



Advisory Circular

AC66-2.17

Aircraft Maintenance Engineer Licence— Examination Subject 17 Human Factors

Revision 1 (4)
05 February 2016

General

Civil Aviation Authority advisory circulars contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule.

An acceptable means of compliance is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular.

An advisory circular may also include **guidance material** to facilitate compliance with the rule requirements. Guidance material must not be regarded as an acceptable means of compliance.

This advisory circular is intended to be read with Part 66 Subpart B of the rule. If there are any conflicts between the advisory circular and the rule, the rule takes precedence.

Purpose

This advisory circular provides an acceptable means of compliance for the syllabus content in respect of written examinations for Subject 17 (Human Factors).

This advisory circular also provides guidance material for recommended study material in respect of the examination syllabus in this advisory circular.

Related Rules

This advisory circular relates specifically to Civil Aviation Rule Part 66 Subpart B — ‘Aircraft Maintenance Engineer Licence’.

Change Notice

Subject to “Memorandum for Technical Cooperation” between the CAA of Mongolia and New Zealand on mutual cooperation in implementation of the International Civil Aviation Organization Resolution of Global Rule Harmonization, which urges States to promote global harmonization of national rules, dated 6th of May, 1999, Mongolian Civil Aviation Safety Regulation has been reconciled to the Civil Aviation Regulation of New Zealand.

Amendment 164 of Annex 1 to the Chicago Convention on International Civil Aviation urges flight crew members, ATC personnel and aircraft maintenance engineers to comply with the language proficiency requirements; and

Under Article 14 of the Civil Aviation Law of Mongolia 1999, “Use of foreign language in civil aviation” the AC has been released in English version only, in order to prevent any mistranslation and misuse of the aviation safety related documents.

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Rule 66.53 Eligibility Requirements

Rule 66.53(a)(2) requires an applicant for an AMEL to have passed written examinations, that are acceptable to the Director, relevant to the duties and responsibilities of an aircraft maintenance engineer in the category of licence sought.

The written examinations acceptable to the Director for Subject 17 (Human Factors) should comply with the syllabus contained in this advisory circular. Each examination will cover all topics and may sample any of the sub-topics.

The new syllabus has been developed after extensive industry consultation and the objectives reflect the knowledge required of current technology and international best work practice.

Examination Overview: Subject 17

The pass mark for Subject 17 (Human Factors) is 70%.

Application to sit an examination may be made directly to PEL office.

General Examining Objective

The objective of the examination is to determine that the applicant for an AMEL has adequate knowledge of Subject 17 to permit the proper performance, supervision and certification of aircraft maintenance at a level commensurate with the privileges of the various AMEL categories.

Knowledge Levels

LEVEL 1: A familiarisation with the principal elements of the subject.

Objectives: The applicant should:

1. be familiar with the basic elements of the subject.
2. be able to give simple descriptions of the whole subject, using common words and examples.
3. be able to use typical terms.

LEVEL 2: A general knowledge of the theoretical and practical aspects of the subject.

An ability to apply the knowledge.

Objectives: The applicant should:

1. be able to understand the theoretical fundamentals of the subject.
2. be able to give a general description of the subject using, as appropriate, typical examples.
3. be able to use mathematical formulae in conjunction with physical laws describing the subject.
4. be able to read and understand sketches, drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using detailed procedures.

LEVEL 3: A detailed knowledge of the theoretical and practical aspects of the subject.

A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

Objectives: The applicant should:

1. know the theory of the subject and the interrelationships with other subjects.
2. be able to give a detailed description of the subject using theoretical fundamentals and specific examples.
3. understand and be able to use mathematical formulae related to the subject.
4. be able to read, understand and prepare sketches, simple drawings and schematics describing the subject.
5. be able to apply his/her knowledge in a practical manner using manufacturer's instructions.
6. be able to interpret results and measurements from various sources and apply corrective action where appropriate.

Recommended Study Material

The publication list below provides guidance material for suitable study references for the overall syllabus content. However, applicants may have to conduct further research using other references or sources (including the internet) or attend a formal course in order to gain a comprehensive understanding of all sub-topics in the syllabus.

Where applicable, publication references have been placed below each main topic or sub topic heading in this syllabus.

Publication List

Study Ref	Title and Internet Address
1*	UK CAA CAP 715: An Introduction to Aircraft Maintenance Engineering Human Factors for JAR 66 See: http://www.caa.co.uk/docs/33/CAP715.PDF
2	UK CAA CAP 716: Aviation Maintenance Human Factors (JAA JAR145) See: http://www.caa.co.uk/docs/33/CAP716.pdf
3	FAA Human Factors Guide for Aviation Maintenance See: FAA Aircraft Maintenance Human Factors (HFSkyway) website Go to - Document Library/Human Factors Maintenance/ Human Factors Guide for Aviation Maintenance
4	Mongolian Health and Safety in Employment See: Ministry of Business, Innovation and Employment web site
5	Mongolian ACC - Hazard Management See: ACC website

* Principal study reference

The material on human factors is extensive. While the above publication list should provide sufficient material to cover the written examination syllabus for Subject 17, the reader who would like additional reference material for aviation maintenance human factors should refer to the following “further reading list”.

Further Reading List

Ref	Title and Internet Address
1	FAA Operator’s Manual for Human Factors in Aviation Maintenance See: http://hfskyway.faa.gov/HFSkyway/index.aspx
2	ICAO Doc 9824: Human Factors Guidelines for Aircraft Maintenance Manual Available for purchase at: http://www.icao.int/publications/Pages/doc-series.aspx
3	Human Factors Background Information See: Grey Owl Aviation Consultants website http://greyowl.com/articles/index.html
4	Safety Behaviours: Human Factors for Engineers resource kit See: CASA website at http://casa.gov.au/scripts/nc.dll?WCMS-STANDARD-pr=PC_100999

Syllabus Layout

Topic Numbering - left hand column

The syllabus is set out by topics, each of which is identified by a single-digit number. Each topic is divided into a number of sub-topics, which are identified by two-digit numbers: the first and second digits of which refer to the topic and the sub-topic respectively.

Each sub-topic is further sub-divided into one or more sub-sub-topics, which are identified by three-digit numbers. Where applicable, sub-sub-topics may be further subdivided into paragraphs that are identified by four/five digit alphanumeric sequences.

