 1

TRAINING PRINCIPLES

1.1 REGULATORY REQUIREMENTS

1.1.1 A Contracting State, or the organization authorized by the State authority providing CNS/ATM services, should establish methods for determining job competencies. All personnel directly engaged in operation, maintenance and installation activities of CNS/ATM systems should be qualified for their job functions. Air Traffic Safety Electronics Personnel (ATSEP) is the ICAO-recognized terminology for personnel involved in the operation, maintenance and installation of a CNS/ATM system.

1.1.2 State regulatory norms should define the requirements with respect to age, knowledge, experience, skill and attitude which determine ATSEP competency. Chapter 4 of ICAO Annex 1 — *Personnel Licensing*, however, contains Standards for other personnel, and States should consult them when establishing their requirements.

1.1.3 The successful application of regulations concerning the safety and regularity of CNS/ATM systems operation and the achievement of regulatory objectives depend on the appreciation by all individuals concerned of the risks involved and on a detailed understanding of the regulations. This can be achieved only by properly planned and maintained basic training, qualification training and recurrent training programmes for all persons involved. ATSEP play a significant role in the safe operation of CNS/ATM systems, and international regulations require that they be appropriately trained.

1.2 TRAINING REQUIREMENTS

1.2.1 Principal duties

1.2.1.1 The principal duties of the ATSEP are:

- a) maintenance of CNS/ATM systems and equipment which includes:
 - 1) calibration of flight and ground radio navigation aids;
 - 2) certification of CNS/ATM systems and equipment;
 - 3) modification of operational CNS/ATM equipment;
 - 4) corrective maintenance; and
 - 5) preventive maintenance;
- b) installation of CNS/ATM systems and equipment;
- c) management, monitoring and control of operational CNS/ATM systems and equipment; and

- d) development, review and modification of CNS/ATM systems and equipment, and maintenance procedures and standards.

1.2.1.2 ATSEP work on a variety of CNS/ATM systems and equipment, and this requires a wide range of expertise. Training will be directed toward the specific work requirement assigned to a specific group or category of ATSEP.

1.2.2 Day-to-day activities

The following are some of the duties that normally govern the day-to-day practical work of the ATSEP. The degree of responsibility given to them varies from State to State and from Air Navigation Services (ANS) provider to ANS provider. It varies from the complex level, where the ATSEP could be considered the brain of the ANS, to a position of limited importance. In the former case, the ATSEP is normally required to be licensed or proved to be trained and competent to certify CNS/ATM systems and equipment, while in the latter case, the ATSEP's duties may be limited to clerical assistance only. With the widespread introduction of technologies, there is a marked tendency for States and ANS providers to make increased use of ATSEP, giving them extensive duties and responsibilities. These include:

- a) carrying out technical duties related to developmental work concerning the electromechanical, electronic and computerized equipment of air navigation systems, and the testing of prototypes;
- b) providing technical support in the design and layout of specific interface circuitry for air navigation and aircraft detection tracking systems;
- c) preparing or contributing to cost estimates and technical and training specifications for air traffic control and safety equipment;
- d) providing or assisting with the technical supervision of construction, installation and operation of ground-based air navigation equipment;
- e) ensuring that system and equipment standards and specifications are met;
- f) applying the knowledge and skills of air traffic safety engineering principles and practices, in order to identify and solve problems arising in the course of their work;
- g) developing, modifying and debugging system software;
- h) modifying CNS/ATM systems and equipment in order to improve capability, reliability and integrity, or to facilitate air traffic control procedures and airspace designation;
- i) controlling and monitoring CNS/ATM equipment;
- j) calibrating ground-based air navigation systems or equipment to ensure maximum accuracy and safety of flight, take-off and landing operations;
- k) certifying CNS/ATM systems and equipment; and
- l) providing technical training.

1.2.3 Minimum entry qualifications

It is generally accepted that the minimum entry qualifications for an ATSEP are the following:

- a) a minimum educational level of successful completion of secondary school;
- b) a minimum of 1 600 hours of post-secondary, college or military education, specialized in electronic technology; and
- c) a minimum of twenty years of age.

1.2.4 ATSEP training concept

In order to cover the various backgrounds of trainees and to ensure training standardization worldwide, it is recommended that training be divided into multiple levels as follows:

Basic training: Fundamental knowledge and skills appropriate to the discipline to be pursued in the CNS/ATM environment.

Qualification training: Job-category-related knowledge and skills appropriate to the discipline to be pursued in the CNS/ATM environment. Various applications have been identified that apply to the five corresponding discipline qualifications of communication, navigation, surveillance, data processing and power supply.

System and equipment rating training (also referred to as "Specific training"): System and equipment knowledge and skills leading to recognized competency.

It also includes on-the-job training (OJT), which is the practical integration of previously acquired knowledge and skills, under the supervision of a qualified on-the-job-training instructor (OJTI), in an operational environment.

Continuation training: Training given to personnel, designed to augment existing knowledge and skills and/or to prepare for new technologies. It includes refresher, emergency and conversion training. Refresher and emergency training are sometimes called "recurrent training".

Refresher training. Designed to review, reinforce or upgrade existing knowledge and skills, including team skills.

Emergency training. Includes training in emergencies, in unusual situations and in degraded systems. Most of this training will be site specific or may make use of incident or accident analysis.

Unusual situations may be described as:

- 1) serious, unexpected, and often dangerous situations, requiring immediate action;
- 2) a set of circumstances which are neither habitually nor commonly experienced. The essential difference with an emergency is that the element of danger or serious risk is not necessarily present in an unusual situation;
- 3) the result of a system failure or malfunction.

Conversion training. Designed to provide knowledge and skills appropriate to a change in either job category (new discipline or new type rating), environment (new procedures) or system (system upgrade or change).

Developmental training: Training designed to provide additional knowledge and skills demanded by a change in the job profile, e.g., flight check inspector, system monitoring and control, training instructor, installation or engineering technologist, or any other career development.

1.2.5 Phase one basic training

1.2.5.1 The training objectives in phase one basic training are related to general duty: the design, installation, operation, maintenance and repair of air traffic control and air navigation systems. The training objectives in the phase two qualification training will be related to the specific tasks of the job duties.

1.2.5.2 The phase one basic training course is all the prerequisite knowledge needed in order to prepare the ATSEP for the next phase of training, phase two qualification training.

