

民 用 航 空 局

C A A

航空器通信電子維護類地面機械員

術科口試及實作參考資料

Aviation Avionics Mechanics

Oral and Practical Test Guide

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## 一、 航電系統維護及檢查(Aircraft avionics systems maintenance and inspections)

### 1. 測試氣象雷達時，有那些必須先期注意觀察的事項？

(What precautions should be observed when working around aircraft radar ?)

答: (1)在操作或測試雷達時，依照手冊規定的距離內，若天線雷達脈波掃瞄的範圍內有工作人員或建築物時，不准操作。

(2)飛機正在執行加油、放油工作時，也不准操作。

*(The pulse of electrical energy transmitted from a radar antenna are strong enough that they can seriously injure a person struck by them. They can be reflected from nearby buildings and return with enough power to destroy the receiver circuitry. For this reason, aircraft radar should never be operated when there are people or buildings within 100 yards of the antenna sweep, and it must not be operated when the aircraft is being fueled or defueled.)*

### 2. 那一類型儀表，可用來測量極高的電阻值？

(What kind of instrument would you use to measure very high resistance ?)

答: 高電阻測量表. *(A megohmmeter)*

### 3. 操作空中管制系統時，必須注意的事項？

(What precautions should be observed when during ATC system operational test ?)

答: 不准使用緊急用碼，例如緊急時是 7700，無線電通訊故障時是 7600，及劫機時是 7500。這些識別碼僅供飛行員緊急時使用。

*(Never use the emergency codes, those codes are used for the pilots only. For example: 7700 for emergency, 7600 for radio communication failure, and 7500 for hijacking, etc. These codes are for the pilots only.)*

### 4. 維修無線電高度表的同軸電纜時，特別的注意事項？

( What special precaution should be taken when repairing a coaxial cable of the radio altitude system ?)

答: 無線電高度計的同軸電纜長度是精確的設定。

*(The length of the RA coaxial cable is critical.)*

5. 那裡可檢查到水下定位信標器電池的有效日期？

(Where can you find the battery expiration date of the under water locator beacon that is mounted on the front panel of the flight data recorder ?)

答: 水下定位信標器的有效日期係標示在圓筒狀的外殼, 在接近有效日期時必須將水下定位信標器送回製造廠或修理廠更換。

*(The battery expiration date prints on the case of the ULD. At or near expiration date return ULD to manufacture for service, the battery no maintenance is required.)*

6. 無線電導航系統執行地面測試時, 有那三個指示狀態？

(What are three types of status when a radio navigation equipment performs a ground test ?)

答: 地面測試時按順序產生故障旗號、無電腦信號及正常的測試數據等三種狀態。

*(The ground test sequences are an invalid data(flag), a no computed data(blank), and a valid data(test/operation).*

7. 動靜壓管更換後, 那些工作項目必須執行？

(What tasks should be done after a pitot-static probe replaced ?)

答: 動靜壓系統試漏檢驗及動靜壓管加溫電路測試。

*(Do a leakage test of the pitot-static system and an operational test of the heater circuits of the pitot-static probe.)*

8. 執行備用磁羅盤維護工作時的注意事項？

(What precautions should be observed when maintenance action is required on the standby magnetic compass ?)

答: 使用無磁性的工具進行維修工作, 且不能使用鋼材螺絲來固定羅盤。

*(Use only nonmagnetic tools for maintenance, and do not use steel screws to attach compass to panel.)*

9. 執行備用姿態儀維護工作時的注意事項？

(What precautions should be observed when maintenance action is required on the standby attitude indicator ?)

答: 備用姿態儀是屬於精密的陀螺儀表, 因此在更換陀螺儀時, 必須在它斷

電後等待約十分鐘的時間，讓陀螺停止轉動後才進行更換。另外在拆下、待裝、儲存或運送過程中的的陀螺，必須以固定插梢鎖定陀螺，以避免不當之運動。

*(The standby attitude indicator is a gyro instrument. Remove the gyro electrical power and wait for 10 minutes for the gyro to stop should be done before the standby attitude indicator removal. A locking device that locks the knob on the front of the standby attitude indicator should be installed to prevent damage to the gyro in the instrument when not installed on the airplane.)*

10.磁羅盤更換後，必須執行那個工作項目？

*(What procedures should be done after a magnetic compass replacement ?)*

答: 校羅盤程序。*(A compass swing procedures.)*

11.簡述校羅盤程序。

*(Explain Compass Swing procedures(tow around procedure) ?)*

答: (1)確認除了校驗飛機拖車外，在兩百五十英尺內不能有其它的機械車輛。

(2)確認沒有磁性物質靠近磁羅盤(工具、手錶等)，因而造成誤差。

(3)在校羅盤工作進行中，無線電的通訊、導航系統必須是上電的狀態。

(4)打開慣性導航系統，以便提供校驗的參考的磁方位。

(5)首先是移動飛機分別對準慣性導航系統的四個參考磁方位，東、西、南、北，並且在誤差為兩度的範圍內記錄磁羅盤的指示度數，完成後經計算程序，再分別予以調整。

(6)接下來是間隔三十度的十二個磁方位數據測量，確認誤差大小及精確度。

(7)完成記錄後，恢復飛機的原始狀態。

*(1) Make sure all vehicles other than the tow vehicle are not less than 250 feet from the airplane.*

*(2) Make sure no ferromagnetic parts are near the standby compass, it can cause compass heading error.*

*(3) Make sure the radio receivers are on during the compass swing.*

*(4) Align the IRS to the NAV mode, it provides a reference magnetic heading.*

- (5) *To do a swing of the standby compass through four compass points (N,E,S,W) that is less than 2 degrees from reference magnetic heading, record and calculate the heading deviation, and make a adjustment on the standby compass.*
- (6) *To do a swing of the standby compass through 12 compass points. Use this procedure to measure the remaining errors and to make sure the standby compass heading is accurate.*
- (7) *Put the airplane back to its usual condition.*

12.甚麼情況下執行校羅盤程序?

(What are the reasons to perform the compass swing ?)

答: 駕駛發現誤差超過正常值或是羅盤內的液體產生氣泡可能影響磁羅盤的運作。

*(Flight crew found a deviation that is not within tolerance, or air bubbles occur that affects compass operation.*

13.執行動靜壓漏氣試驗時的注意事項?

(What precautions should be observed when performs a pitot-static leakage test ?)

答: (1)首先必須確認切除靜壓管電源，以避免工作人員及動靜壓管損傷。

(2)在進行動靜壓試驗時，不能超出測試允許的壓力範圍，否則將會損及儀表。

(3)在試驗完成後，確實拆除工作進行中所貼的膠帶、膠紙，以避免影響系統的運作。

*(1) Make sure that you do not apply electrical power to the pitot-static probe heaters. You can cause injury to persons or damage to the pitot-static probes.*

*(2) During the test, make sure that the pitot-static line pressure not exceed the maximum allowed pressure.*

*(3) After the test, make sure that you remove all the pieces of the tape from each pitot-static probe. The system will not operate correctly when the tape is in its position.)*

14.說明飛機安裝電線時，線束路徑之注意事項？

(What precautions should be observed when installs an electric wiring ?)

答: (1)間距：1.與結構、設備間距不小於八分之一英吋。

2.與油管、氧氣管及操作鋼繩的間距不小於三英吋。

3.與水管、動靜壓管及液壓管的間距不小於二分之一英吋。

4.與氣管間距不小於二英吋。

(2)曲率半徑：大於十倍線徑或電纜 或線束內最大線徑 直徑。

(3)線束下垂間距：兩線夾間的最大間距為二十四英吋、中心點的偏移量為四分之一到四分之三 AC 43.13-1B, max. 1/2" 。

(4)滴水環的使用，以避免液體進入接頭及設備。

(1) CLEARANCE

*1.Installed wiring with sufficient clearance to prevent chafing of the Installed bundles against sharp edges of structures, equipment, etc. (1/8 IN. clearance minimum)*

*2.Make sure there is at least three inches separation between wiring and lines carrying fuel or oxygen, and between wiring and control cables.*

*3. Maintain a minimum of 1/2 IN. separation between wiring and water, pitot static and hydraulic lines, etc.*

*4.Maintain a two IN. minimum separation between wiring and insulated bleed air ducts.*

(2) BEND RADIUS

*Use a minimum bend radius of ten times the wire or cable diameter, the bend radius of a wire bundle will not be less than the minimum radius ( 10 times DIA.) of the largest wire in the bundle.*

(3) SLACK IN WIRING

*A 24 IN. maximum length between two clamping points, and at midpoint, 1/4 IN. to 3/4 IN. deflection( AC43.13-1B, max. 1/2" ).*

(4) DRIP LOOPS

*To prevent fluids from entering junction boxes, connectors, or other enclosed items provide a drip loop in the wire or bundle just before it enters the item of equipment.*

15.如何檢查同電纜軸及安裝是否良好？

(How to inspect a coax cable and the condition of the coax cable installations ?)