The three-digit sub-sub-topic numbers shown in the left hand column are used in the 'knowledge deficiency reports' to provide feedback on individual examinations.

Objective description - middle column

The middle column objectively describes each sub-sub-topic by stating, in plain language, its subject matter and the type of performance or activity required. The objectives are intended to be simple, unambiguous, and clearly-focussed, outcomes to aid learning.

Knowledge levels - right hand column

The right hand column specifies the knowledge level for each sub-topic heading. The three levels of knowledge used in this syllabus are described above. Note that the knowledge levels indicate the depth of knowledge required NOT its safety importance.

Syllabus: Subject 17 (Human Factors)

1. General		
1.1. The Need to Take Human Factors into Account		
Study Ref. 1, 2 & 3		
1.1.1	Describe the original purpose and roots of human factors (HF) research.	2
1.1.2	Describe the extent to which human factors impacts on an engineer's work and working environment.	2
1.1.3	Outline the philosophy of human factors in terms of the following criteria. <ol style="list-style-type: none"> a. A practical definition of human factors in respect of aircraft maintenance b. The aim of HF c. Relationship of HF to crew resource management (CRM) d. Context of HF in aircraft maintenance e. The human factors and ergonomics relationship f. Human factors attributes g. The learning of maintenance related skills h. Maintaining worker safety i. Maintaining public safety j. The cost effectiveness of a human factors approach to maintenance 	1
1.1.4	Outline the importance of human input into aircraft maintenance activities.	1
1.1.5	Describe the factors that would be covered under the heading of human psychology.	2
1.1.6	Describe the SHELL model as a framework around which human factors is structured.	2
1.1.7	Identify the four components of the SHELL model and give practical aviation related examples of the items that would be included under each component.	1
1.1.8	Describe how an engineer would relate to each of the SHELL model components in an aircraft maintenance environment.	2
1.1.9	Identify deficiencies under each of the SHELL components that may have an unfavourable impact on aircraft maintenance and aviation safety.	1
1.1.10	Describe how the application of the SHELL model components affects human performance and limitations.	2
1.1.11	Describe ways in which human unreliability may be reduced.	2
1.1.12	Describe the importance of training in reducing maintenance errors.	2
1.1.13	Describe human factors elements that can be evident when carrying out specific aircraft maintenance tasks such as inspection of aging aircraft and other tedious and boring activity.	2
1.1.14	Identify internal and external performance shaping factors (PSF) that have an impact on the performance and reliability of aircraft maintenance engineers.	1

1.2. Incidents and Accidents Attributable to Human Factors/Human Error		
Study Ref. 1 & 2		
1.2.1	Identify the extent to which human factors are a component in civil aircraft accidents and incidents.	1
1.2.2	Categorise the human factors deficiencies in example maintenance-related incidents and accidents.	1
1.2.3	Describe the “error chain” concept when determining human factors problems associated with aircraft accidents.	2
1.2.4	Illustrate the various links that may form as part of an error chain.	1
1.2.5	Describe how an accident may be prevented by breaking the error chain.	2
1.3. Murphy’s Law		
Study Ref. 1 & 6		
1.3.1	Define the notion termed “Murphy’s Law”.	2
1.3.2	Explain how complacency is detrimental to the maintenance of safety standards.	2
1.3.3	Illustrate how complacent attitude may occur in the workplace.	2

2. Human Performance and Limitations		
2.1. Vision		
Study Ref. 1		
2.1.1	Outline how the eye functions to convert light into a perceived image in the brain.	1
2.1.2	Outline how colour sensitivity is achieved.	1
2.1.3	Describe what is meant by the term “peripheral vision” and how this is achieved in the eye.	2
2.1.4	Identify the “arc of accurate” vision when associated with performing an inspection function.	1
2.1.5	Describe the changes that take place as the intensity of light decreases.	2
2.1.6	Describe what is meant by a blind spot and how it occurs.	2
2.1.7	Describe how the use of a narrow light beam for prolonged inspection can cause a central blind spot.	2
2.1.8	Describe visual acuity and how it is measured and expressed.	2
2.1.9	Describe physical factors that can affect the visual acuity of the eye, such as: <ul style="list-style-type: none"> a. long sight b. short sight c. cataracts d. migraine headaches e. tiredness and fatigue 	2
2.1.10	Describe the reason why it is common for people over the age of 40 to require spectacles for reading and other close-up work.	2
2.1.11	Describe how certain drugs, medications, alcohol and smoking may adversely affect vision.	2
2.1.12	Describe how vision may be improved or impaired in respect of the following factors. <ul style="list-style-type: none"> a. The adverse effects of glare b. Moving from brightly lit to dimly lit areas c. Light adapted and dark adapted vision d. Eye focussing techniques for dimly lit areas e. The effects of airborne substances on vision f. Limitations and adverse effects of wearing contact lenses g. Eye protection requirements 	2
2.1.13	Explain the meaning of “visual cues” and provide examples relating to the detailed inspection of objects.	2
2.1.14	Describe the importance of colour vision to the aircraft maintenance engineer and give examples of why good colour vision is required.	2