1.2.5.3 To undertake the duties and responsibilities described above, ATSEP must be appropriately trained in all the subjects required to ensure that every link of the safety chain is solid. As technical specialists, ATSEP need to demonstrate a high level of responsibility and the ability to think clearly and rapidly and to accomplish their duties carefully. The training of ATSEP should invariably include several stages of selection in order to eliminate trainees who lack the necessary qualities.

1.2.5.4 States and organizations may select their ATSEP from personnel who have various forms of aviation experience. However, experience has shown in many States that ATSEP do not have a basic knowledge of the operational environment and safety-related aspects of civil aviation. Therefore, it is the role of the phase one basic training to cover the operational and technical environment related to ATSEP duties and all the safety aspects of civil aviation.

1.2.5.5 Trainees who do not have previous aviation experience will have to undergo the complete training programme as recommended in phase one basic training. Trainees who have had suitable aviation experience may not need to undertake this complete programme. For example, a pilot, flight navigator, air traffic controller or a flight radio operator can be assumed to have at least partially completed phase one basic training if he has been actively employed in these occupations within the past few years. In such cases, training institutes, with the approval of the State authorities, are encouraged to apply the necessary flexibility in arranging appropriate training courses, emphasizing subjects of particular concern to ATSEP duties. The same flexibility can also be applied during continuation or recurrent training.

1.2.5.6 Table 1-1 provides a listing of the subjects contained in phase one basic training. In using the curriculum recommended in the following chapters, local considerations may dictate changing the sequence of the subjects. However, the relative importance accorded to each subject should, as much as possible, remain unchanged. The multiplicity of types of CNS/ATM systems and equipment and operational practices throughout the world makes it undesirable to define too rigidly many of the headings of the syllabus, and it is necessary to leave some flexibility to those in charge of the training course. Instructors must, however, ensure that all items in the training manual syllabus are adequately covered, and any requirements relevant to individual authorities should be treated as additional subjects and not as substitutions for the syllabus recommended in this manual. Instructors must also ensure that all items required in their State's licensing or certification programme are adequately covered. Any choices in the examination itself should be confined to the additional subjects dealing with those practices and procedures which the trainee is most likely to use in the first period of his duties as an ATSEP.

1.2.5.7 Paragraph 1.2.5.8 presents the various subjects that need to be covered during phase one basic training. It is recommended that phase one basic training be fully completed before proceeding with phase two qualification training. The training duration for the various subjects in phase one basic training will vary depending on the size and complexity of the organizations, the CNS/ATM systems and the air traffic control (ATC)/airspace structure of the State. The training organization should ensure that all sections of the syllabus are adequately covered to meet the desired level of knowledge before proceeding with phase two qualification training. Phase one basic training could be expanded based on the requirement of each particular State.

1.2.5.8 The phase one basic training is designed to give an overview of the overall CNS/ATM technical and operational environment, as well as an overview of the most important systems and equipment, and the role of all the

operators within this complex environment. In order for the ATSEP to perform their role and duties, it is important that they understand each of the essential system components.

1.2.5.9 This phase has been split into three sub-sections with the possibility of teaching each chapter separately.

Table 1-1. Subjects covered in phase one basic training

Subject matter
Chapter 3.1 – International and national organizations and standards
Chapter 3.2 – Familiarization with air traffic services, airspace standards, meteorology and altimetry
Chapter 3.3 – Familiarization with CNS/ATM concepts

1.2.6 Phase two qualification training

1.2.6.1 Following the completion of phase one basic training, the ATSEP will require specialized qualification training in a discipline such as: communications, navigational aids (Nav aids), surveillance, data processing or power supply. The ATSEP may receive the training for more than one speciality. The ANS provider or State organization determines the number of ATSEP to be trained in each speciality.

1.2.6.2 The phase two qualification training will provide the ATSEP with in-depth knowledge of and the appropriate skills needed in the CNS/ATM discipline to be pursued. It provides job-category-related knowledge and skills appropriate to the discipline to be pursued in the CNS/ATM environment. Various applications have been identified that apply to the five corresponding discipline qualifications of communication, navigation, surveillance, data processing and power supply.

1.2.6.3 The knowledge, skills and attitude gained in the phase two qualification training are needed for the third phase the system or equipment rating training that is specific to the equipment or system.

1.2.6.4 Each discipline in the phase two qualification training has been developed in a separate multi-part chapter. While the content elements of each chapter are generic, this does not prevent the State organization from including examples to illustrate real-life situations or to use systems and equipment that are available to enhance the learning activities.

1.2.6.5 Table 1-2 provides a listing of the subjects contained in phase two qualification training. This training phase is important for the ATSEP, since it makes the link between the general knowledge received in the phase one basic training and the specific equipment knowledge and skills to be acquired in the system or equipment rating training. In phase two qualification training, the knowledge, skills and attitudes needed for each of the specialities will be developed, and their applicability will be emphasized. Safety aspects of the personnel (ATSEP) and of the equipment and systems are covered for each discipline.

Table 1-2. Subjects covered in phase two qualification training

Subject matter
Chapter 5 – Communication systems
Chapter 6 – Radio navigation aids

Chapter 7 – Surveillance
Chapter 8 – Data processing training demand
Chapter 9 – Power supply
Chapter 10 – System safety training

1.2.7 Phase three specific training

1.2.7.1 The phase three specific training focuses on a specific area of training or on specific ATSEP functions. This phase is the final stage for ensuring ATSEP competency. It provides system and equipment knowledge and skills leading to recognized competency. It also includes on-the-job training (OJT), which is the practical integration of previously acquired knowledge and skills, under the supervision of a qualified on-the-job-training instructor (OJTI) in an operational environment.

1.2.7.2 The knowledge, skills and attitude gained in the phase two qualification training in areas such as communication, NavAids, surveillance, data processing and power supply are needed for the third phase, the system or equipment rating training that is specific to the equipment or system.

1.2.7.3 Following the completion of phase three specific training, the ATSEP will be assessed in order to meet the competency requirement to receive the certification delegation. The ATSEP licensing and the system and equipment certification programmes are not defined here, however, this training is a prerequisite to certification.