答: (1)檢查同軸電纜安裝情況:

1. 外觀檢查是否受損。
2. 不可與大電力線在一起。
3. 使用正確之線夾。
4. 曲率半徑為同電纜軸直徑六倍以上。
5. 不可用塑膠束帶固定。

(2)使用 *TDR (Time Domain Reflectometer)*測量同軸電纜

1. 使用相同材質同軸電纜、調整出正確之  $V_p$  值。
2. 使用前先將距離歸零。
3. 定位被測同軸電纜開路、斷路、壓扁等不良情況的地點。

(1)*Check the condition of coax cable installation*

1. *Inspect for wire chafing.*
2. *Inspect for adequate wire separation from power cable.*
3. *Check for proper wire clamps.*
4. *Ensure proper bend radius on coax cable.(6 times DIA.)*
5. *Do not uses plastic straps.*

(2) *Use a time domain reflectometer to do a check of coaxial cables*

1. *Set proper  $V_p$  controls for the applicable cable.(adapter cable)*
2. *Make sure the monitor shown distance is equal to the adapter cable length.*
3. *Examine the applicable cable to locate opens, shorts, crimps and other defects in coax cables.)*

16.說明下列 Splice 之用途：

(Explain the purpose of the splice, listed as follows :)

答: (1) *High temperature & non-insulated Splice* :可用於高溫及加壓/非加壓區內。

(2) *Copper-Aluminum Splice* :用於 *Power feeder cable aluminum wire* 與 *copper wire* 銜接。

(3) *Thermal Splice* :用於非熱電偶效應來計算溫度之 *wire harness* 上。

17.ESDS components 維護的注意事項？

(What are the ESDS maintenance procedures ?)

答: (1) 易受靜電損壞的裝備元件在維護時，必須限制在防止靜電處理場所內實施。

(2) 拆裝易受靜電損壞的裝置、組件時，工作人員必須穿戴防靜電手環。

(3) 工作人員盡量避免身體衣物碰觸易受靜電損壞裝備的接點。

(4) 週期性的檢查防靜電手環、接地線及各接點間的導電性、是否合乎標準的電阻阻抗範圍內。

(5) 易受靜電損壞的元件必須儲存於防靜電的包裝袋內。

(6) 防靜電的包裝袋必須先釋放靜電(碰觸接地點)，才進行包裝。

*(1) The handling of ESDS devices should be restricted to static safeguarded work areas by personnel wearing either foot straps or wrist straps connected to ground.*

*(2) Personnel must be grounded with a wrist or foot strap when handling ESDS devices or assemblies.*

*(3) Personnel should minimize contact of ESDS parts or assemblies with their clothing.*

*(4) Regular inspections should be made to ensure that wrist and foot straps have continuity and that the required series impedance is present. Grounding of the work surface should also be checked.*

*(5) Place all ESDS devices or assemblies in antistatic packaging.*

*(6) Antistatic packages should be placed on the grounded surface prior to remove, transfer, or insertion of their contents. This allows dissipation of any accumulated charge.)*

18.請問 ARINC 429 是單向或雙相傳輸？ 串列或並列傳輸？

(What kind of transmission in use for the ARINC 429?)

答: 單向串列.(*mono-directional bus and series transmission.*)

19.請問 ARINC 429 bus 整個 32bits 的資料格式有些什麼部份？

(Determine the significance of the different bits (32 bits) of an ARINC 429 word.)

答: *Label, SDI, Data field, SSM, and Parity check bit.*

20.請問 ARINC 429 的資料編碼的格式?

(How many types of transmissible data in use in the ARINC 429 data field ?)

答: *BCD(Binary coded decimal), two's complement binary notation(BNR), Discrete Data, Maintenance data and Acknowledgement , and ISO-Alphabet No. 5 character data.*

21.緊急燈開關，放置在 ARMED 的作用為何？

(What are the functions of the emergency lighting switch when put it in the armed positions ?)

答: 這是飛行中緊急燈開關正確的放置位置，而當電力系統發生故障時緊急燈的電池裝置將可提供給組員及旅客約二十分鐘的照明服務。

*(This is the normal switch position, guard closed. In the event of power failure, the emergency lights provide illumination for crew and passenger movement in the airplane which are supplied by the battery units (package) for approximately 20 minutes.)*

22.更換信標燈電源供應器的注意事項？

(What precautions should be observed when removes the power supply of the beacon light ?)

答: 信標燈電源供應器內具有產生高壓電的裝置，因此在維修時，注意電源切斷後必須等待約十分鐘讓電容殘留電荷釋放，保障安全。

*(High voltage is present at the beacon light components, it is necessary to wait 10 minutes after removing power, then performing maintenance.)*

23.測試滅火瓶炸藥筒電路的連續性，必須注意的事項？

(What precautions should be observed when testing the continuity of the fire extinguisher bottle squibs ?)

答: 滅火瓶炸藥筒電路連續性測試時，注意不能使用輸出超過限定電流八十毫安培的三用電表，避免炸藥筒擊發滅火瓶，而造成工作人員受傷。

*(For testing of the squib continuity, do not use ohmmeter capable of supplying more than a limited current (80 milliamps) or the squib may be detonated. An accidentally fired bottle may be cause injury to personnel. )*

## 二、無線電基本原理 (Basic radio technology)

1.說明“TRANSCEIVER”為何？

(What is meant by a transceiver ?)

答：一個內部具有接收機及發射機的無線電通訊裝備。

*(A piece of radio communications equipment in which all of the circuits for the receiver and the transmitter are contained in one housing.)*

2.那一種導線，被使用在極高頻超/高頻無線電，天線到接收/發射機之間？

(What kind of conductor is used to connect a VHF or UHF antenna to its receiver or transmitter ?)

答：同軸電纜。*(Coaxial cable.)*

3.在地表上，無線電發射器和接收器之間，無線電波的傳遞可透過那些方式？

(What kind of the radio waves may follow above the earth, between a transmitter and a receiver)

答：無線電波路徑包括有表面波、天波及空間波(或叫直線波)。

*(The radio wave paths include surface wave, sky wave and space wave (also called direct wave).)*

4. 在無線電波帶範圍內，可分為那些頻率波段？

(What frequency bands are within the radio spectrum ?)

答：頻率波段有 VLF, LF, MF, HF, VHF, UHF, SHF and EHF.

*(The frequency bands include VLF, LF, MF, HF, VHF, UHF, SHF and EHF.)*

5. 何謂微波？

(What is meant by microwave ?)

答：無線電波頻率高於十億赫芝稱之為微波。

*(Radio waves at frequencies higher than 1000megahertz are usually termed microwave.)*

6. 天波適合傳播那一種無線電頻段？

(What is the preferred frequency band for the sky wave propagation ?)

答: 天波主要運用在高頻波段，它適合中、長距離點至點之間的通訊系統。

*(The main application for sky waves is in the HF band for medium and long range point -to -point communication systems.)*

7. 那一種傳播方式，適合極高頻以上頻段？

(What kind of wave propagation is used for the VHF band and above ?)

答: 空間波提供了直線及地表反射傳導路徑，適合極高頻以上頻段傳播。

*(The space wave, which includes a direct path and an earth-reflected path.)*

8. 在調幅接收器內部，有那些主要的電路？

(What main circuits are installed in a AM receiver ?)

答: 高頻放大器、混波器、振盪器、中頻放大器、檢波器及聲頻放大器。

*(The radio frequency amplifier, mixer, oscillator, intermediate frequency amplifier, detector and audio amplifier.)*

9. 無線電波傳播的速度為何？及它兩個組成的成份？

(What is the speed of radio wave propagation and what two components make up this wave ?)

答: 從天線輻射的無線電波是以每秒鐘三十萬公里的光速行進，而無線電波是由電磁場及成九十度差的靜電場來組合而成。

*(Radio waves travel as an energy field from the antenna at the speed of light, approximately 300,000,000 meters per seconds. An RF wave is composed of an electromagnetic field and a 90 degrees displaced electrostatic field.)*

10. 說明高頻無線電波傳播的距離遠比極高頻無線電波為長？

(Explain why HF radio wave travel at much greater distance than VHF radio waves.)

答: 高頻無線電波的特性，可透過地表及電離層來回跳躍式的反射，達成數千哩的傳播。而較高頻率的極高頻無線電波只能傳遞視距的直線波，因它的信號將穿透電離層，不為電離層所反射。

*(HF radio waves “skip”, or bounce back and forth between the ground and*

*the ionosphere for many thousands of miles, there making possible long-range communications. VHF and above radio waves allow only line-of-sight communication. At these higher frequencies, the radio wave is not reflected by the ionosphere, but passes right through it.)*

11. 300MHz 的波長為何？

答: 壹公尺。 (*1 meter.*)

12. 一般基本接收機中，RF 信號的處理流程？

(*What are the radio frequency (RF) processing steps in a general receiver ?*)

答: 無線電信號經由天線進入射頻放大器，其輸出和本地振盪頻率在混波器混合產生中頻信號，經中頻放大器放大後、檢波器還原成音頻信號，音頻放大器放大後輸出到喇叭。

*(The RF amplifier increase the strength of the signal. The output of the RF amplifier is fed to the mixer stage. Another input into the mixer is an unmodulated RF signal from the local oscillator. The intermediate frequency is produced by a process, called heterodyning. This action takes place in the mixer. The difference frequency is used as the intermediate frequency. The signals through the intermediate frequency amplifier then fed to the detector stage, the intelligence component of the modulated wave is separation from the RF carrier. The audio amplifier is to amplify the audio signal for the speaker.)*

13. 何謂 AM ？

(*What is meant by Amplitude Modulation ?*)

答: 載波振幅為隨信號波變化所得之調變波。

*(Where the modulating frequency alters the amplitude of the carrier wave.)*

14. 何謂 FM ？

(*What is meant by Frequency Modulation ?*)

答: 載波頻率為隨信號波變化所得之調變波。

*(The amplitude of the carrier remains constant, but its frequency is varied by the amplitude of the modulation frequency.)*

15.理想駐波比值為何?