2.1.15	Explain the following factors relating to colour vision. <ul style="list-style-type: none"> a. The normal causes of defective colour vision b. Colours that are affected by the common, and less common, types of colour-defective vision c. The colour of objects as seen by a person with colour-defective vision d. The degrees of colour-defective vision in relation to viewing objects in variable lighting conditions e. The effects of aging on colour vision 	2
2.1.16	Outline the importance of regular eye tests in identifying visual deterioration that may cause work-related problems.	1
2.2. Hearing		
Study Ref. 1		
2.2.1	State the two functions that the ear performs and how each function is achieved.	1
2.2.2	Describe how the three divisions of the ear function to detect sound.	2
2.2.3	Outline how the ear protects itself from high levels of noise and the limitations on this "self protection" in a hangar environment.	2
2.2.4	Describe the performance of the ear when associated with the range of sounds that can be heard, particularly in respect to pitch (frequency) and volume.	2
2.2.5	Identify the frequency of sound at which the ear achieves its greatest sensitivity.	1
2.2.6	Outline the intensity levels of sound that certain aviation related activities may produce around an airport.	2
2.2.7	Illustrate the various negative effects of noise in the workplace.	2
2.2.8	Distinguish between types of noise, such as: <ul style="list-style-type: none"> a. Sudden b. Continuous c. High frequency d. Low frequency 	2
2.2.9	Describe the adverse effects of each type of noise in respect of errors, variability and work rate.	2
2.2.10	Describe the causes and effects of noise-induced hearing loss.	2
2.2.11	Describe, with examples, internationally accepted requirements that place responsibility on employers to take action to mitigate the adverse effects of noise in the workplace.	2
2.2.12	Estimate the noise intensity at which temporary and permanent hearing damage likely to occur.	2
2.2.13	Describe "noise dose" and the parameters against which it is measured.	2
2.2.14	State the noise intensity level, above which, hearing protection is required.	1
2.2.15	Describe the effects that advancing age has on hearing and indicate the signs that show hearing loss may be occurring.	2
2.2.16	Describe in a practical sense, how the condition of a person's hearing may be subjectively assessed.	2
2.2.17	State the engineer's responsibilities for ensuring that they are properly protected from hearing damage.	1

2.3. Information Processing		
Study Ref. 1 & 3		
2.3.1	Describe the importance of human senses as people interact with the environment.	2
2.3.2	Identify the human senses that gather information for processing into decisions and actions.	1
2.3.3	Describe the active listening process and how to achieve active listening.	2
2.3.4	Describe "attention" as it may apply to functions performed by the maintenance engineer.	2
2.3.5	Illustrate how the following forms of attention may be applied to the functions an engineer may perform in the workplace. <ul style="list-style-type: none"> a. Selective attention b. Divided attention c. Focussed attention d. Sustained attention 	2
2.3.6	Explain the meaning of perception and give practical examples.	2
2.3.7	Explain the decision-making process.	2
2.3.8	Explain the importance of feedback during the decision making process.	2
2.3.9	Describe memory and its importance when performing aircraft maintenance activities.	2
2.3.10	Explain the three processes associated with memory.	2
2.3.11	Explain the following three forms of memory: <ul style="list-style-type: none"> a. Ultra short-term. b. Short-term. c. Long-term. 	2
2.3.12	Explain "motor programmes" and where they may be in effect during the performance of aircraft maintenance.	2
2.3.13	Explain situational awareness, the factors that lead to situational awareness and its importance in the course of an engineer's work activities.	2
2.3.14	Describe the limitations associated with information processing including the following. <ul style="list-style-type: none"> a. Attention and perception errors b. Missing data c. Filling in the gaps with erroneous information d. Visual illusions e. Contextual error f. Expectation error g. Fallibility of human memory (forgetting) 	2
2.3.15	Explain the importance of manuals and temporary aides-memoires in overcoming problems associated with memory.	2

2.4. Claustrophobia, Physical Access and Fear of Heights		
Study Ref. 1 & 3		
2.4.1	Describe the cause and symptoms of claustrophobia.	2
2.4.2	Outline precautions that should be taken to avoid the onset of claustrophobia.	1
2.4.3	Identify measures that may be taken to reduce the feelings of discomfort when working in confined spaces.	1
2.4.4	Outline how the fear of heights may be alleviated while working on the external surfaces of aircraft.	1
2.4.5	Describe deficiencies that may arise if an engineer carries out inspection functions while at the same time fearing heights.	2

3. Social Psychology		
3.1. The Social Environment		
Study Ref. 1		
3.1.1	Describe the organisational aspects (“big picture”) of a typical maintenance system including the following factors: <ol style="list-style-type: none"> a. Engineering staff requirements b. Immediate environment c. Supervision d. Organisation e. Regulation f. Wider environment 	1
3.1.2	Outline what is meant by the term “organisational culture” and how it impacts on staff, customers, and wider aviation interests.	1
3.1.3	State stresses in an organisation that may place undue pressure on an engineer and contribute to a decline in aviation safety standards.	1
3.1.4	Outline the factors that make up the social environment at work, such as; motivation, culture, workplace layout and physical work.	1
3.2. Responsibility: Individual and Group		
Study Ref. 1 & 3		
3.2.1	State what is meant by a responsible person working in an aviation organisation.	1
3.2.2	Outline the advantages and disadvantages of individual responsibility.	1
3.2.3	Outline the advantages and disadvantages of group responsibility.	1
3.2.4	Outline the meaning of “diffusion of responsibility”.	1
3.2.5	Compare the terms responsibility and accountability.	1
3.2.6	Outline, in a practical sense, the following negative terms as they could relate to the functioning of a group, team or shift. <ol style="list-style-type: none"> a. Inter-group conflict b. Group polarisation c. Risky shift d. Groupthink e. Social loafing f. Norms beliefs and habits 	1
3.2.7	Outline what is meant by a ‘troubled employee’ and factors or symptoms that may identify such a person.	1
3.2.8	Outline the factors that may be found in an effective employee assistance programme (EAP) operating in a maintenance organisation.	1
3.2.9	Outline problems associated with lack of assertiveness.	1

3.3. Motivation and De-motivation		
Study Ref. 1 & 3		
3.3.1	Outline motivation and its importance to aircraft maintenance engineers.	1
3.3.2	Outline how the level of motivation may be determined.	1
3.3.3	Outline work-related factors that could be considered motivators particularly in respect of gaining benefit and avoiding loss.	1
3.3.4	Outline work-related factors that could be considered de-motivators.	1
3.3.5	Outline Maslow's Hierarchy of needs as it relates to the performance of a maintenance engineer.	1
3.3.6	Identify characteristics of a well-motivated person.	1
3.3.7	Identify the characteristics of a de-motivated person.	1
3.4. Peer Pressure		
Study Ref. 1 & 3		
3.4.1	Outline what is meant by peer pressure and its adverse safety implications.	1
3.4.2	Outline what is meant by conformity and how it may adversely affect safety.	1
3.4.3	Identify factors that may cause a person to conform or feel subjected to peer pressure.	1
3.4.4	Outline measures that can be taken to counter peer pressure and conformity.	1
3.4.5	Outline how conflict may arise in an organisation, its effects on morale, and how conflict may be effectively managed.	1
3.5. Culture Issues		
Study Ref. 1, 2 & 3		
3.5.1	Outline what is meant by the culture of an organisation.	1
3.5.2	Identify factors that make up the culture and sub-culture of an organisation.	1
3.5.3	Outline safety culture in an organisation and the key components that imply a strong safety culture exists.	1
3.5.4	Outline what is meant by sexual harassment, its effects on employees and how it should be dealt with should it arise in the workplace.	1
3.5.5	Outline what is meant by stereotypes and stereotypical behaviour and where such behaviour may have a negative impact on safety.	1
3.5.6	Outline what is meant by positive reinforcement as a means of behaviour modification.	1
3.5.7	Outline how best to manage situations involving employees who have experienced traumatic personal events.	1
3.5.8	Outline what is mean by social culture and how this impacts on an engineer's performance in the workplace.	1