Table 1-3. Subjects covered in phase three specific training

Subject matter
Chapter 11 – System or equipment rating training
Chapter 12 – Continuation training
Chapter 13 – Developmental training
Chapter 14 – Human Factors

1.2.8 Continuation training

Continuation training is designed to augment the existing knowledge and skills. This could be done in a number of ways such as: refresher training which reviews or reinforces existing knowledge and skills; emergency training which includes training for unusual, and often dangerous, situations; unusual situation training which is provided to deal with a set of circumstances which are neither habitually nor commonly experienced; degraded system training which is provided to deal with a situation that is the result of a system failure or malfunction; and conversion training which provides the knowledge and skills appropriate to a change in a job category or to a new discipline or new procedure.



1.2.9 Developmental training

Finally the last training phase is developmental training needed when there is a major change in the ATSEP's job profile, for example, an ATSEP who wants to become a flight check inspector, training instructor or an installation technologist.

1.2.10 Standard of accomplishment

1.2.10.1 Each training objective in this manual is described with reference to the establishment of conditions, performance and a standard of accomplishment. The conditions describe the scenario where trainee performance will be developed and tested while indicating whether actual equipment, mock-ups or simulators, etc., are to be used. The standard of accomplishment establishes the level of trainee performance that must be attained and may differ from school to school, depending on the training equipment available.

1.2.10.2 In measuring the standard of accomplishment, the use of only two grades, *pass* or *fail*, is recommended. It must, however, be noted that many training establishments prefer to use a numerical grading system, as trainees strive harder and learn more when rewards increase. If the same grade, *pass*, is given for an 80 per cent score, trainees may strive for perfection.

1.2.10.3 Tests to assess the trainee achievement in performing the training objective should be valid and reliable. Validity of a test refers to the extent to which a test is an appropriate measure of what it was intended to measure. The validity of a test can be ascertained by checking that the conditions, performance and standards of the test correspond to those described in the training objective. Reliability is the ability of a test to consistently reproduce similar results when administered on similar groups of students under similar conditions with different instructors or assessors. To ensure that the test is reliable, the score key, providing model answers and specific instructions on how the test should be administered, is critical.

1.2.11 Examination database

1.2.11.1 Where possible, States or ANSP should build an examination database, or at least a comprehensive written list, of all need-to-know questions and performance exercises for each rating (charts may be included), covering both general and critical objectives. Due to the quick evolution of technology and systems, these questions and performance exercises must be kept up to date to ensure the currency of the ATSEPs' knowledge and skills.

1.2.11.2 A model answer should give the instructor enough information to establish how closely the trainee masters the tested material. These three elements, score key, model answer and the conditions in which the test has been administered, provide the basis to determine a pass or fail in a consistent manner.

1.2.12 Training reference guide

1.2.12.1 In addition, the various parts of the training manual have been marked with a coding level from 0 to 5, indicating the degree of expertise required to perform a clear demonstration of a desired level of accomplishment.

1.2.12.2 The level of complexity refers to the taxonomy of verbs used (a list of these verbs can be found in Appendix A), and can be explained as follows:

Level 0: Denotes a simple level of awareness.

Level 1: Denotes a basic knowledge of the subject, and the ability to state or list the essential points. Trainees should have a basic understanding of the subject, but are not expected to apply the learned skills and knowledge.

- Level 2:** Denotes the ability to apply, in practice, the learned knowledge and skills of the subject with the help of reference manuals and instructions.
- Level 3:** Denotes a thorough ability to apply learned knowledge and skills of the subject with speed and accuracy.
- Level 4:** Denotes extensive ability to apply the learned knowledge and skills of the subject, to procedures derived from it, with judgement appropriate to the circumstances.
- Level 5:** Denotes ability to analyse a new situation in order to elaborate and apply one or more relevant strategies to solve a complex problem. The defining feature is that the situation is qualitatively different to those previously met, requiring judgement and evaluation of options.

1.2.12.3 As mentioned earlier, there is no training duration identified for the various subjects in each of the training phases. The duration for each phase will vary depending on the size and complexity of the organizations, the CNS/ATM systems and the ATM/airspace structure of the State. The duration will also depend on many other factors such as: the availability and the number of equipment or systems for training, the number of trainees, the availability of the necessary test equipment, the maintenance philosophy, and the teaching strategy used by the instructors. It can be appreciated that identifying course duration without looking at the specific criteria of the State would be misleading and unrealistic.