(What is the preferred V.S.W.R.?)

答: 1 : 1

16.特性阻抗是否可以用三用電表測量?

(The characteristic impedance can be measured by the multimeter, or not ?)

答:不可以。 (*impossible.*)

17.阻抗匹配的目的為何 ?

(What are the purpose of the load impedance matching ?)

答:從來源經傳輸線一直到負載 , 有最佳的能源轉換。

(*achieve maximum transfer of power from the source to the load.*)

18.請問單旁波帶調變優於振幅調變的主要優點?

(Advantages of SSB over AM.)

答: (1)有較小的頻寬。

(2)有較小的發射功率對相同的距離。

(3)有較小的干擾

(1)*narrow band width.*

(2)*less transmission energy required for given range.*

(3)*less distortion.*

19.請問 BFO(beat frequency oscillator)是用來處理何種信號?

(What is the purpose of the BFO(beat frequency oscillator ?)

答: *To make the unmodulated (A0) or keyed(A1) transmission audible.*

20.何謂 A0 和 A1 波?

(What are meant by unmodulated (A0) or keyed(A1) transmission ?)

答: A0 它只有載波信號 , 而 A1 它是間斷的載波信號

(*A0 only carrier wave , A1 interrupt(On and off) carrier wave*)

21.高頻通信系統所使用之頻率範圍？

(Which frequency band is used for high frequency(HF) communication system ? )

答:高頻通信的頻率範圍從 3 MHz 到 30 MHz 。

*(The HF band, between 3 MHz and 30 MHz.)*

22.超高頻通信系統所使用之頻率範圍？

(Which frequency band is used for very high frequency(VHF) communication system ? )

答: 超高頻通信的頻率範圍從 30MHz 到 300 MHz 。

*(The VHF band, between 30 MHz and 300 MHz.)*

23.極高頻通信系統所使用之頻率範圍？

(Which frequency band is used for ultra high frequency(UHF) communication system ? )

答: 極高頻通信的頻率範圍從 300MHz 到 3000 MHz 。

*(The UHF band, between 300 MHz and 3000 MHz.)*

### 三、電子電路及電子元件(Electronic circuits and electronic elements)

1. 歐姆定律的三個基本量？

(What are three basic quantities of ohm's law ?)

答:電壓、電流及電阻，它們的關係是電壓等於電流乘上電阻。

*(Ohm's law states that voltages, current, and resistance are linear related.*

*V=IR.)*

2. 電流，電阻，和電壓的基本單位？

(What are the unit of the current, resistance, and voltage ?)

答:安培、歐姆及伏特。 (*Ampere, ohm, and volt.*)

3. 基本的整流電路可分為那兩種？兩者有那些不同？

(What are two basic types of the rectifier circuits ? and the difference between them ?)

答: (1)半波整流器及全波整流器。

(2)半波整流器僅利用正或負半波交流電來產生直流電，而全波整流器利用了正及負半波交流電來產生直流電。比較起來全波整流器有較平穩的輸出及比較小的漣波，但卻需要較多的二極體元件來組成。

*(1)Half-wave rectifier and full-wave rectifier.*

*(2)The half-wave rectifier circuit uses only the positive or the negative of the alternate current to produce the direct current. The full-wave rectifier*

*circuit uses the positive and the negative of the alternate current to produce the direct current. Compared to the half-wave rectifying, the output is a smoother, less pulsating direct voltage. But, double or more of the diodes are necessary for the full-wave rectifier circuit.)*

4. 普通二極體和稽納二極體有何不同？

(What are the difference between a normal diode and a zener diode ?)

答:稽納二極體的工作電壓大約為一至兩百伏特，而這電壓值相當於普通二極體的崩潰電壓值。稽納二極體工作特性是反向電壓，且較普通二極體有較陡的崩潰電壓曲線圖。

*(Zener diodes are manufactured for zener voltage of about 1~200 volt, the*

*voltage is equivalent to the breakdown voltage of a normal diode.*

*The zener diodes are always operated in reverse direction, the characteristic curve of the Z-diode in the range of the breakdown is steeper than the curve of a normal diode.)*

5. 電晶體可分為那兩種？及各極之間的電流方向？

(What are two types of the transistors ? and the current flows between the electrodes ?)

答:(1) PNP 型及 NPN 型。

(2) NPN 型，它的集極電流流向射極，控制電流進入基極流向射極。PNP 型，它的射極電流流向集極，從基極取得逆向控制電流(射極流向基極)。

(1) PNP and NPN.

(2) Transistor type 1 (NPN) which the collector current flows from the collector to the emitter, and the control current flows into the base (from the base to the emitter). Transistor type 2 (PNP) which the collector current flows from the emitter to the collector, and the control current flows out of the base (from the emitter to the base).

6. 電容量與電感量的測量單位？

(What are the basic unit of the capacitance and the inductance ?)

答：法拉及亨利 (*farad and henry*)。

7. 電螺管和繼電器有那些不同？

(What is the difference between the solenoid and relay ?)

答：電螺管它利用可移動的鐵心依線圈通電後產生的磁力和彈簧力的交互作用來改變機械輸出的位置。而繼電器是利用電磁的作用來控制電子接點的開與關。

*(The solenoid is a type of electromagnet that has a movable iron core whose movement depends on both an electromagnetic field and a mechanical spring force, relays differ from solenoids in that the electromagnetic action is used to open or close electrical contacts other than to provide mechanical movement. )*

8. 請問 10 的 BCD 為何？

(Convert ten to Binary Code Decimal(BCD).)

答: 0001 0000

9. 請問 10 的 BNR 為何？

(Convert ten to binary.)

答: 1010

#### 四、儀表、顯示及記錄系統(Instruments, indicating and recording systems)

1. 電子飛行儀的系統中，使用了那些儀表？

(What instruments in an aircraft are used for the electronic flight instrument system?)

答: 主要飛行顯示器及導航顯示器或是電子式水平狀態儀及電子式姿態導向儀。

*(The primary flight display(PFD) and navigation display(ND), or EHSI and EADI.)*

2. 那些飛行資料，可顯示在主飛行顯示儀(PFD)？

(What kind of flight data are displayed on the primary flight display ?)

答: 計算空速、馬赫數、高度、垂直升降速率、姿態、航向、無線電高度、儀表降落系下滑及左右定位信號及飛行模式顯示。

*(The computed air speed(CAS), mach(M), altitude(ALT), vertical speed(VS), attitude(ATT), heading(HDG), radio altitude(RA), trajectory deviation glide slope & localizer(G/S & LOC), and flight mode annunciator(FMA).)*

3. 那些飛行資料，可顯示在導航顯示儀(ND)？

(What kind of flight data are displayed on the navigation display (ND)?)

答: 地速、真空速、風速、風向、航向、飛行路徑資料、電台資料及方位、電台資料及方位、防撞系統資料、氣象雷達資料及地形資料。

*(The ground speed(GS), true air speed(TAS), wind speed & direction, heading(HDG), flight plan, ADF characteristic & bearing, VOR characteristic & bearing, TCAS data, WX data, and terrain.)*

4. 飛行資料記錄儀提供儲存資料的時間？及主要的記錄資料內容？

(How long of flight data can be recorded by the digital flight data recorder ? and the contain of the recorder ?)

答: 飛行資料記錄儀最長的資料儲存時間是二十五小時，它記錄的內容包括時間、空速、高度、氣溫、航向、姿態、加速度、飛操面位置、引擎推力及駕駛艙警告訊息。

*(The flight recorder provides the maximum recording time is 25 hours, the*

*tape is continuously erased and re-recorded.*

*The data include time, airspeed, altitude, air temperature, heading, attitude, acceleration, flight control surface position, engine power, and flight deck warning.)*

5. ADI 及 HSI 可顯示那些資料?

*(What information is displayed on the ADI and HSI ?)*

答: 姿態導向儀提供了飛機俯仰及傾斜的姿態及導向信號, 而水平狀態儀提供了飛機航向及航向選擇、航道選擇及誤差。

*(The ADI displays pitch and roll attitude information and flight director command bars.*

*The HSI displays navigation radio information, aircraft heading information, selected heading, selected course and course deviation .)*

6. 那些飛行儀表是利用空氣壓力原理?

*(Which of the flight instruments are actuated principally based on air pressure ?)*

答: 空速表、垂直升降速率表及高度表。

*(Airspeed indicator, Vertical speed indicator, and Altimeter.)*

7. 那些飛行儀表是利用陀螺原理?

*(Which of the flight instruments are based on gyro ?)*

答: 人工水平儀、轉彎傾側儀、航向指示儀。

*(Attitude director indicator, Turn & bank indicator, Heading indicator.)*

8. 遠距指示羅盤系統中, 磁流瓣 (Flux valve)的作用為何?

*(What is the flux valve in the remote indicating compass system ?)*

答: 磁流瓣是磁力的感測元件, 感應的電子信號提供磁方位至航向指示器。它通常是裝設在翼尖, 以避免機身的干擾。

*(The flux valve is a magnetic sensor, which is positioned well away from other magnetic influences in the airframe, usually in a wing tip, this sensor detects magnetic direction and sends electrical signals to heading indicator to automatically align it with the current magnetic heading of the airplane.)*

9. 國際標準大氣的目的為何？及平均海平面的標準壓力值？

(What is the main purpose of the international standard atmosphere, and what is the standard pressure at mean seal level ?)