3.6. Team Working		
Study Ref. 1 & 3		
3.6.1	Outline the concepts of a team in terms of the following: <ul style="list-style-type: none"> a. Team working and working together b. Working in parallel c. The leader d. Followers e. Telling or selling f. Involving or delegating g. Team building 	1
3.6.2	Illustrate the composition and operation of a team in a typical aircraft maintenance environment.	1
3.6.3	Outline advantages and disadvantages of team working.	1
3.6.4	Outline the important elements of a properly functioning team under the following headings: <ul style="list-style-type: none"> a. communication. b. co-operation. c. co-ordination. d. mutual support. 	1
3.6.5	Identify the factors, good and bad, that affect team performance.	1
3.6.6	Outline how effective teams or team working can reduce maintenance errors.	1
3.6.7	Outline the principles of effective team dynamics within an organisation and how the operation of an effective team may be identified.	1
3.7. Management, Supervision and Leadership		
Study Ref. 1 & 3		
3.7.1	Outline the importance of management, supervision and leadership both at team and company organisational level.	1
3.7.2	Outline the requirements for a maintenance organisation to be properly resourced.	1
3.7.3	Identify problems that may exist within an organisation if management, supervision or leadership is deficient.	1
3.7.4	Outline the role of line managers and supervisors in respect of ensuring the proper functioning of teams working in a maintenance organisation.	1
3.7.5	Identify difficulties that may arise where a manager or supervisor gets too involved in the performance of work related tasks.	1
3.7.6	Define an effective leader.	1
3.7.7	Identify the qualities an effective leader should possess in the maintenance environment and give practical examples of each.	1
3.7.8	Outline factors relating to quality decision making.	1
3.7.9	Identify the various decision-making tools (e.g. "decision tree") available to managers and supervisors involved in aircraft maintenance engineering.	1

4. Factors Affecting Performance		
4.1. Fitness and Health		
Study Ref. 1 & 3. (See also MCAR 66.19)		
4.1.1	Outline the conditions laid down by ICAO, UKCAA and CAA Mongolia that require an AME licence holder to maintain proper mental and physical fitness standards.	1
4.1.2	State who is responsible for establishing an engineer's fitness to perform work functions.	1
4.1.3	Identify common conditions that may impact on fitness and health.	1
4.1.4	Describe symptoms, causes, and effects the conditions identified above may have on the work performance of an engineer.	2
4.1.5	State who is responsible for making contingency arrangements in cases where engineers report in sick.	1
4.1.6	Describe positive fitness and health measures that may be taken by an engineer in respect of: <ul style="list-style-type: none"> a. eating b. exercise c. smoking d. alcohol consumption e. medication 	2
4.1.7	Describe what is meant by 'emotional imbalance' and how it would show up in a person.	2
4.2. Stress: Domestic and Work Related		
Study Ref. 1 & 3		
4.2.1	Describe what is generally termed "stress".	2
4.2.2	Describe how stress occurs in a person.	2
4.2.3	Describe, with examples, what is regarded as positive and negative stress.	2
4.2.4	Describe the symptoms and causes of physical and mental stress and how each varies.	2
4.2.5	Illustrate the effects of acute and chronic stress.	2
4.2.6	Illustrate stressors under the following headings. <ul style="list-style-type: none"> a. Physical b. Environmental c. Task-related d. Reactive e. Organisational f. Psychological. 	2
4.2.7	Describe the possible signs of stress under the following headings. <ul style="list-style-type: none"> a. Physiological symptoms b. Health effects c. Behavioural symptoms d. Cognitive effects e. Subjective effects 	2
4.2.8	Illustrate stressors arising in a domestic environment.	2
4.2.9	Illustrate stressors arising in a work-related environment.	2
4.2.10	Explain defence and coping strategies as they relate to dealing with stress.	2

4.2.11	Describe the beneficial effects of regular physical exercise in reducing the effects of stress.	2
4.2.12	State the best time of the day to undertake physical exercise.	1
4.2.13	Describe the factors that improve personal stress tolerance.	2
4.2.14	Describe how best to cope with a high mental workload so as to reduce the possible effects of stress.	2
4.3. Time Pressure and Deadlines		
Study Ref. 1 & 3		
4.3.1	Describe how time pressures can exist in an aircraft maintenance organisation.	2
4.3.2	Explain the difference between actual, perceived and self-imposed time pressures.	2
4.3.3	Describe the overall effects of time pressures and deadlines on safety standards.	2
4.3.4	Describe how persons setting or scheduling work may reduce time related pressures on the workforce.	2
4.3.5	Describe actions that an engineer should take if they feel affected by inappropriate deadlines.	2
4.3.6	Describe the principles of proper time management.	2
4.4. Workload - Overload and Underload		
Study Ref.1 & 3		
4.4.1	Describe what is meant by the term "arousal" as it relates to the human ability to perform work.	2
4.4.2	Define arousal or stimulation in relation to work performance.	2
4.4.3	Describe the effects that a low level of arousal or stimulation may have on work performance.	2
4.4.4	Describe the effects that over arousal or over stimulation may have on work performance.	2
4.4.5	Identify environmental factors that may adversely affect worker arousal or stimulation.	1
4.4.6	Describe how workload may be assessed.	2
4.4.7	Illustrate the effects of mental and physical workload.	2
4.4.8	Identify factors that limit an engineer's mental and physical workload.	1
4.4.9	Describe factors that affect the workload that engineers may experience in regard to the following: a. Nature of the task b. Circumstances under which the task is performed c. The state of the person	2
4.4.10	Describe factors that cause overload and identify symptoms of this condition.	2
4.4.11	Describe the effects that overload may have on safety.	2