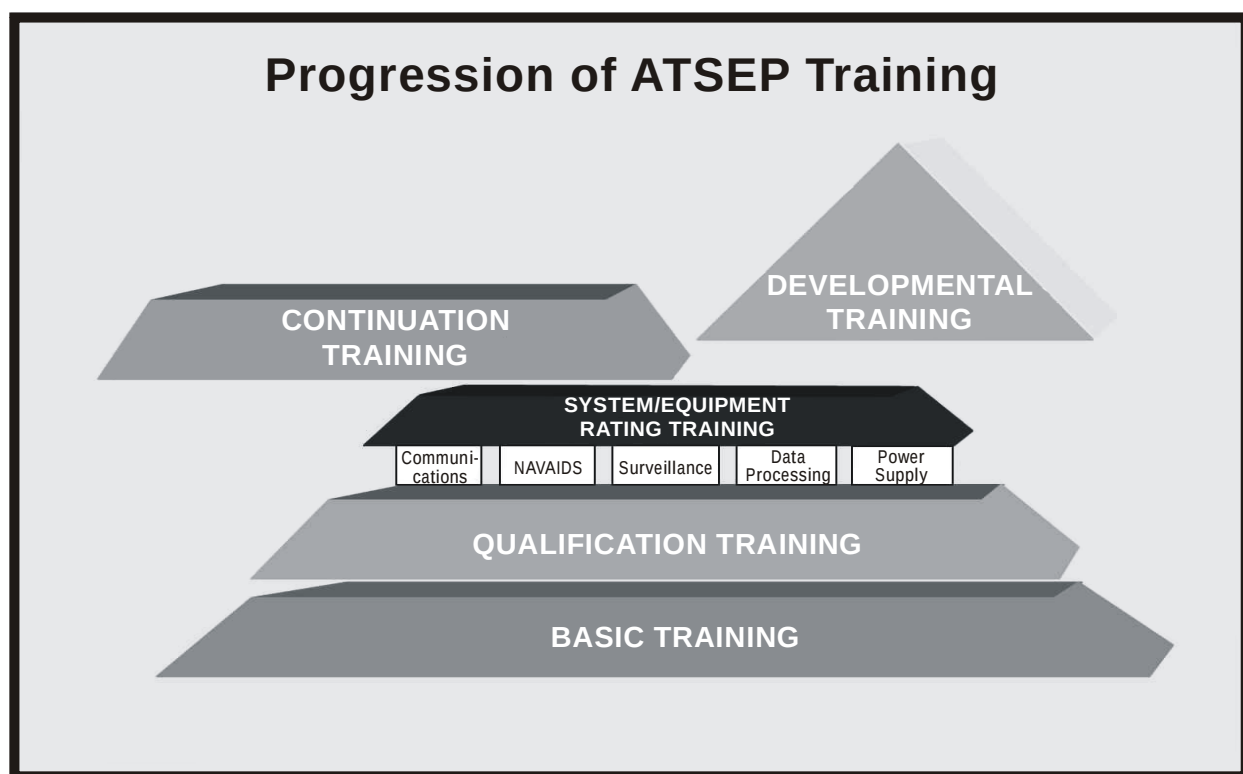


Figure 1. Progression of ATSEP training

Chapter 2

GENERAL RECOMMENDATIONS

2.1 ACCOMMODATIONS AND EQUIPMENT FOR CLASSROOM-BASED TRAINING

2.1.1 General

The *TRAINAIR Training Management Guideline (TMG)*, developed by ICAO, provides detailed information on, among other things, training support functions, training delivery, administrative support functions, and the planning and design of training facilities. A second manual, the *TRAINAIR Training Development Guideline (TDG)*, details the development methodologies of training courses for aviation personnel and provides guidelines on validation, revision and implementation of courseware, training techniques, design of tests, post-training evaluation, etc. The aim of both the TMG and TDG is to provide civil aviation training managers with the tools they need to effectively manage their training organizations, and, while the majority of the material included in both manuals may not be directly applied to the training of ATSEP, the providers of ATSEP training can effectively benefit from utilizing these tools. Both the TMG and TDG contain detailed information on the issues discussed in this chapter.

2.1.2 Classrooms and equipment

2.1.2.1 Opinions differ on how much classroom space is required for each trainee. The range of “ideal” space for each adult in a classroom varies from a low of 1.4 m² to a high of 6.7 m². The reason for the wide range in ideal figures is that classroom designers may envision different classroom environments or account for certain spaces within the classroom, such as aisles and front setback, differently. The sizes of classrooms are affected by:

- a) number of trainees in a class;
- b) trainee workstation size;
- c) class configuration;
- d) size of aisles; and
- e) use of media (in particular, projected media and hands-on projects).

Note.— The ratio of trainees to instructor required to achieve efficient and good quality training depends on the mode of delivery (individualized or group-paced) and the training techniques used (lesson/demonstration mediated lecture, group discussions, small group discussions, case studies, role play, supervised practice, etc.). Labs require group and individualized supervision and control that does not allow having more than 10 to 14 trainees for two instructors. This ratio may be also used for group-paced training when the trainees need a large number of reference materials and the training includes several training techniques.

2.1.2.2 The use of media and hands-on experiments and the number of trainees per instructor are important factors in determining the amount of common space required in a classroom. The most commonly used visual media are

slides, chalk/marker boards, overhead projectors, videotape and easels. Room size has a considerable impact on the effectiveness of projected media (slides, overheads, television, etc.) and should be taken into consideration when assigning classrooms.

2.1.2.3 In planning the space requirements for the training of ATSEP, training managers must take into consideration the trainee workstations, the area required for hands-on training, the faculty workstations and any storage area.

2.1.2.4 Trainee workstation space includes the trainee's work surface, additional equipment (computer terminal, audio-visual, etc.), a chair, and the space for chair pushback and manoeuvrability. The concept of workstation space is important when sizing rooms for classes containing different numbers of trainees. An adequate work surface within the workspace is very important. The large amount of reference material used in the training of ATSEP requires considerably larger work surfaces than would be provided by the attached writing surface of an auditorium chair.

2.1.2.5 Computers are also useful training aids for ATSEP. Used as instructional media, computers usually are desktop models with keyboard and monitor. They can communicate verbal and graphic information, and can accept verbal as well as manual or tactile responses. Computers may be used for drills, computer-managed instruction, testing and simulations.

2.1.3 The learning environment

2.1.3.1 The key to a good learning environment is the elimination of discomfort and other undesirable characteristics. Ten primary factors have been identified:

- a) the climate must be comfortable;
- b) lighting must be of adequate level for work or viewing;
- c) distracting sounds must be kept to a minimum;
- d) work areas must be aesthetically pleasing;
- e) workstations must be comfortable;
- f) work space must be adequate;
- g) work area must be reasonably clean;
- h) training equipment must be adequate;
- i) visual media must be visible; and
- j) audio media must be at a suitable level.

2.1.3.2 If any of these factors are unsatisfactory, the result can be distraction from the task at hand, and fatigue can result from the effort required of the trainee to adapt to a poor environment. One of the most widely recognized factors listed is the comfort of workstations, which includes chair comfort.

2.2 PERFORMANCE EVALUATION (TESTING)

2.2.1 Performance evaluation (testing) is an integral part of the training process. For the trainee, testing provides incentive and motivation, and it confirms learning. From the instructor's point of view, testing confirms that the objectives have been met and indicates whether instruction methods need to be improved. Tests should always be prepared with the sole purpose of measuring whether or not the trainee has achieved the training objective. Trainees must always be informed how they are going to be evaluated, so they can orient their efforts. The information must include the conditions that will exist during the test, the performance that is expected from the trainees, the standards of accomplishment that have to be met, and the consequences of an inadequate performance. It is recommended that errors on knowledge exams and skill tests be reviewed with trainees to reflect corrections to 100 per cent. Trainees must be informed of the result of their evaluation, and instructors must offer correction of incorrect responses.

2.2.2 Time and resource constraints may limit the amount of testing that can be given to each objective. However, the criticality of the subject and the performance difficulties which can be encountered should give some indication as to when, how and what performance evaluation should be required. Generally speaking, performance measurement is undertaken to evaluate whether or not the trainees have understood and assimilated, at the desired level, the material taught.

2.2.2.1 Skills are best tested by performance tests (the trainee performs the task described in the objective, under real or simulated conditions).