答: 主要是用來校正高度表。平均海平面的標準壓力值是 1013.2 毫巴或是 29.92 水銀汞柱高。

*(It is used to calibrate altimeters.*

*The standard pressure at mean sea level is 1013.2 hectopascals(or the older pressure unit the millibar(mb)) or the US system 29.92 inches of mercury.)*

10. 何謂磁差？十度的東磁差的意義為何？

(What is the meant by magnetic variation? and what is 10 degrees east variation ?)

答: 真北角度和磁北角度之差稱之為磁差。

在某一點上磁北剛好是真北的東邊十度。

*(The difference between true north and magnetic north is called magnetic variation.*

*It means that magnetic north is actually 10 degree to the east of true north for that particular location.)*

11. 何謂航向？行跡？

(What is the meant by heading ? track?)

答: 航向就是飛機機身縱軸所對應的方位。而行跡是飛機實際飛行路徑的方位。

*( **Heading** is the actual direction toward which the aircraft is pointed or headed. **Track** is the course actually flown.)*

12. 真北與磁北有何不同？

(What are the difference of the true north and magnetic?)

答: 真北和磁北是常用的方位參考基準。真北是地球自轉軸心的一端，為角度的基準點。而磁北是靠近真北附近的一個點為角度的基準點。

磁北可以很容易獲得，而真北不易偵測取得，因而磁北是一般常用的方位參考基準，但磁北較不穩定且和真北因地而有不同的角度差變化。

*(Both true north and magnetic north are the most commonly used references,*

*the true north is located at one end of the axis about which the earth rotates, while magnetic north is a point near true north that is used as a convenient and substitute, true north is difficult to locate, magnetic is fairly easy to find, but it is somewhat unstable and it varies in its relationship to true north.)*

13. 請問 LVDT 的全名?和主要功用?

(The letters LVDT are an abbreviation for ? and the main purpose of the LVDT ?)

答: *Linear Variable Differential Transformer/Transducer.*

提供伺服電路迴授信號及位置顯示.

*(It provides position feedback signals for the servo circuits and indication.)*

14. 請問 RVDT 的全名? 和主要功用?

(The letters LVDT are an abbreviation for ? and the main purpose of the LVDT ?)

答: *Rotary Variable Differential Transformer/Transducer.*

提供伺服電路迴授信號及位置顯示.

*(It provides position feedback signals for the servo circuits and indication.)*

15. 在典型油量指示系統中, 利用何種方式感測油量的多寡? 用何種電路計算油量?

(What kind of sensing element is used in the fuel tank for fuel quantity indicating measurement ? and the circuits type ?)

答: (1)電容器, (2)電橋電路。

*((1)Capacitance, (2)bridge circuits.)*

16. 在油量指示系統中, compensator unit 之目的為何?

(What is the purpose of the compensator unit which installed in the fuel tank?)

答: 保持燃油電介質和密度的線性關係。使燃油油量指示更為精確。

*(Maintain a linear relationship between fuel dielectric and fuel density.)*

17. 在油量指示系統中, compensator unit 位於油箱何處? 目的為何?

(What is the preferred location for a compensator unit in the fuel tank? and

the purpose ?)

答: 最低點。

要確保在不同的油面下 compensator unit 提供正確的補償信號以獲得正確的油量值。

*( It installs at the lowest position in a fuel tank that ensure the compensator unit completely immersed in fuel to get a proper compensate signals.)*

18. 說明熱電偶之運作原理及應用於飛機那些系統？

*(Explain thermal couple operation theorem and use for which aircraft systems. )*

答: (1)原理：

熱電偶的運作原理，取決於測量來源的熱能變化，所導致的電子能量，此能量轉變的形態，是建立在二條由不同金屬的導線之二端接線得結果；假設二導線相接的一端產生不同的溫度變化，則整個回路有電流產生，可利用此原理來將溫度變化轉變為電子訊息，提供操作者得知。

一般飛機上為 Chomel 及 Alumel 二種金屬, Chomel 為 Positive ; Alumel 為 Negative, 二金屬相接的端點，待測溫端為 Hot Junction or Measuring Junction ; 而另一端為 Cold Junction or Reference Junction.

*(The thermal couple is decided by heat source change cause electronic energy transfer. It is established by two different metals contact. If two conduct lines connected one end produced temperature changed that will cause circuit electronics current flow. Use these signals to product reading and indication.*

*Normal aircraft uses Chomel and Alumel two kinds metals. Chomel is positive, Alumel is negative. Two metal connect points, measuring check temperature point is hot junction or measuring junction; another is cold junction or reference junction.)*

(2).應用之系統(Application system)：高溫系統(*high temperature system*)

(a). 引擎尾溫指示(*Engine Exhaust Gas Temperature*)，即 EGT.

(b). 氣缸頭溫度(*Cylinder head temperature for Air-cooling Engine.*)

(c). 煞車溫度(*Brake temperature.*)

19. 說明空速錶之運作原理。

(Explain the airspeed indicator theorem.)

答: 在 Airspeed indicator 內主要有 :

- (1). 膜盒 *Diaphragm*
- (2). 指針 *indication pointer*
- (3). 機械結構 *mechanism*

其中 Pitot pressure 連接 Diaphragm , 而 Static pressure 則連接在 Case 與 Diaphragm 間的區域內 , 利用動壓和靜壓的壓差 , 造成 Diaphragm 的膨脹或收縮 , 帶動機械結構來驅動 indication pointer 指示出目前的空速於表頭上。

*(There are composed of diaphragm, indicator pointer, mechanism.*

*The pitot pressure connects to diaphragm. The static pressure connects to case. Use the difference of the pressure caused the diaphragm operation triggered the indication pointer.)*

20. 說明 LVDT (Linear Variable Differential Transformer/Transducer)之運作原理。(Explain the principles of LVDT operation .)

答: 當 Target 移動時 , 兩組次級線圈的磁通 , 在一組增加時 , 則另一組減少 , 兩組次級線圈所產生的電動勢之差 , 該值等比於位移量。

*(During the target moving, the two secondary coil fluxes are changed. One is increased, the other is reduced. The secondary coils produce EMF differences which are proportional to the target position displacement.)*

21. 在 EFIS 的飛機 EFIS 的 PLAN Mode 的功能?

(What is PLAN Mode function of EFIS?)

答: 檢查整個飛行計劃 Flight Plan.

*(To check the Flight Plan.)*

22. 在 EFIS 的飛機 PFD 或 ND 可以看到 Flight Plan?

(Where are you can watch the Flight Plan at PFD or ND?)

答: 導航顯示器(*Navigation Display(ND)*).

## 五、通信系統 (Communication systems)

1. 高頻通信系統所使用之頻率範圍？

(Which frequency band is used for high frequency (HF) communication system ?)

答: 高頻通信系統頻率範圍 2~30MHz.

*(The HF band, between 2 MHz to 30 MHz.)*

2. 高頻通信系統是使用何種無線電調變方式？

(What kind of modulation is used for high frequency (HF) communication system ?)

答: 振幅調變或單旁波帶抑制載波調變。

*(Amplitude modulation(AM) or single side band(SSB) suppress carrier modulation.)*

3. 試述高頻通信系統中，避電器 (Lightning Arrester) 之功用？

(What is the purpose of a lightning arrester in the high frequency(HF) communication system ?)

答: 當 HF 天線被雷擊時，避電器是提供較佳雷擊電流通路到機身結構，以降低對 HF 系統內部之損壞。

*(Lightning arrester provides good ground contact to structure to reduce the damage of HF components.)*

4. 試述高頻通信系統中有那幾種天線需要避電器？而那種天線不需避電器及原因為何？

(Which kind of HF antennas need lightning arrester, and which kind is no need ? Explain the reason why ?)

答: HF 系統中如使用 probe type 或 wire type 作為天線時，容易遭受雷擊，必須使用 lightning arrester, 但如使用 notch type 則不用，因 Notch type 天線是利用機身結構作為天線一部份。

*(If HF system installs probe or wire type antenna, it will be easily lightning strike. So it must have lightning arrester. If it uses notch type antenna, there will no lightning arrester request. Because antenna is a part of aircraft*

*structure.)*

5. 在高頻通信系統中,天線耦合器之功用為何?  
(What are the functions of the HF antenna coupler ?)  
答: Coupler 是可變的電感和電容,裝置於接收發射機和天線之間,主要的工作是匹配天線的阻抗和傳輸線的阻抗。  
(*The main function of HF antenna coupler is to match the impedance of the antenna and transmission line at selected frequency.*)
6. 在高頻通信系統中,天線耦合器內部是由那兩種主要電子元件組成?  
(What are the two main electronic elements in the HF antenna coupler ?)  
答: 天線耦合器 antenna coupler 主要是由可變線圈(variable coil)及可變電容(variable capacitor)所組成。  
(*Antenna coupler composes of various coil and capacitor circuits.*)
7. 在高頻通信系統中,注入天線耦合器內部的是那一種氣體?及功用為何?  
(What kind of gas is used in the HF antenna coupler ?)  
答: Antenna coupler 是注入氮氣(N<sub>2</sub>). 注入 N<sub>2</sub>之原因是防止可變線圈調動時產生火花及接點氧化。  
(*N<sub>2</sub>. Prevent arc in antenna coupler.*)
8. 在高頻通信系統中,當天線耦合器進行調諧時,在駕駛艙可監聽到何種訊號?(What tone will be heard during HF tuning?)  
答: 1 KHz 之 tuning tone.維持二到七秒鐘(少於十五秒鐘)。  
(*An 1 KHz tuning tone lasts for 2 to 7 seconds (less than 15 seconds).*)
9. 在高頻通信系統系統控制面板上“RF SENSE”之功能為何?  
(What is it used for on HF control panel “RF SENSE” knob?)  
答: 用來調整 HF 接收器之訊號靈敏度。  
(*Use for adjusting receiver signals' sensitivity.*)
10. 在高頻通信系統中,天線耦合器達成調諧時的駐波比是多少?  
(What is VSWR(Voltage Standing Wave Ratio) for HF system? )

答: Voltage standing wave ratio(V.S.W.R.) 約小於 1.3 : 1。

11. 何謂長調諧狀態(long tuning) ?