4.4.12	Describe factors that cause underload and identify symptoms of this condition.	2
4.4.13	Describe the effects that underload may have on safety.	2
4.4.14	Describe the factors that lead to good workload management in an aircraft maintenance organisation.	2
4.4.15	Describe methods that may be employed to prevent an overload situation developing.	2
4.4.16	Describe important factors that must be considered when allocating work.	2
4.5. Sleep		
Study Ref.1 & 3		
4.5.1	Describe the “state of sleep” and why it is necessary for human wellbeing.	2
4.5.2	State the general sleep requirements (in hours) of most people.	1
4.5.3	State the ratio of high quality sleep required per hours of activity.	1
4.5.4	Describe the impact of sleep deficit on worker performance and the measures to be taken when a temporary deficit has been built up.	2
4.5.5	Outline the five stages of sleep.	1
4.5.6	Describe the cycles of sleep identifying where deep sleep and REM occurs.	2
4.5.7	Describe the rebound effects resulting from sleep deprivation.	2
4.5.8	Describe what is meant by “circadian rhythms”.	2
4.5.9	Identify the external factors that influence and synchronise circadian rhythms.	1
4.5.10	Describe the symptoms and adverse effects of jet lag.	2
4.5.11	Describe how jet lag is minimised when travelling through time zones.	2
4.5.12	State the direction of travel around the world that has the least affect on body rhythm.	1
4.5.13	Describe the co-relation between body temperature and human alertness and performance.	2
4.5.14	Identify the times of day and night when body temperature is at its highest and lowest points.	1
4.5.15	Identify factors that will improve an engineer’s performance during the low point of the circadian rhythm.	1
4.5.16	Describe measures that can be taken to assist sleep during the day.	2

4.5.17	Describe the following effects relating to rest, sleep and shiftwork: a. Eating a large meal before going to bed b. Eating times c. Going to bed hungry d. The effects of alcohol e. Use of drugs to aid sleeping f. Sleep requirements when feeling unwell g. Sleeping times h. Socialising before work	2
4.5.18	Describe the importance and beneficial effects of napping.	2
4.5.19	Describe what is meant by sleep inertia, when this condition is most likely to occur, and how long it takes to wear off.	2
4.6. Fatigue		
Study Ref.1, 2 & 3		
4.6.1	Outline what is meant by physiological and subjective fatigue.	2
4.6.2	Identify factors that typically cause fatigue, especially when working in an aircraft maintenance environment.	1
4.6.3	Identify symptoms of fatigue in an aircraft maintenance worker.	1
4.6.4	Describe the symptoms, causes and effects of chronic fatigue.	2
4.6.5	Describe ways of reducing fatigue.	2
4.7. Shiftwork		
Study Ref.1, 2 & 3		
4.7.1	Identify the advantages and disadvantages of working shifts.	1
4.7.2	Describe the negative effects of working at night in regard to personal health and human error.	2
4.7.3	Describe the sequence, in a rolling shift pattern, of shift changes that provide the least adverse effects on the engineer.	2
4.7.4	Identify the extent of shift changes (in hours) after which people will start to experience disruption to the wake-sleep cycle.	1
4.7.5	Identify the shift periods or times where error rates and absenteeism have been found to be higher than on other shifts.	1
4.7.6	Describe, in terms of safety standards and fatigue, the merits of working longer or shorter shifts.	2
4.7.7	Describe the adverse effects of working at other employment during shift stand down periods.	2
4.7.8	Describe the effects of advancing age on working rotating shifts.	2
4.7.9	Describe the negative impacts of shiftwork on an engineer's work, family and social life.	2
4.7.10	Describe how a person can re synchronise their wake-sleep cycles while on shift work.	2
4.7.11	Describe how the biological effects of shiftwork can be minimised.	2

4.8. Alcohol		
Study Ref.1		
4.8.1	Describe how alcohol affects the human body with particular regard to the nervous system.	2
4.8.2	Describe how alcohol is removed from the blood and state the effects of coffee, sleep and other measures on the rate of alcohol removal.	2
4.8.3	State the general rule relating to the lapsed time between consuming alcohol and performing aviation related work functions.	1
4.8.4	Describe how the effects of alcohol may be worsened through fatigue, medication or illness.	2
4.8.5	Describe symptoms that may indicate an engineer is suffering from mild or severe alcohol impairment.	2
4.9. Medication		
Study Ref.1		
4.9.1	Define the term "medication".	2
4.9.2	State precautions when taking medication for the first time.	1
4.9.3	Describe how adverse effects may be identified when taking medication for the first time.	2
4.9.4	Describe how medication normally acts in relation to the illness itself.	2
4.9.5	Describe the effects that the following types of medication may have on an engineer's fitness for work: <ul style="list-style-type: none"> a. Analgesics b. Antibiotics c. Anti-histamines d. Cough suppressants e. Decongestants f. Pep pills g. Sleeping tablets h. Melatonin 	2
4.9.6	State where you would obtain advice from in relation to work while using any of the above medication.	1
4.10. Illicit Drugs and Substance Abuse		
Study Ref.1 & 3		
4.10.1	Define an illicit drug.	2
4.10.2	Outline how a person may be impaired after smoking cannabis.	2
4.10.3	Outline the symptoms that would identify the various types of substance abuse by an employee.	2
4.10.4	Identify, and describe, reasonable and acceptable actions to be taken with an employee suspected, or found to be suffering from substance abuse.	2
4.10.5	Identify known barriers that may prevent a person receiving treatment for the abuse of alcohol, medication or illicit drugs.	2