2.2.2.2 Knowledge is best tested by oral or written tests.

2.2.2.3 Attitudes are the feelings and opinions concerning the job, and other people, as well as personal conduct and responsibility. They are best tested by observation of performance, or by means of questionnaires.

2.2.3 There are no terminal objectives in this manual, because terminal objectives refer to specific tasks, and these can vary substantially between States, service providers and manufacturers. The terminal objectives are subject to the systems or equipment used on the course being delivered in the type rating phase. These objectives should be determined and administered by the local training administration or responsible authority. All of them should be tested.

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Chapter 3

FAMILIARIZATION WITH AIR NAVIGATION SERVICES

3.1 INTERNATIONAL AND NATIONAL ORGANIZATIONS AND STANDARDS

3.1.1 Introduction

International regulations and air laws are promulgated to ensure the safety, regularity and efficiency of international aircraft operations. Internationally, ICAO, pursuant to the provisions of Article 37 of the Convention on International Civil Aviation, develops and adopts Standards and Recommended Practices (SARPs, contained in the Annexes to the Convention) as the minimum requirement for ANS operation. CNS/ATM systems operations are governed by international organizations that provide rules and standards to ensure safe operation and interoperability of air navigation services worldwide. Among these organizations are ICAO, the European Civil Aviation Conference (ECAC), Joint Aviation Authorities (JAA), and the Institute of Electrical and Electronic Engineers (IEEE). Achievement of safety and efficiency in air navigation operations requires that all States accept and implement a common standard for air navigation service with regard to training, licensing, certification, etc. The standardization of operational practices for international services is of fundamental importance for the prevention of costly errors, which may result from misunderstanding or inexperience. Although this manual and other ICAO manuals address international ATSEP training, the need for standardization is equally applicable to any ANS operation. The syllabus contained in this chapter gives a general view on aviation law, as adopted by ICAO and practised in international ANS operations.

3.1.2 Training objective

3.1.2.1 Students shall describe the national and international organizations, the regulations, national legislation, and the work environment.

Condition: Given the description of a specific situation relating to a State Air Navigation Service provider, and the relationship with international and national authorities.

Performance: The trainee will be able to describe:

- a) the role of international and national organizations as well as the SARPs;
- b) the importance of applicable international and national regulations; and
- c) the standard of accomplishment.

All the descriptions should include the essential points of the given situation.

3.1.2.2 This sub-section includes five parts:

Introduction;
International and national organizations and standards;
Working positions and environment;
Environmental protection;
Personal safety.

<i>Intermediate Objectives.</i>			
<i>Topic</i>	<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>
3.1 International and national organizations and standards			
3.1.1 Introduction			
1. National and international organizations	1) Name the key national and international aviation organizations.	1	ICAO, ECAC, EUROCONTROL, JAA.
	2) Describe the impact these organizations have on ATM, and their interaction with each other.	2	National authority, others.
	3) State the necessity to have special aviation law, the source and development of aviation law.	1	Show example of guidelines or recommendations. ICAO Annex 2, Annex 10. Technical recommendations. National Aviation Law.
3.1.2 International and national organizations and standards			
1. ICAO	1) Explain the purpose and function of ICAO.	2	History, convention, international agreement.
	2) State the methods by which ICAO notifies and implements legislation.	1	ICAO Annexes, ICAO documents, Regional Offices.
	3) Describe the ICAO technical recommendations.	2	PANS, SARPS, FANS, ICAO Annexes 2 and 10.
2. International Standards and Recommended Practices	1) Demonstrate an awareness of ATM engineering standards and practices.	2	ICAO Annexes 1 and 10. ICAO Doc 8071. International Standards, IEEE, JAA: CCITT, guidance material on reliability and availability.
	2) Describe the purpose of the CCITT.	2	Guidance material on network, communication and frequency at location.
3. Other agencies	1) Describe the purpose and function of other international agencies and their relevance to air traffic operations.	2	ECAC, EU, JAA, ITU, EUROCONTROL, other agencies from Africa, Asia, etc.
4. Aviation associations	1) Describe the purpose of ATSEP, engineers, controller, pilot, airline and airspace user associations, and their interaction with ATM.	2	IFATSEA, IEEE, IFATCA, IFALPA, IATA, IEA, IAOPA, IACA. Other civil or military services.

		<i>Intermediate Objectives.</i>		
	<i>Topic</i>	<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>
5.	International dimension	1) Explain the relationship between States and the relevance to ATC operations.	2	Harmonization, flow management, bilateral agreement, sharing of radar data, or other information. ICAO. ECAC. Harmonization programme EATCHIP/EATMP.
		2) Demonstrate an awareness of the legal framework of international and national ATC regulations.	2	ICAO, EUROCONTROL, ITU.
		3) Demonstrate an awareness of the roles and specific functions of a range of international bodies.	2	Major studies, research programmes and policy documents, FANS.
6.	National legislative procedures	1) Describe the methods by which legislation is notified and implemented.	2	ICAO Annex 15, AIS, AIP, AIC, SUP. Type of publication, AIRAC, NON-AI RAC. NOTAM, integrated aeronautical information package, national legislation.
		2) State the appropriate accountabilities and responsibilities.	1	Technical and operational responsibility; system management
7.	National regulatory body	1) Name the body responsible for certification and enforcing legislation for technical procedures.	1	Department, quality control, safety management, documents in use.
		2) Describe how the regulatory body carries out its safety regulation and responsibilities.	2	Technical safety department; redundancy policy.
8.	National aviation associations	1) Describe the purpose of national ATSEP, pilot, controller, airspace user associations and their interaction with ATM.	2	National organization, professional organization and representation to international body.
9.	National organizations	1) Describe the history and organizational structure of the national CAA.	2	History of your national organization, national policy, agencies. Headquarters, regulator, provider.
		2) Describe the purpose and function of appropriate national agencies and their relevance to ATM operations.	2	Civil aviation administration agencies, your organization or department, government agencies, military agencies.

<i>Topic</i>	<i>Intermediate Objectives. The students should be able to:</i>	<i>Level</i>	<i>Content</i>
	3) Describe the organizational structure and functions of the major departments within the national CAA, and particularly the technical organization.	2	Provider organization. Technical organization flow chart, control centres, operational flow chart, airports. Outstations civil/military interfaces. Other national or international interfaces, bilateral agreements.
	4) Describe the operational services and list the type of existing ANS and list the Air Traffic Services.	2	ATM (ATS, ATFM, ASM), ATC (ACC, TWR, APP) FIS/AIS, Alerting.