(What is meant by a long tuning ?)

答: HF antenna coupler 無法調諧至阻抗匹配且達成理想的 V.S.W.R. 值。

12. 極高頻通信系統的操作頻率範圍 ?

(In which frequency band does the VHF equipment operate ?)

答: 其系統的操作頻率範圍 118~136.975MHz.

(*In the VHF band, between 118 and 136.975 MHz.*)

13. 極高頻通信系統的頻道間隔是多少 ?

(What is the channel spacing of the very high frequency system ?)

答: 25 KHz and 8.33 KHz.

14. 極高頻通信系統是使用何種無線電調變方式 ?

(What kind of modulation is used for very high frequency(VHF) communication system ?)

答: 振幅調變。 (*Amplitude modulation(AM)*).

15. 極高頻通信系統中, "SQUELCH" 開關的功能為何 ?

(What is the function of the "SQUELCH" switch?)

答: Squelch 電路的功能是將雜音去除,使飛行員只聽到欲接收之語音訊號。

(*The squelch circuit compares the detected audio with a threshold value, if the level of the detected audio is greater than the threshold, the audio signal passes the circuit.*)

16. 高頻與極高頻通信系統在使用上的差別為何 ?

(What is the difference of usage between the HF and VHF communication systems ?)

答: 高頻通信系統提供調長距離通訊,輸出功率可達 400 W,分為振幅及單旁頻帶兩調變模式。極高頻通信系統提供短距離通訊,輸出功率僅約 25 W,係振幅調變模式。

(*HF system provides long distance communication. It has AM and SSB*

*modes. Its output power is 400 W.*

*VHF system uses for short distance communication, and it is AM mode.*

*Its output power is 25W.)*

17. 試述 SELCAL 之功能？

*(What is the function of the “SELCAL” system ? )*

答: 地面塔台人員如欲與特定航機進行通話時，先透過高頻或極高頻通信系統，送出一特定知會訊號，該航機若接收到此訊號則產生響鈴及燈號通知飛行員，雙方即可進行通話。

*(When air traffic controller want to communicate with aircraft in flight. They Use the VHF or HF to send a dedicate aircraft specific codes to cause its SELCAL system warning light and sound. Then crew can know to contact with ground. )*

18. 透過那些通信系統來達成 SELCAL 訊號的傳輸？

*(Which communication systems are used for the SELCAL system operations ?)*

答: 高頻通信系統或極高頻通信系統。

*(The HF or the VHF systems.)*

19. 在何種情況下旅客廣播系統，將增加放大器的功能（增益）？

*(In which conditions the passenger address(PA) system will be increased the gains of the amplifier ?)*

答: (1)在地面上當航機發動機啟動 *(When engine starts on ground. )*

(2)當航機進入飛行模式 *(Aircraft in air mode. )*

(3)飛行中的航機客艙失壓時 *(Aircraft decompression in flight. )*

20. 使用中的航機旅客廣播系統，它的優先等級次序為何？

*(What are the input sources of the passenger address system, and the priority ?)*

答: 最優先駕駛艙；客艙空服員廣播；預錄廣播/娛樂影片；最後為登機音樂廣播。

*(From the cockpit P.A. has the highest priority, the cabin flight attendant P.A. is the second priority, pre-announcement / entertainment video is third*

*priority, and then boarding music is the last priority.)*

21. 在音頻控制板上，語音/兩用/音週選擇鈕的作用為何？

(What is the function of the voice/ both / range selector on the audio control panel ?)

答: voice/ both / range 選擇鈕是使飛行員能夠選擇只收聽 VOICE 或 TONE 或兩者都收聽。

(1) 如飛行員選擇 VOICE 時, 1020Hz 之 TONE 會被過濾掉;

(2) 如飛行員選擇 RANGE 時,則只有 1020Hz 之 TONE 會通過;

(3) 如飛行員選擇 BOTH 時, 則 VOICE 及 1020Hz 之 TONE 皆能通過。

*(The selector determines how the VOR, ADF, and ILS audio is processed by the filter. In the voice position, only voice frequencies are passed while the 1020 hertz range frequency is filtered out. In the range position only the range frequency is passed while the voice frequencies are filtered out.*

*In the both position, voice and range frequencies are both passed through to the audio output.)*

22. 有那些無線電導航系統，提供了摩爾斯識別碼到飛行通話系統？

(Which radio navigation systems provide identification Morse code for the flight interphone system ?)

答: 無線電導航系統 VOR, ADF, ILS, MKR, 和 DME.

*(The radio navigation systems include VOR, ADF, ILS, MKR, and DME.)*

23. 在駕駛艙內，有那三種型式的麥克風？如何操作這些麥克風？

(What are three types of microphone can be used in the cockpit ? and how to operate these microphones ?)

答: (1)a. hand-microphone,

b. boom-microphone,

c. oxygen mask microphone.

(2)Select a transmitting system on the audio control panel (ACP),

a. uses hand-mic with push to talk (PTT) switch on its self for voice communication,

b. the PTT switch on the ACP,

c. the control wheel or sidestick , while transmitting with boom mic. or mask mic..

24. 音頻控制板的作用為何 ( audio control panel, ACP ) ?

(What are the functions of the audio control panel ? )

答: 音頻控制板可分為麥克風電路及音頻電路兩部分。

(1) 麥克風電路提供麥克風切換至通訊發射器、內部通訊或客艙廣播等系統且一次僅有單一系統在使用中。

(2) 音頻電路提供選擇至通訊或導航系統接收器，可藉由耳機或座艙擴音器發出聲音，並容許同時接聽由數個接收器所傳來之訊號且可個別調整音量。

*(The ACP can be divided into **mic circuits** and **audio circuits**.*

*(1)The **mic circuit** makes it possible to switch the microphone to the various communication transmitters, the interphone system, or the passenger address system, only one system can be select at a time.*

*(2)The **audio circuit** makes possible an individual selection of communication and navigation receivers. Reception via headphone or cockpit loudspeaker is possible, several receivers can be heard at the same time and the volume can be adjusted individually. The Morse code filter circuit are used for the radio navigation receivers.)*

25. 音頻控制板上 “R / T”(“MIC”) 及 “INT” 有甚麼不同 ?

(What is the difference between the “R/T”(“MIC”) position and “I/C”(“INT”) position on the audio control panel ?)

答: *The “R/T”-OFF-“MIC” switch provide the keying signal for the boommic or the maskmic. If the switch is in the “INT” position, the mic select switch is bypassed and a flight interphone connection is made directly.*

*If the switch is in the “MIC” position, the mic signal and P.T.T. discrete are send to the selected system on the audio control panel.*

26. 試述 push to talk (P.T.T.)通話開關信號的作動功能 ?

( What can be the functions of the push to talk(P.T.T.) discrete signal ?)

答: *These functions include enable mic audio connect to the selected system, the transmitter/receiver circuits switching in the transceiver, loudspeaker muting in the cockpit, reset a selcal call or a interphone call, the P.T.T. is record by*

*the flight data recorder, and provides a priority keyline for the passenger address system.*

27. 駕駛艙通話記錄器可記錄那些聲音？及記錄的時間長度？

*(What voice can be recorded by the cockpit voice recorder(CVR) ? and the continuously records time of the cockpit voice recorder(CVR) ?)*

答: *There are four separate inputs are used for the cockpit voice recorder that record simultaneously. These inputs include captain's headphone signals, first officer headphone signals, flight engineer(or observer) headphone signals, and signals from the cockpit monitor microphone.*

*The recording storage time of the cockpit voice recorder is at last 30 minutes, or 2 hours if a new solid states cockpit voice recorder is installed.*

28. 水下定位信標器的作用為何？及啟動的條件為何？

*(What is the function of an underwater locating device(ULD)? and that is activated in which condition ?)*

答: *When the ULD is activated, it sends out an acoustic-pulse-tone of 37.5 KHz at a rate of one pulse per second, its operating life is 30 days.*

*The ULD activates when it is submerged in water.*

29. 駕駛艙通話記錄器進行測試時，指示為何？及資料消除時，有那些必要情況條件及指示為何？

*(What are the cockpit recorder test indications ? and the erase preconditions and indications ?)*

答: *During CVR test, all the channels are checked with 600 hertz test signal, the test signal can be monitored via the headphone jack and cause a pointer deflection(or a indicating light) in the test monitor meter.*

*The CVR data can be erased by pressing the erase button for more then 2 seconds, this is only possible when the aircraft is on the ground and the parking brake is set. A 15 seconds of 400 hertz tone will be monitored via the headphone jack after release the erase button.*

30. 勤務通話系統的作用目的為何？

*(What is the purpose of the service interphone system ?)*

答: *The service interphone system allows communication between ground crew*

*members at different locations on the airplane, and between ground crew members and the flight deck.*

31. 地勤呼叫聲響 ( ground crew call horn ), 響鈴的情況有那些 ?