5. Physical Environment		
5.1. Noise		
Study Ref. 1, 2 & 3		
5.1.1	Outline the short term and long term effects of noise.	1
5.1.2	State noise levels at which hearing damage may or may not occur.	1
5.1.3	Outline how noise intensity and period of exposure to the noise, work together to cause hearing damage.	1
5.1.4	Outline what is meant by the 'action threshold' for hearing protection.	1
5.1.5	Outline how general background noise can be filtered out by the brain.	1
5.1.6	Outline the common forms of hearing protection available in the workplace and discuss the relative effectiveness of each.	1
5.1.7	Identify common sources of noise in the hangar and on an airport ramp or apron.	1
5.1.8	Outline the general "rule of thumb" method for determining if hearing protection is required in a noisy environment.	1
5.1.9	Outline the safety aspects of noise-impaired communication.	1
5.1.10	Outline why it is important to wear proper hearing protection when working around aircraft on the ramp.	1
5.2. Fumes and Vapours		
Study Ref. 1		
5.2.1	Identify the source of common fumes that may be encountered while performing aircraft maintenance related tasks.	1
5.2.2	Outline how fumes and vapours are generated from benign substances such as: <ul style="list-style-type: none"> a. electrical conductors. b. grease. c. oils. d. brake linings. 	1
5.2.3	Outline how fumes may affect an engineer, with particular regard to: <ul style="list-style-type: none"> a. breathing. b. vision. c. skin contact. 	1
5.2.4	Outline precautions when working in confined spaces while fumes are present with particular regard to: <ul style="list-style-type: none"> a. special equipment. b. ventilation. c. safety arrangements. 	1
5.2.5	Outline how an engineer's work performance may be affected by the presence of fumes.	1

5.3. Illumination		
Study Ref. 1, 2 & 3		
5.3.1	Describe illumination in respect of the working environment.	1
5.3.2	Outline the importance of illumination when performing aircraft maintenance tasks.	1
5.3.3	Outline the following aspects relating to illumination of the working environment. <ul style="list-style-type: none"> a. Advantages of natural light b. Effects of shadows and how they can be eliminated c. Ambient hangar lighting d. Artificial or task lighting e. Advantages and disadvantages of flood lighting f. Advantages and disadvantages of illumination with a narrow light beam g. Use of torches both hand held and head mounted h. Carriage of spare torch batteries when working away from the section i. Maintenance of hangar lighting j. Causes and problems associated with direct, indirect and reflected glare k. Use of ancillary equipment such as mirrors and borescopes 	1
5.3.4	Outline how the illumination of an object varies as a function of distance from the light source.	1
5.4. Climate and Temperature		
Study Ref 1 & 3		
5.4.1	Identify the various climatic conditions that can have an effect on an engineer's performance.	1
5.4.2	State the levels of tolerance people have to such conditions.	1
5.4.3	Outline how extremes of temperature may affect the performance of tasks.	1
5.4.4	Outline the relationship between climate, temperature and performance.	1
5.4.5	Outline how the performance of maintenance should be managed in a deteriorated working environment.	1
5.4.6	State measures that can be taken to reduce the effects of an extreme working environment.	1
5.5. Motion and Vibration		
Study Ref. 1		
5.5.1	Outline the adverse safety effects that may arise from using unsteady maintenance stands and mobile access equipment.	1
5.5.2	Identify the range that problematic low frequency vibrations may occur in, and identify the sources of such vibrations.	1
5.5.3	Identify parts of the body that may be affected by vibrations.	1
5.5.4	Outline how vibration may affect the performance of an engineer.	1
5.5.5	Outline the cause and symptoms of "vibratory-induced white finger syndrome".	1

5.6. Working Environment		
Study Ref. 1, 2 & 3		
5.6.1	Outline the following physical influences in the workplace and how they may impact on an engineer's performance, particularly in regard to safety standards. a. Workplace layout, cleanliness and general tidiness b. Use of safety equipment and the provision of proper signage c. Storage and use of toxic chemicals	1
5.6.2	Outline the three components of a working environment and give practical examples of each.	1
5.6.3	Outline the prime factors that would constitute a safe working environment.	1
5.6.4	Outline how human performance can be positively influenced by adopting a user, or work centred, approach to designing facilities for carrying out aircraft maintenance activities.	1
5.6.5	Outline the effects of a poorly designed workplace on work output and human performance.	1

6. Tasks		
6.1. Physical Work		
Study Ref. 1, 2 & 3		
6.1.1	Outline the importance of good planning before commencing the performance of a task.	1
6.1.2	Identify important aspects that need to be considered in the planning process before a task is performed.	1
6.1.3	Outline the importance of written guidance material when preparing for a task.	1
6.1.4	Identify the role a shift supervisor may have in planning and supervising the performance of tasks.	1
6.1.5	Identify who has responsibility for ensuring that engineers have the appropriate level of skill, proficiency and experience to perform work functions.	1
6.1.6	Identify the physical requirements an engineer should possess to enable them to perform tasks requiring fine motor control and gross manipulation.	1
6.1.7	Outline how the musculoskeletal system operates to perform fine and gross movements.	1
6.1.8	Outline how advancing age affects the human musculoskeletal system and give examples of symptoms and problems that may occur.	1
6.1.9	Outline how the effects of aging on the musculoskeletal system may be minimised.	1
6.1.10	Outline the following points relating to the performance of physical tasks. <ul style="list-style-type: none"> a. Lifting of heavy objects b. Use of lifting aids c. Onset of physical fatigue d. Importance of regular rest breaks 	1
6.1.11	Outline the importance of correct posture when carrying out physical work functions in the workplace.	1
6.1.12	Outline the meaning and applications of biomechanics when using body posture and physical strength to carry out work.	1
6.1.13	Outline how people differ in their capacity and ability to perform physical work.	1
6.2. Repetitive Tasks		
Study Ref. 1 & 3		
6.2.1	State the safety consequences associated with a reduced level of arousal.	1
6.2.2	State how repetitive tasks can affect an engineer's work performance.	1
6.2.3	Outline the importance of habituation as a contributory factor in human error.	1
6.2.4	Outline the dangers associated with repetitive tasks, with examples of where repetition has been a factor in aviation accidents and incidents.	1
6.2.5	Identify the dangers associated with complacency especially when performing visual inspections.	1
6.2.6	Outline the benefits of work/shift rotation for employees performing boring or repetitive type work.	1