3.1.3 Working positions and environment

1. General	1) Describe the workplace, fire and safety regulations.	2	Pass a simple first aid test, fire exit, safety regulation, building, rest room, ID card.
	2) Describe the maintenance policy, the safety policy and quality control related to systems.	2	Maintenance concept and philosophy, system certification, ISO certification.
	3) Identify the equipment in the working position.	3	Stores and requisitioning process. Safety procedure, certification of equipment, tools, measuring instruments.
	4) Describe the environment surrounding your building.	2	Airport environment, tarmac rules, security, ID card, location of NAVAID.
	5) Describe the special rules that apply in this environment.	2	NAVAID station, safety rules, power and logistic suppliers, fire brigade. Special rules for driving in airport environment, use of radio (radio licence), ILS/localiser testing vehicle.
2. Study visits	1) Demonstrate familiarization with technical and operational ATM facilities.	0	Technical room, outstations, ACC, TWR, APP, AIS Radar, NAVAID and communications facilities.
	2) Demonstrate familiarization with airport facilities and local operator.	0	Airport services, airlines, customs.

3.1.4 Environmental protection

1. Environmental protection	1) Recognize the importance of environmental protection.	1	Air, water, noise.
	2) Recognize the importance and danger of non-ionizing electromagnetic radiation.	1	Power transmitter and radar transmitter.

		<i>Intermediate Objectives.</i> <i>The students should be able to:</i>			
<i>Topic</i>			<i>Level</i>	<i>Content</i>	
3.1.5 Personal safety					
1. Personal safety	1)	Demonstrate general awareness of personal safety responsibilities in the work environment.	0	Safety statement, high voltage precautions.	
	2)	Demonstrate general awareness of potential hazards to health and safety generated by equipment, or contained within the work environment.	0	First aid.	
	3)	State safety procedures for persons working on or near such equipment.	1	Radar beam, handling of dangerous materials (TR cells, components with radioactive element).	
	4)	State any applicable legal requirements.	1	Procedures in use, company rules, national rules.	

3.2 FAMILIARIZATION WITH AIR TRAFFIC SERVICES, AIRSPACE STANDARDS, METEOROLOGY AND ALTIMETRY

3.2.1 Introduction

3.2.1.1 The ATSEP are performing several critical tasks on CNS/ATM systems or equipment which could have an impact on users. In order for ATSEP to fully understand the impact of their work on these systems, they must have a sound knowledge of the operational environment, such as ATM. ATM systems are vital in order to provide safe, reliable and efficient delivery of air traffic services. The consequences of system outages and their direct impact on users (i.e. pilots, air traffic controllers) may result in unsafe situations or cause excessive delays in airline operations.

3.2.1.2 ATSEP must understand the effects of varying temperature and weather conditions on the CNS/ATM systems. For example, high-level humidity or snow accumulation may impact radio frequencies. They also must have a good appreciation of altimetry, height, altitude and flight level.

3.2.1.3 The syllabus contained in this sub-section gives a general view of these elements.

3.2.2 Training objectives

3.2.2.1 Students shall describe air traffic services, airspace standards, meteorology and altimetry.

Condition: Provided with a broad outline of air traffic services, airspace standards, meteorology and altimetry.

Performance: The trainee will be able to describe:

- a) the role of the national ATM services, clients and customers;

- b) the importance of separation standards and collision avoidance; and
- c) the importance of meteorology and altimetry, and how they can affect operations.

Standard of accomplishment: All the descriptions should include the essential points of the given situation.

3.2.2.2 This sub-section includes eight parts:

Airspace users and customer relations;
 Air traffic management;
 Separation standards and collision avoidance;
 Meteorology, altimeter and level allocation;
 Atmosphere and atmospheric processes;
 Meteorological phenomena and codification;
 Meteorology tools and equipment; and
 Altimetry and operational aspects.

Intermediate Objectives.				
Topic	The students should be able to:		Level	Content
3.2 Familiarization with air traffic services, airspace standards, meteorology and altimetry				
3.2.1 Airspace users and customer relations				
1. Civil aviation	1)	Demonstrate general awareness of the different airspace requirements for civil aircraft.	0	Commercial flying, recreational flying, gliders, balloons, VFR, IFR.
2. Military aviation	1)	Demonstrate general awareness of the different airspace requirements for military aircraft.	0	Low-level flying, test flight, special military operations, training.
3. Expectations and requirements of pilots	1)	Demonstrate general awareness of the expectations and requirements of pilots.	0	
4. Customer relations	1)	State the role of ATM as a service provider.	1	
	2)	Recognize the means by which ATM is funded.	1	System of funding, en route charge, landing charge, system of clearing (EUROCONTROL)

		<i>Intermediate Objectives.</i> <i>The students should be able to:</i>		<i>Level</i>	<i>Content</i>
3.2.2 Air traffic management					
1.	Terminology and units of measurement	1)	Apply the terminology and units of measurement appropriate to ATM.	3	Glossary, ACC, APP, TWR, TMA, CTR.
		2)	Demonstrate an understanding of ATM terminology.	2	
2.	Air traffic control services	1)	Describe the types of flight.	2	ICAO Annex 11. AIP, national services.
		2)	Explain the division of ATM services.	2	IFR, VFR, CVFR, civil, military.
		3)	Demonstrate an awareness of airspace organization and associated concepts.	2	Airways within national boundaries, TMA, CTR.
		4)	Describe the functions and services provided by ATC and the different ATC tasks.	2	ICAO Annex 11.
		5)	Describe the sectorization.	2	Principle of sectorization, logical sectors, physical sectors.
		6)	Describe the data displayed on the screen.	2	Radar track, SSR code, labels, maps. See a controller position screen. Flight information region, area control centre, terminal manoeuvring area, APP, TWR.
		7)	Describe the function of ground control.	2	
		8)	Describe the function of tower control.	2	
		9)	Describe the function of approach control.	2	The task of ACC, approach, tower and oceanic control.
		10)	Describe en-route control.	2	
		11)	Describe the transfer of control.	2	
3.	Flight information service (FIS)	1)	Define FIS.	1	ICAO Annex 11, AIP.
		2)	Define the scope of the FIS.	1	National organization, FIC.
		3)	Explain the responsibility for the provision of FIS.	2	ATIS, VOLMET, RTF, data link.
		4)	State the methods of transmitting information.	1	