(What conditions does the ground crew call horn activate ?)

答: *The ground crew call horn will be activated if a ground crew call, a failure of E/E equipment ground cooling and the gyro system is on battery(or APU fire).*

32. 一般 VHF 通信系統天線位置?

答: 機腹或機背。

33. VHF 通信系統中通常使用多少波長的天線?

答: 1/4 波長。

34. VHF 系統是用何種無線電形態傳播 ?

答: VHF 是用 AM mode line of sight propagation.

35. 安裝在機腹下之 VHF 天線為何要漆成紅白相間之顏色 ?

答: 為防止機邊作業之地面裝備或人員碰撞 VHF 天線造成損壞。

36. VHF 天線目視檢查要注意地方:

答: (1) 是否有 CRACK。

(2) VHF 天線前緣迎風面是否有 erosion。

(3) VHF 天線尖端是否有被雷擊。

(4) 漆是否有脫落。

37. HF antenna coupler tuning sequence 為何?

答: (1) 選擇一新頻率, antenna coupler 回到起始點 (home position).

(2) Push PTT switch, tuning 開始, 且產生 1KHZ 的 audio tone.

(3) 調整輸出阻抗至 50 歐姆和產生諧振(純電阻電路或同位).

(4) 調整 VSRW<1.3:1(reflect power<2watt).

(5) tuning tone stop, standby for transmission.

38. HF antenna coupler 裝置位置如何選擇?

答: 接近天線。

39. 在 HF 系統中為何 Lightning arrester 與接地間要有一電阻其用意為何？

答: lightning arrester 與接地間接一電阻是希望附注在 HF antenna 之靜電經 lightning arrester 放電速度不要太快,因  $t=RC$ , 如放電太快則電流會過大天線易受損。

40. 為何飛機在加油時不能操作 HF 系統？

答: 因 HF 發射之功率很大, Peak power 達至 400W,故當飛機在加油時不能發射 HF, 防止發射時產生之電磁波造成 Electrical shock 產生火災。

41. 當 2 套 HF 系統共同使用一組 HF 天線時, 如何防止發射中之 HF 系統訊號回輸至另一套 HF 系統？

答: 在 Antenna coupler 內有一個 Interlock 設計. 當 1 套 HF 系統在發射時, 會把另一套 HF 系統 Antenna coupler 天線輸入端接地以防止訊號回輸。

42. 當航機拖進棚廠內是否可發射 HF？

答: 不可. 因棚廠是用金屬建構, HF 發射的訊號又很強,故當在棚廠內發射 HF, 則易造成 Electrical shock。

43. HF 收發機機內如何防止發射訊號回傳之接收電路造成訊號過強把接收電路損壞？

答: 當發射時,接收電路之天線接收端會接地來防止發射訊號回傳。

44. 有那些人員或信號可以使用 PA (Passenger Address)傳送？

答: (1) Pilot

(2) Attendant

(3)預錄廣播系統

(4)影帶(VTR)

(5)Boarding music and

(6)CHIME.

45. 請試述航機 PA SYSTEM 之功用？

答: PA SYSTEM 為航機客艙內之廣播系統, 為使飛行員或空服員對乘客廣播

之用。

46. Flight interphone 的主要功能？

答: Flight Crew 與 Flight Crew 及 Flight Crew 與 Mechanic 之間的通信。

47. Cabin Interphone 的主要功能？

答: Cabin crew 與 cabin crew 及 Cabin crew 與 Flight crew 之間的通信。

48. 在駕駛艙中，一般 PTT( Push To Talk)的開關的裝設位置？

答: Audio control panel (Audio select panel) , handmic 及 control wheel 上。

49. 請簡述 “Muting”在 Audio Integrating System 之功能？

答: 為防止飛行員在通話時其 SIDE TONE 或其他正接收之聲音經 cockpit 內之 Speaker 回傳入飛行員之話筒內造成通話之噪音,故當飛行員通話時把 cockpit 內 Speaker 之聲音輸出降低或消音。

50. 當飛行員使用那一種方式通話時, Audio Integrating System “Mute”功能會消失？

答: 當飛行員使用 Oxygen Maskmic 時“Mute”功能將無效。

51. 在航機外有多少個 Flight interphone jack ？

答: 在航機鼻輪附近只有一個 Flight interphone jack, 使地面人員能與飛行員通話。

52. 為何在飛行時會把 Service interphone system 切掉？

答: 因部份 service interphone jacks 在航機外部, 故當航機飛行時, 靜電會從 service interphone jacks 傳至 Audio Integrating System 造成 cockpit 之噪音。

53. 如何組成 SELCAL 的代碼? 及標示於何處?

答: 4 英文字母, 它標示於 cockpit 的 Main instrument panel

54. SELCAL 之接收訊號處理流程？

答: SELCAL 之接收訊號由 HF 或 VHF 系統經 Demodulation 後之 audio signal

傳送至 SELCAL decoder 產生 tone signal 及 lights.

55. 當 VHF Squelch 之功能啟動時是否會影響 SELCAL 之功能？

答: 不會, 因 Squelch 之功能只在 Audio Integrating System 的部份, 到 SELCAL 之輸出不會被影響。

56. 請試述 Cockpit Voice Recorder(CVR)內可紀錄幾個 Channel? 及每一個 Channel 錄的信號來源?

答: (1) Cockpit Voice Recorder(CVR) 有 4 個 Channels.

(2) Channel 1: Flight engineer (Observer)

Channel 2: Co-Pilot

Channel 3: Pilot (Captain)

Channel 4: area MIC

57. 請說明何謂 HOT MIC?

答: HOT MIC 即飛行員在沒有按 PTT (Push To Talk) Switch 時所發出之聲音仍能被紀錄在 Cockpit Voice Recorder(CVR).

58. 簡述 Static discharger 之功能?

答: 當航機在空中飛行時, 因機身與空氣磨擦而產生靜電, Static discharger 之功能是把靜電釋放至空中, 以避免干擾航機通信、導航系統, 損壞設備及危害人員安全。

59. 簡述 Static discharger 放置位置之考量?

答: Static discharger 放置在航機尖端位置, 因該位置積存之靜電量大。

60. Static discharger 之內電阻值約多少及為何?

答: Static discharger 之內電阻值約為 6 至 100 Mega ohms. 內電阻是防止靜電放電太快造成電流過大, 但如電阻太大則會降低放電之效能。  $t=RC$

61. Static discharger 失效或不足時, 那一個系統最易受影響?

答: ADF 系統將受影響。

## 六、導航系統 ( Navigation systems )

### 1. RMI 可顯示那些資料？

(What kind of information that can be displayed on the radio magnetic indicator ?)

答: The heading data from the compass system and bearing data from the VOR and ADF systems.

Heading 及 VOR/ADF 系統的 BEARING 資料

### 2. 那些導航系統可提供摩爾斯電碼？

(What are the navigation systems that supply morse signal when system operate ?)

答: The VOR, ILS, DME, and marker beacon.

### 3. 那個物件提供人工調諧頻率給無線電導航系統？那個物件提供自動調諧頻率給無線電導航系統？

(What component that provides manual tuning frequency for the radio navigation system ?)

答: Manual tuning supplies by the VHF NAV control panel or Multipurpose Control Display Unit(MCDU) if installed.

Automatic tuning supplies by the Flight management computer (FMC).

Manual tuning 由 VHF NAV CONTROL PANEL 或 MCDU 輸入  
Auto tuning 由 FMC 自動提供。

### 4. 極高頻導航控制板 ( VHF NAV CONTROL PANEL)可提供調諧信號到那些無線電導航系統？

(What are the radio navigation systems that can be tuned by the VHF NAV control panel ?)

答: VOR, ILS, and DME.

### 5. 那些無線電導航系統，操作在超高頻 (UHF)頻段範圍？

(What are the radio navigation systems that operate in the ultra high

frequency band ?)

答: DME, ATC and TCAS.

6. 根據 ICAO 標準海平面其壓力,溫度,密度為何?

答: 1013.25Hpa or 1013.25mb,or 29.92inHg ,15°C ,1.225Kg/m<sup>3</sup>

7. 請問高度須要何種壓力信號來計算?

答: Static pressure.

8. 請問空速須要何種壓力信號來計算?

答: Static pressure and Pitot pressure.

9. 請問 MACH 須要何種壓力信號來計算?

答: Static pressure and Pitot pressure.

10. 請問 vertical speed 須要何種壓力信號來計算?

答: Static pressure.

11. 請問 CAS 和 IAS 主要功能為何? (除了速度指示以外)

答: Lift information or (maximum load for flaps and airframes).

12. 請問 TAS 主要功能為何? (除了速度指示以外)

答: NAVIGATION AID.

13. 請問那二種系統可計算 V/S?

答: ADC system or IRS(INS) system.

14. 請問 SAT 和 TAT 的最主要的差異因素為何?

答: MACH (Ram Rise ).

15. Drift angle 是那 2 個的差?

答: Track and heading.