6.3. Visual Inspection		
Study Ref. 1, 2 & 3		
6.3.1	Outline what is meant by visual inspection.	1
6.3.2	Outline the importance of visual inspection in aircraft maintenance.	1
6.3.3	Outline how to overcome distraction when performing inspection functions.	1
6.3.4	Outline the two important components of a reliable visual inspection.	1
6.3.5	Identify the human senses that may be used in the performance of an effective visual inspection.	1
6.3.6	Outline the factors that enhance visual inspection.	1
6.3.7	Outline the steps an engineer should take in performing an effective visual inspection.	1
6.3.8	Outline the importance of arousal when performing a visual inspection.	1
6.3.9	Outline how mild stimulation (music etc) helps to improve a person's performance during repetitive inspection tasks.	1
6.3.10	Outline the importance and timing of breaks taken when performing visual inspections.	1
6.3.11	State the time limit, after which, a person carrying out repetitive inspections will lose vigilance or concentration.	1
6.3.12	State how long it should take to perform the inspection process of looking, seeing and recognising a defect in a particular visual zone.	1
6.4. Complex Systems		
Study Ref. 1 & 3		
6.4.1	Outline what are termed "complex systems" in aircraft.	1
6.4.2	Compare complex and simple systems for maintenance purposes.	1
6.4.3	Identify the pitfalls associated with engineers working on complex systems pertaining to one or more aircraft.	1
6.4.4	Outline the importance of guidance material to an engineer in the maintenance of complex systems.	1
6.4.5	Outline the importance, and principles behind, carrying out a 'user analysis' of equipment and tools required in the maintenance environment.	1
6.4.6	Outline what would be involved in carrying out a human factors evaluation in the work place and what this activity may achieve in terms of safety.	1

7. Communication		
7.1. Within and Between Teams		
Study Ref. 1, 2, & 3		
7.1.1	Define communication and describe the following facets of good communication. <ol style="list-style-type: none"> a. Relevance b. Correctness c. Conciseness d. Completeness e. Communication purpose and target audience f. Communication behaviour style such as; assertiveness, aggression and feedback g. Body language h. Facial expression i. Effective writing j. Recognising approved and unapproved data k. Overcoming barriers to the use of approved data 	2
7.1.2	Describe the importance of communication for an engineer working in the maintenance environment.	2
7.1.3	Outline, where deficient communication could cause safety related incidents and accidents.	2
7.1.4	State when effective communication is vital in a maintenance organisation.	2
7.1.5	Outline the various modes of communication.	2
7.1.6	Describe feedback and its importance in the process of effective communication.	2
7.1.7	Compare upward, downward and horizontal communication, with examples of where each is used in the workplace.	2
7.1.8	Illustrate the following forms of communication when used in the maintenance environment. <ol style="list-style-type: none"> a. Verbal/spoken b. Written/textual c. Non-verbal; graphic, symbolic, body language 	2
7.1.9	Explain the conditions that must exist for a spoken or written message to be understood, with particular regard to the following points. <ol style="list-style-type: none"> a. Message content b. Context c. Expectations d. Ambiguity e. Clarification 	2
7.1.10	Describe how loud background noise can be a barrier to effective communication in the workshop or hangar, thereby creating a potential work hazard.	2

7.2. Communication Within Teams		
Study Ref. 1 & 3		
7.2.1	Identify when communication is important when performing a work function in a maintenance organisation,	1
7.2.2	Describe the effects of communication on group cohesion.	2
7.2.3	Describe the importance of the different ingredients of clear, spoken communications.	2
7.2.4	Illustrate when written communication should be used within teams.	2
7.3. Communication Between Teams		
Study Ref. 1 & 2		
7.3.1	Describe the importance of effective communications between teams in a maintenance organisation.	2
7.3.2	Outline the information that would normally be passed on to another team at shift changeover/handover.	1
7.3.3	Describe the place of written reports and spoken details at shift changeover.	2
7.3.4	Describe the importance of traceability and continuity of information, at shift changeover.	2
7.3.5	Describe the key processes of listening in terms of hearing, interpreting, evaluating and responding.	2
7.3.6	Describe the practice of reflective listening and give examples of when it may be used.	2
7.4. Communication Problems		
Study Ref. 1		
7.4.1	Outline the two main ways in which communication can cause problems.	1
7.4.2	Outline the dangers of making assumptions when communicating and state how problems with assumptions can be minimised.	1
7.4.3	Describe basic rules that an engineer can follow to help minimise poor communications in their working environment.	2
7.5. Work Logging and Recording		
Study Ref. 1		
7.5.1	Outline the importance of work logging and recording when working in an aircraft maintenance organisation.	1
7.5.2	Describe the key aspects of work logging and recording.	2
7.5.3	Describe current technology that may be used for work logging and recording.	2

7.6. Keeping up to Date, Currency		
Study Ref. 1		
7.6.1	Describe the importance of gaining knowledge through approved training, when entering the aircraft maintenance profession.	2
7.6.2	Describe the four elements of effective skills training with particular respect to; explanation, demonstration, imitation and application.	2
7.6.3	Outline when it is necessary for an engineer to keep abreast of pertinent information.	1
7.6.4	Identify ways an engineer is likely to keep up to date with changes in the maintenance environment.	1
7.6.5	Identify where the responsibilities lie for maintaining an engineer's currency and competence, and give examples of who is responsible for what.	1
7.6.6	Describe the risks that may underlie small changes made to technology or procedures.	2
7.6.7	Describe problems associated with lack of awareness.	2
7.7. Dissemination of Information		
Study Ref. 1, 2 & 3		
7.7.1	Describe the importance of effectively disseminating information.	2
7.7.2	Describe how engineers working away from base familiarise themselves with new information.	2
7.7.3	Identify persons in an organisation who would normally have responsibility for disseminating information.	1
7.7.4	Illustrate poorly disseminated information that has caused adverse safety occurrences.	2
7.7.5	Describe, using examples, what is meant by a 'useable' work instruction or procedure.	2
7.7.6	Describe the following criteria relating to good document design: <ul style="list-style-type: none"> a. Information content and readability b. Clear, concise and accurate writing c. User involvement and field testing 	2