Topic	Intermediate Objectives. The students should be able to:		Level	Content
	5)	Issue information to aircraft.	3	State of Nav aids, weather, flight safety information, NOTAM.
4. Alerting service (ALRS)	1)	Define ALRS.	1	ICAO Annex 11.
	2)	Define the scope of the ALRS.	1	
	3)	Differentiate between phases of emergency, and between distress and urgency signals.	2	Uncertainty, alert, distress, mayday, pan, visual signals. Responsibilities. Local organization.
5. Air traffic flow management (ATFM)	1)	Define ATFM.	1	Flow control, Integrated Initial Flight Plan Processing System (IFPS), Central Flow Management Unit (CFMU), slot, national organization and interface.
	2)	Describe the scope of ATFM.	2	Fields of the flight plan and their uses.
	3)	Demonstrate an awareness of the content of a flight plan and state the different fields.	2	Exchanges between centres, OLDI messages, estimated times.
	4)	Explain the life cycle of a flight plan.	2	
	5)	Explain the responsibility for the provision of ATFM.	2	Database, EUROCONTROL CFMU.
	6)	State the methods of providing ATFM.	1	
6. Aeronautical Information Services (AIS)	1)	Define AIS and the responsible bodies in charge of aeronautical legislation.	1	ICAO Annex 15. CAA, military.
	2)	Define the methods by which the legislation is notified and implemented.	1	ICAO Annex 15. Code of the air, AIP, NOTAM, SUP, AIC, national services.
	3)	Define the structure of the AIS, its area of responsibility and its position inside the national air traffic services.	1	ICAO Annex 15.
	4)	Describe the AIP.	2	ICAO Annex 11. Data contents of AIP, SUP, AIC. Types of publication (AIRAC, NON-AIRAC), data collection and preparation and data format, distribution channels.

		<i>Intermediate Objectives.</i> <i>The students should be able to:</i>		<i>Level</i>	<i>Content</i>
7. Airspace management (ASM)	5)	Define the aeronautical charting service.		1	ICAO Annex 4. Types of charts, operational use and distribution channel.
	6)	Define the AIRAC and the AIC.		1	
	1)	Define ASM.		1	
	2)	Describe the scope of ASM.		2	Procedures, airways system design, points, maps design. Reference document.
8. Particular situation	3)	Explain the responsibility for the provision of ASM.		2	Airspace delegation (if it exists).
	4)	State the methods of managing airspace.		1	Flexible use of airspace, airspace design.
	1)	Describe the particular problems confronting ATM.		2	Weather conditions, environment, special flights, military activity, emergencies, search and rescue operation, hijacking, faulty aircraft equipment, faulty ground equipment.
	2)	Describe the emergency procedure in case of equipment failure.		2	Responsibilities, restriction, emergency procedure.
9. System and equipment	1)	Describe the operational importance of equipment and facilities provided for ATM.		2	Reliability, redundancy, contingency, procedural backup.
	2)	Describe the emergency procedure in case of equipment failure.		2	Responsibilities, restriction, emergency procedure.
	1)	Explain the principle of coordination and transfer.		2	Notification, negotiation, agreement, transfer of flight data, local agreements, bilateral agreements between countries.
	2)	Appreciate the need for coordination.		3	
10. Coordination	3)	Describe the means of coordination		2	Data link, telephone, intercom, voice.
3.2.3 Separation standards and collision avoidance					
1. Vertical separation	1)	State the vertical separation standards and procedures.		1	Standard separation, RVSM (AIP, ICAO).
2. Horizontal separation	1)	State the longitudinal separation standards and procedures.		1	Separation based on time and distance.
	2)	State the lateral separation standards and procedures.		1	Aircraft performance.

		<i>Intermediate Objectives.</i>			
<i>Topic</i>		<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>	
3. Visual and geographic separation	1)	State the occasions when visual separation can be used.	1	Separation provided by pilot.	
	2)	Explain the use of geographic separation.	2		
4. Wake turbulence separation	1)	Explain the wake turbulence categories and separation.	2		
5. Radar separation	1)	Explain the use of radar in ATS.	2		
	2)	Explain the radar separation standards and procedures.	2		
6. Collision avoidance	1)	Explain the Airborne Collision Avoidance System and the effect on ATC operations.	2	ACAS	
	2)	Explain the conflict alert systems and their effect on ATC operations.	2	MTCA, STCA, MSAW, DAIW.	
7. Separation	1)	Demonstrate general awareness of the separation standards that apply to the ACC.	0	Explanation of how controllers apply the ACC separation, restriction due to faulty equipment.	
	2)	Demonstrate general awareness of the separation standards that apply to APP and TWR.	0	Identify for APP and TWR (see also the function of ACC, APP and TWR).	
8. Familiarization with ATM simulator	1)	Confirm an understanding of the operational ATC role through practical exercises on ATC simulators, or with flight simulator.	3	Exercise on simulators (ACC/APP simulator, TWR simulator, flight simulator....), follow a flight plan.	
	2)	Explain the need for good communications between operational staff.	2	During the flight see the role of ACC, TWR, APP, FIS and all the technical systems involved for each step. Coordination between sectors, between centres.	
	3)	Explain the need for good communications between operational staff and technical staff.	2	Good communications in case of system failure, description of new specifications, identification of problems.	
9. Familiarization visits	1)	Undertake station familiarization visits.	0	Visits.	
	2)	Visit various operational stations in order to state their purpose, function and role in relation to ATC operations.	0		

<i>Intermediate Objectives.</i>			
<i>Topic</i>	<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>
3.2.4 Meteorology, altimeter and level allocation — Introduction			
1. Terminology and units of measurement	1) Demonstrate an awareness of the terminology and units of measurement appropriate to meteorology.	1	Glossary and abbreviations.
2. Aviation, ATM and meteorology	1) Explain the relevance of meteorology in aviation and in the ATC environment.	2	From the operational point of view.
	2) Explain how technical systems contribute to ATC operations.	2	
	3) Describe the function and the performance of the weather measurement systems.	2	
3. Organization of meteorological services	1) Name the basic duties, organizations and working methods of meteorological offices.	1	Local, national and international meteorological offices.
	2) State the international and national standards for the exchange of meteorological data.	1	Local, national and international meteorological offices.
		1	National services, interface with your ATM systems networks, satellite, Meteosat.
3.2.5 Atmosphere and atmospheric processes			
1. Composition and structure	1) State the composition and structure of the atmosphere.	1	Gasses, layers, troposphere, stratosphere, mesosphere, thermosphere.
2. Standard atmosphere	1) Define the elements of the ISA and why it has been defined.	1	ICAO standard atmosphere, temperature, pressure, density.
3. Air masses and general air circulation and frontal systems	1) State the origin and general location of typical air masses.	1	Polar, arctic, equatorial, maritime and continental.
	2) State the major wind systems on the Earth.	1	Polar, east winds, west winds, zone.
	3) Define high and low pressure systems.	1	Trade winds, inter-tropical convergence zone.
	4) State the differences between various fronts and the associated weather.	1	Warm front, cold front, occluded front.