16. Drift angle 的產生主要在於什麼的影響?

答: Wind.

17. 何謂 (DOPPLER EFFECT) ?

答: 頻率發射端與移動測試物之間的相對運動會造成頻率改變稱之為都卜勒效應。

(The frequency shift that occurs when there is relative motion between the transmitting station and a remote object is known as the Doppler effect.)

18. 何謂 SKIN EFFECT?

答: 交流電流通之導體,當頻率高時,會集中在導體表面部份流動的現象。

### **AIR DATA system:**

19. 空氣數據電腦(air data computer)提供那些資料 ?

(What kind of data that provide by the air data computer?)

答: The data include computer air speed, mach, altitude, altitude rate, true air speed, total air temperature, and static air temperature.

包含 CAS,MACH,ALT, ALT RATE , TAS ,TAT ,SAT

20. Air data computer 需要那些輸入信號 ?

(What type of input signals are necessary for a air data computer ?)

答: An ADC receives both impact and atmospheric pressure from the pitot-static system, total air temperature from the TAT sensor, barometric correction from the EFIS control panel, and VMO/MMO program pin discrete( and or landing gear down dispatch discrete).

包含 Static pressure , Pitot pressure , TAT ,Barometric correction data , VMO/MMO program pin discrete 及 landing gear down dispatch discrete.

21. ADC 的基本輸入信號?

答: Static pressure, Pitot pressure, AOA, TAT.

22. 請問 CAS 和 TAS 在何種高度比較有可能相等?

答: 海平面。

23. 請問 CAS 和 TAS 的最主要的差異因素為何?

答: 密度(density).

24. 飛機基本可顯示那 5 種飛機速度?

答: IAS, CAS, MACH, GND SPD 及 TAS.

25. ADC 可計算出那些速度(說出 3 種)?

答: CAS, TAS, MACH, V/S.

26. ADC 可算出那些信號? (說出 6 種)

答: CAS, TAS, MACH, V/S, TAT, SAT, ALT.

27. 請問 CAS 和 IAS 的最主要的差異因素為何?

答: Static source error correction and instrument error.

28. 請問 TAS 和 GROUND SPEED 的最主要的差異因素為何?

答: WIND SPEED.

29. 請問 MACH 是那一個速度和音速的比?

答: True Air Speed.

30. 請問 PITOT Pressure 是何壓力?

答: Total pressure.

31. 何謂高度警告 (Altitude Alert) ?

答: Aircraft approach or leave selected altitude.

32. 高度警告(Altitude Alert)有那 2 種模式?

答: Approach mode and Deviation mode.

33. 那些系統使用 ADC 的信號?(至少 6 種)

答: Gain control (Trim rate, Yaw damper), Cabin pressure, artificial Feel, autopilot, GPWS, ATC, IRS(INS), DFDR, ALT alert system.

34. 在有 EFIS 的飛機 PFD 的指示有那些來自 ADC ? (至少 3 種)

答: CAS , ALT , MACH , V/S(primary from the IRS, secondary from the ADC)

35. 在有 EFIS 的飛機 ND 的指示有那些來自 ADC?

答: TAS.

36. 隨高度增加 VMO 增加或減少?

答: 增加,因為 density 減少

### **HEADING ATTITUDE systems:**

37. 慣性參考座標 ( IRU ) 提供那些資料 ?

(What kind of data that provide by the inertial reference unit ?)

答: The data include attitude, heading, track, inertial vertical speed, ground speed, wind data, accelerations, and navigation steering signal.

包含 Altitude , Heading , track , Inertial vertical speed , Ground speed, Wind data , Accelerations , Navigation steering signal.

38. 慣性導航系統( INS)提供那些資料 ?

(What type of information is supplied from inertial navigation systems ?)

答: The inertial navigation system is the only self-contained single source for all navigation data. After being supplied with initial position information, it is capable of continuously updating extremely accurate displays of position, ground-speed, attitude, and heading. In addition, it provides guidance or steering information for the autopilot and flight instruments.

包含 Position , Ground speed , Altitude , Heading.

39. 備用姿態儀的電力供應為何 ?

(What kind of power supply is used for the standby attitude indicator ?)

答: It can be a 28 volt direct current from battery bus, if a static inverter is integrated in the standby attitude indicator, or 3 phase 115 volt alternate current from an external static inverter, if inside the standby attitude indicator without a static inverter.

The static inverter converts 28 volt direct current into 3 phase 115 volt

alternate current. 必須由 Static inverter 供應 3 相 115 伏特交流電給備用姿態儀 (Standby Altitude Indicator)。

40. 在有 EFIS 的飛機 PFD V/S 的主要來源為何?

答: IRS.

41. IRS 可提供那些信號? (至少 4 種)

答: ATT , HDG , Position , Ground speed, wind speed, wind direction , track , drift angle, vertical speed.

42. 那些 AVIONICS 系統使用 IRS 的信號? (至少 4 種)

答: A/P , WX , GPWS , TCAS, YAW DAMPER , DFDR, RMI.

43. 在有 EFIS 的飛機 PFD 的指示有那些來自 IRS?(至少 3 種)

答: ATT , HDG , V/S, TRACK, DRIFT ANGLE.

44. 在有 EFIS 的飛機 ND 的指示有那些來自 IRS?(至少 4 種)

答: HDG, GND SPD, Wind SPD, Wind Direction , Track , Drift Angle.

45. IRS 內最主要的二個基本元件為何?

答: Laser gyro and accelerometer.

46. 啟動 IRS 最主要要輸入什麼資料才能完成 align?

答: Present position.

47. IRS 主要先計算 True Heading 或 Magnetic Heading?

答: True Heading.

48. 飛機那些信號可以計算位置? (至少 4 種)

答: GPS, IRS(INS), DME/DME, DME/VOR and DME/LOC.

49. IRS 進入 ATT mode, 是否可提供 position ?

答: 不可以。

50. 飛機在空中 IRS 進入 ATT mode 後, 如何再回到 NAV mode?  
答: 必須關掉 IRS 系統, 所以飛機在空中就無法再回到 NAV mode.

51. IRS 本身可計算 latitude 或 longitude ?  
答: Latitude.

52. Ground speed 何時等於 TAS?  
答: WIND SPEED 等於 0.

53. 沿著 TRACK 的速度為 TAS, CAS, IAS, OR GROUND SPEED?  
答: Ground speed.

54. IRS 主要先計算 West-East 或 North-South?  
答: West-East.

55. 在 INU 的系統中 DG mode 或 Slave mode 有使用到 GYRO?  
答: DG mode 和 Slave mode

56. 在 INU 的系統中 DG mode 或 Slave mode 有使用 flux valve?  
答: Slave mode.

57. 在 INU 的系統中 DG mode 或 Slave mode 何者使用在 high latitude?  
答: DG mode.

58. 在正常工作下 INS 或 IRS 有儲存 waypoint 的功能?  
答: INS.

59. 若 Wind Speed =0 ,則 Ground speed 等於什麼 Speed?  
答: True air speed

#### **ADF system:**

60. 無線電自動定向系統, 使用何種無線電電波頻率?  
(In what frequency band does the ADF equipment operate ?)

答: between 190 and 1750 kilohertz.

61. 無線電自動定向系統，使用何種天線？

(What two types of antenna are used for with most ADF receivers?)

答: 包含有方向性的 loop antenna 及無方向性的 sense antenna。

(A directional loop antenna and a non-directional sense antenna.)

62. 象限誤差修正器的之目的為何？

(What is the purpose of the quadrantal error correction (QEC) ?)

答: Minimizes the RF field distortions by the airplane.

63. 無線電自動定向系統在天線模式運作下會提供那些訊息信號？

(What information will be provided by the ADF receiver, if the system operates in the ANT mode ?)

答: 僅有 Morse signal 且 bearing pointer 指到 9 點鐘方向。

(Only the morse signal, and the bearing pointer will show 9 o'clock.)

64. 無線電自動定向系統在自動定向模式運作下會提供那些訊息信號？

(What information will be provided by the ADF receiver, if the system operates in the ADF mode ?)

答: Morse signal 且 bearing pointer 指到 ADF 地面站方向。

(The morse signal and the bearing pointer for the ADF ground station.)

65. Non-directional Beacon(NDB) ground station 是給那一個系統使用？

答: ADF system.

66. 典型的 ADF 系統中有那 2 個天線？那一個天線有線圈在裡面？

答: Loop antenna 及 sense antenna.

67. Quadrantal Error Correction(QEC) 是連接在那一個 ADF 的天線？

答: Loop antenna.

68. 在 RMI 指示器中 ADF Bearing 及 VOR Bearing, 那 1 個系統須要 heading 的信號才能獲得正確的指示？

答: VOR 系統。

69. Morse code 是由 ADF 系統中的那一個天線接收?

答: Sense antenna.

70. 在 ADF 系統中, ANT mode 是由那個天線接收?

答: Sense antenna.

71. 新式飛機的 ADF 天線位於飛機的何處?

答: 機背。

72. 在 RMI 指示器中, HDG 旗子出現時 ADF bearing(pointer)是否還有效?

答: 是。

73. 在 ADF 系統中 BFO switch 是用在接收那一種 tone 的信號?

答: BFO provides a tone allowing unmodulated CW keying to be heard.

74. 使用 ADF 是否須要輸入 COURSE?

答: 否。

75. 當使用 ADF ANT mode 時, 則 RMI 的指針的指示位置?