8. Human Error		
8.1. Error Models and Theories		
<i>Study Ref. 1, 2, 3 & 5</i>		
8.1.1	Define the term "error".	2
8.1.2	Describe key roles an engineer plays in keeping modern aircraft reliable.	2
8.1.3	Describe the various models and theories that capture the nature of error and its characteristics.	2
8.1.4	Describe the importance of good aircraft and equipment design in reducing human error.	2
8.1.5	Describe the importance of effective procedures and work instructions in reducing error.	2
8.1.6	Identify, when or at what time on various shifts, an engineer is more likely to make an error.	1
8.1.7	Identify when an engineer is more likely to make errors while carrying out dismantling and assembly tasks,	1
8.1.8	Distinguish between reversible and irreversible errors and give practical examples of each.	2
8.1.9	Distinguish between slips, lapses, errors and mistakes.	2
8.1.10	Illustrate slips, lapses and mistakes under work condition each is likely to occur.	2
8.1.11	Outline what is meant by the term "violation".	1
8.1.12	Distinguish between skill, rule, and knowledge-based behaviours, with emphasis on the specific errors associated with each.	2
8.1.13	Describe what is meant by environmental capture.	2
8.1.14	Outline what is meant by reversion.	1
8.1.15	Describe the defences that exist in an organisation to prevent human error.	2
8.1.16	Describe the term "latent failure" and give examples.	2
8.1.17	Identify where latent failures are more likely to occur in an organisation.	2
8.1.18	Describe what would be termed a latent failure at the line management level.	2
8.1.19	Describe the term "active failure" and where such failures occur in a maintenance organisation.	2
8.1.20	Describe how accidents or incidents occur when the defences within an organisation fail to capture human error.	2
8.1.21	State the proportion of accidents and incidents caused by human error.	1
8.1.22	Describe the James Reason's model and the "Dirty Dozen" in respect of contributory causes of human error.	2

8.2. Types of Error in Maintenance Tasks		
Study Ref. 1 & 2		
8.2.1	Outline the specific forms that errors in aircraft maintenance engineering generally take.	1
8.2.2	Describe how errors may occur in relation to maintenance tasks that are performed on a non-frequent basis.	2
8.2.3	Describe what is meant by violation errors.	2
8.2.4	Outline the four types of violation error.	1
8.2.5	Identify the various factors that could give rise to the commission of violation errors.	1
8.2.6	Describe errors that can occur as a result of individual practices and habits.	2
8.2.7	Describe the two types of error that are associated with visual inspection and state the importance and significance of each in relation to safety.	2
8.2.8	State the approximate ratios between the types of maintenance errors that often exist in a maintenance organisation.	1
8.3. Implications of Errors		
Study Ref. 1 & 3		
8.3.1	Distinguish between aviation accidents and incidents.	2
8.3.2	Outline, using the "iceberg model", the relationship between accidents, serious incidents, incidents, errors and minor events.	1
8.3.3	Identify the meaning and effects of criminal negligence and how an engineer may become liable for accidents or incidents in the workplace.	2
8.3.4	Describe the need to report accidents and incidents under a mandatory reporting scheme.	2
8.3.5	Describe the benefits to an engineer of learning from one's own errors and the errors of others.	2
8.3.6	Describe the downside of apportioning blame for errors.	2
8.3.7	Describe the ideal environment that should exist in an organisation with respect to investigating and addressing maintenance errors.	2

8.4. Avoiding and Managing Errors		
Study Ref. 1, 2 & 3		
8.4.1	Describe how a maintenance organisation should approach error prevention and management including: a. use of confidential reporting systems. b. changing conditions rather than changing people	2
8.4.2	State the dual aims of error management.	1
8.4.3	State the two components of error management.	1
8.4.4	Outline the purpose and functions of a Safety Management System. (SMS)	1
8.4.5	Describe practical measures that can be taken in a maintenance organisation to manage error.	2
8.4.6	Outline the importance of selective retraining for engineers in order to prevent the repeat of errors.	1
8.4.7	Describe the importance of engineers following procedures in terms of error reduction.	2
8.4.8	Outline the tensions that exist between error reduction (safety) and company profitability.	1
8.4.9	Identify individual responsibilities engineers have towards reducing errors.	1
8.4.10	Describe how human reliability is improved and human variability is reduced.	2
8.4.11	Describe ways of effectively reducing/eliminating errors during aircraft maintenance operations.	2
8.4.12	Outline why it is important to determine the root cause/s of errors in the workplace.	1
8.4.13	Outline the requirements for occurrence reporting and management.	1

9. Hazards in the Workplace		
9.1. Recognising and Avoiding Hazards		
Study Ref. 1, 3, 4, & 5		
9.1.1	Identify hazards that may exist in a typical aircraft maintenance environment.	1
9.1.2	Identify activities and equipment in a workshop that are regarded as imminently dangerous.	1
9.1.3	Describe how human factors are used to improve workplace safety.	2
9.1.4	Show familiarity with the OSH website (Ref 4) in respect of: <ul style="list-style-type: none"> a. Relevant legislation. b. Duties of an employer c. Duties of employees d. Accidents e. Hazard identification and mitigation 	2
9.1.5	Describe the elements of an acceptable health and safety policy for an aircraft maintenance environment.	2
9.1.6	Describe the responsibilities of a maintenance organisation under the health and safety legislation.	2
9.1.7	Describe the main cause of injury to persons in the workplace.	2
9.1.8	Describe actions that must be taken if hazards cannot be removed from the workplace.	2
9.1.9	Describe the specific requirements of signage erected to warn of hazards.	2
9.1.10	Describe the construction, wording and colour coding of warning signs for different levels of risk.	2
9.1.11	Describe the responsibilities of an engineer towards health and safety in the workplace.	2
9.1.12	Describe how the attitude of the individual engineer, team, and organisation can have a direct bearing on health and safety.	2
9.1.13	Describe ways of maintaining a safe working environment, including the prevention of FOD.	2
9.1.14	Describe particular safety precautions to be observed when actually working on or around aircraft.	2
9.1.15	Describe the various limits and conditions relating to ladders, ramps and steps when used during the servicing of aircraft.	2
9.1.16	Describe how emergencies that could arise in the workplace should be dealt with.	1
9.1.17	Identify the basic actions to be taken in dealing with an emergency.	1
9.1.18	Identify first aid training and qualification requirements for staff working in a maintenance organisation.	2
9.1.19	Describe basic first aid practices relating to injuries that may be sustained in the aircraft maintenance environment.	2
9.1.20	Know the "ABC" immediate actions when initially treating an injury or medical condition.	2