<i>Intermediate Objectives.</i>				
<i>Topic</i>		<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>
4.	Heat and temperature	1) Identify the processes by which heat is transferred and how the atmosphere is heated.	1	Radiation, convection, conduction, turbulence.
		2) Describe how temperature varies.	1	
5.	Water in the atmosphere	1) Differentiate between the terms related to air saturation levels.	2	Saturation, condensation, evaporation, relative humidity, dew point.
6.	Air pressure	1) Define the relationship between pressure, temperature and altitude.	1	QFE and QFF definition, QNH definition, QNH computation, standard pressure, use in ATM (see also altimeter setting).

3.2.6 Meteorological phenomenal and codification

1. Clouds	1)	Identify the different conditions for the formation of clouds, cloud types and state their characteristics.	1	
	2)	State how the density of clouds is measured.	1	
	3)	Define the cloud base and ceiling.	1	
2. Precipitation	1)	State the significance of precipitation in aviation, and the types of precipitation.	1	Rain, snow, sleet, hail.
3. Visibility	1)	State how visibility is measured and the significance for ATM.	1	RVR, camera, transmission of data, impact on ILS categories.
4. Wind	1)	State the significance of wind phenomena and types.	1	
	2)	State how wind is measured.	1	
5. Meteorological hazards	1)	State the meteorological hazards to aviation.	1	Turbulence, storms, icing, wind shear.
6. Impact on ATM	1)	Demonstrate general awareness of the impact of the different atmospheric conditions on ATM operations.	0	Give examples.
7. METAR and TAF Code	1)	Explain the aim and use of METAR and TAF code.	2	Observation at airport, METAR/SPEC, forecast TAF/TREND, aviation weather report.
	2)	Define the content of the METAR.	1	Content of the message, wind, visibility, type of weather, clouds, temperature, dew point, pressure.

Topic	Intermediate Objectives. The students should be able to:	Level	Content
8. Significant weather information	3) Decode a METAR by using the METAR table.	2	Examples of METAR and interpretation.
	4) Define the content of the TAF code.	1	Example of terminal area forecast message and interpretation.
	1) Define the aim and use of SIGMET.	1	Content of the terminal area forecast, examples.
	2) Define the aim and use of GAMET.	1	
	3) Define the aim and use of AIRMET.	1	
9. Typical situation	4) Define the aim and use of SWC and TEMSI chart.	1	
	1) State the typical weather situation over your region.	1	Examples.

3.2.7 Meteorology tools and equipment

1. Meteorology sensors	1) Explain the main functions of each tool.	2	Sensors, anemometers, RVR, barometers, ceilometer
	2) Explain the technical principle of each piece of equipment and its location.	2	Technical description of each system, photo of equipment.
	3) State the relevant measurements and instrumentation.	1	System diagram (global).
	4) Define the main function of Meteosat.	1	Radar, display, distribution, use for approach.
	5) Explain the main function of airborne and ground weather radar.	2	Radar, display, distribution, use for approach. Visit approach display.
2. Documents	1) State the main documents, national and international.	1	
3. Information	1) State the different networks for transmitting meteorological information.	1	Distribution system, network, Infonet, type of data transmitted.
	2) State the types of meteorological messages and reports.	1	METAR, SPECI, SIGMET, FIS.
	3) Define the content, main function and characteristic of the broadcasting system.	1	ATIS, VOLMET.
4. System in use in your unit	1) Describe, with the help of a block diagram, the system that transmits the meteorological data.	2	Block diagram of the system.

<i>Intermediate Objectives.</i>			
<i>Topic</i>	<i>The students should be able to:</i>	<i>Level</i>	<i>Content</i>
	2) Name the ATSEP who are in charge of the system maintenance.	1	Name of the group of ATSEP, and how to contact them.
3.2.8 Altimetry and operational aspects			
1. Atmosphere parameters and altitude	1) State general consideration of the atmosphere with respect to altimetry.	1	Atmosphere, pressure, standard atmosphere.
	2) Explain the difference between QNE and QFF.	2	Definition of QNE and QFF.
	3) Explain the different parameters of the atmosphere.	2	Atmosphere layers, ICAO standard atmosphere – ISA, pressure lapse rate (ISA).
	4) Explain the atmospheric pressure QNH.	2	Definition of the QNH, QNH computation, example.
	5) State the two specific altimeter errors.	1	Altimeter errors caused by non-standard atmospheric conditions.
2. Temperature effect on altimeters	1) Describe the altimeter errors due to the temperature.	2	Indicated altitude, true altitude.
	2) Describe an example of error with the help of a temperature table.	2	Table of temperature deviation from ISA, example of map.
3. Pressure effect on altimeter	1) Describe with the help of a drawing the altimeter errors in different pressure conditions.	2	Standard, low and high pressure conditions. Altimeter setting.
4. Altimeter settings	1) Describe the different altimeter settings with the help of a drawing.	2	In flight or ground QFE setting, QNH setting, standard setting, flight level and separation, QNE setting.
	2) Show the lowest usable flight level with help of a drawing.		
5. Flight procedures	1) Describe the departure, en-route and arrival procedures.	2	Departure procedure transition altitude, transition level and transition layer, flight level and separation, low pressure situation. Lowest usable flight level.
6. Altimetry	1) Appreciate the relationship between height, altitude and flight level.	3	QFE, QNH, standard pressure.
7. Transition level	1) Appreciate the relationship between transition level, transition altitude and transition layer.	3	Give examples for arrival, departure.