答: 指針成水平狀。

76. 請問 RMI MAG HDG 240 度, ADF Pointer 在 0 度(QDM),則 Relative Bearing 幾度?

答: 120 度。

77. RMI MAG HDG 240 度,當 ADF TEST 時內部產生 135 度的信號, 請問 ADF 指針在 Compass 幾度(QDM)? Relative BEARING 幾度?

答: 115 度, 135 度。

### **MARKER BEACON:**

78. 訊標臺的信號是用多少頻率?

(On what frequency is the marker beacon signal transmitted ?)

答: 75 megahertz.

79. 信標儀接收機可提供那些信號？及在何種情況下提供信號？

(What are the indication of the marker beacon receiver ? and at what condition the marker beacon receiver supplied these indication ?)

答: There are three marker lights and aural are supplied by the marker beacon receiver. The outer marker is a blue light with dashes(-----)400 Hz tone, the middle marker is an amber light with dots and dashes(.-.-.-.), the inner marker is a white light with dots(.....).

When the aircraft passes through the beam of the marker transmitter, the system provides visual and aural indications to the flight crew the position of the outer marker at approximately 4.6 nm from the runway threshold, the middle marker at approximately 0.6 nm from the runway threshold, the inner marker at the runway threshold.

80. 新式飛機 marker beacon 電路通常都和那個接收器合併在一起？

答: VOR 接收器。

81. Marker beacon 的天線位置？

答: 機腹。

82. Marker beacon 的指示燈顏色為何？(從 outer marker 到 inner marker)

答: Blue , amber and white.

83. 在 EFIS 的飛機中 marker beacon 的指示位於何處？

答: PFD

84. Marker beacon 的目的為何？

答: The system provides visual and aural indication of the passage of the aircraft over the marker transmitter located on the ground at known distance with respect to the runway threshold.

85. Marker beacon 提供那二種指示訊息給組員？

答: Aural and visual signals.

### **VHF OMNIDIRECTIONAL RANGE (VOR) :**

86. 極高頻萬向導航臺，使用何種無線電電波頻率？

(In what frequency band does the VOR equipment operate ?)

答: In the VHF band, between 108.0 and 112 megahertz(even-tenth decimal frequencies), plus between 112 and 117.95 megahertz.

87. 飛機的那一部位，是裝設極高頻萬向導航臺天線較好位置？

(What is the preferred location for a VOR antenna on an airplane?)

答: On top of the aircraft, along the center line of the fuselage.

88. 高頻萬向導航臺的資料顯示在那些儀表？及這些儀表所顯示的資料為何？

(What are the indicators which show the information of the VHF omnidirection range system ? and what kind of data can be displayed ?)

答: The VOR data can be displayed on the radio magnetic indicator, horizontal situation Indicator, or navigation display(or course deviation indicator). The RMI shows the data of station bearing/pointer and the status of the receiver, the HSI shows the data of the course, deviation, to/from, and the status of the receiver. The ND shows the data of the station identifier, course, deviation, to/from, bearing/pointer, and the status of the receiver.

89. 高頻萬向導航臺 radial 的意義為何？

(What is an omnirange radial ?)

答: The magnetic bearing of an aircraft from an omnirange station.

90. 高頻萬向導航臺 bearing 的意義為何？

(What is the VOR bearing ?)

答: The bearing is the direction from an airplane to a VOR station.

91. 高頻萬向導航臺接收的信號中，三十赫芝調幅及三十赫芝調頻信號的作

用為何？

(What are the purpose of the 30 Hz amplitude modulation and 30Hz frequency modulation signals that received by a VOR receiver ?)

答: These two signals are used to compare the phase difference, in order to discover on which radial the receiver is located, it can also be used in a needle-pointing RMI by adding compass information to it.

92. 用比較 reference signal 和 Variable signal 的相位差來得到方位是那一種系統?

答: VOR 系統。

93. VOR 頻率和那一種 Navigation Radio 系統的頻率在同一個頻帶 (frequency band) ?

答: Localizer system.

94. VOR 天線通常位於何處?

答: 直尾翅上面。

95. 那些 Navigation radio 電台會有配對的 DME 電台?

答: VOR and LOC.

96. 112.5MHZ 是什麼系統的頻率?

答: VOR 系統。

97. RMI magnetic heading 240 度,當執行 VOR test 時內部產生 0 度的信號, 請問 VOR 指針在 compass 幾度(QDM)? Relative bearing 幾度?

答: 0 度, 120 度。

98. 請問 VOR RECEIVER 本身接收信號為 QDM 或 RB ?

答: QDM.

99. 當執行 VOR test 時內部產生 180 度的信號, 輸入 COURSE 0 度, 則 deviation bar 和 TO/FROM 位置為何?

答: centered and FROM.

100.當 VOR 收到信號後, deviation bar 和 TO/FROM 是由何信號決定?

答: COURSE.

101. VOR 的頻率範圍為何?

答: 108.00~117.95MHZ except on odd tenths up to 111.90.

102. 那一種 radio navigation system 有 30HZ AM 和 30HZ FM 的調變信號?

答: VOR system.

103. 在 EFIS 的飛機中, 那裡可看到 VOR 的資料?

答: ND.

104. 在傳統的飛機中,那些儀表可看到 VOR 的資料?

答: HSI and RMI.

105. 那些其他 Avionics 系統會使用 VOR 的信號?

答: FMC and autoflight systems.

106. VOR 的 IDENT 是多少頻率?

答: 1020HZ.

### **ILS system:**

107. 儀器降落系統的地面電台設備, 裝設的位置為何?

(What are the locations of the instrument landing system ground stations ?)

答: The ILS localizer transmitter is located at the end of the runway opposite the approach, the glide slope transmitter is located at the one side of the front-course of the runway.

108. 儀器降落系統, 使用何種無線電電波頻率?

(In what frequency band does the ILS equipment operate ?)

答: In the VHF band, between 108.1 and 111.95megahertz(odd-tenth decimal frequencies).

109. 儀器降落系統中，下滑線電台使用何種無線電電波頻率？

(In what frequency band does the Glide Slope equipment operate ?)

答: In the UHF band, between 329.15 and 335 megahertz.

110. 儀器降落系統中，那一部份和極高頻萬向導航臺共用天線？

(Which component of the instrument landing system share the antenna with the VOR ?)

答: The ILS localizer.

111. 所謂的儀器降落系統，它包括那三部份？

(What three components of an instrument landing system are installed in an aircraft ?)

答: The receivers for the localizer, the glide slope, and the marker beacons.

112. 儀器降落系統中，下滑道角通常是多少度？下滑角發設器裝設的位置在何處？

(What is the angle of the glide slope path ? and the location of the glide slope transmitter ?)

答: The glide path at an angle of 2.5 degrees – 3 degrees. The glide slope transmitter is located at one side of the front-course of the runway.

113. 儀器降落系統的資料顯示在那些儀表？及這些儀表所顯示的資料為何？

(What are the indicator which show the information of the instrument landing system ? and what kind of data can be displayed ?)

答: The ILS data can be displayed on the attitude director indicator and horizontal situation indicator or primary flight display and navigation display.

The ADI shows the data of glide slope deviation, localizer deviation, and rising runway with a valid radio altitude, the HSI show the data of the glide slope deviation and localizer deviation. These two indicators also show the status of the receiver.

The PFD shows the data of the glide slope deviation, localizer deviation, and rising runway with a valid radio altitude, the ND shows the data of the glide

slope deviation and localizer deviation. These two indicators also show the status of the receiver.

114. 當航機在下滑道下方及跑道中央靠右側飛行時，水平姿態儀顯示的資料為何？

(What are the indications on the horizontal situation indicator, when in flight airplane is below the glide path, right side of the runway center ?)

答: The HSI shows a upper glide slope pointer and a left localizer pointer.

115. LOC 和 G/S transmitter 的位置？

答: LOC at the departure end of the runway(400-1200m), G/S at one side of the front-course(240-480m) of the runway.

116. G/S transmitter 的角度？和其 frequency band？

答: 大約 2.5~4 度 above the ground level, UHF.

117. LOC 和 G/S 調變那 2 個頻率信號？

答: 150HZ and 90 HZ.

118. LOC 和 G/S one dot 是多少安培？

答: 75 microamps.

119. 一般 LOC 和 G/S 天線在飛機上裝設的位置？

答: LOC 天線在雷達罩內或 vertical fin , G/S 天線在雷達罩內或輪艙門內。

120. 在傳統的飛機上，那些儀表可看到 ILS 的資料？

答: ADI and HSI.

121. 在 EFIS 的飛機上，那些儀表可看到 ILS 的資料？

答: PFD and ND.

122. Localizer deviation bar one dot 大約幾度？

答: 1 度。

123. ILS 的 COURSE 的設定為何?

答: 輸入要降落的 runway heading (Course).

124. Glide slope one dot deviation 大約幾度?

答: 0.35 度。

125. 在 back course landing 的情況下, 那一個 ILS 信號無法使用?

答: glide slope 信號, 但 localizer 信號必須反 180 度來使用。

126. LOC 和 G/S 的信號是多少得調變?

答: 150HZ 和 90HZ.

127. LOC 的頻率範圍為何?

答: 108.10~111.95 odd tenths.

128. 那些 Avionics 系統會使用 ILS 的信號?

答: Autoflight, FMC, GPWS and DFDR.

129. LOC 和 G/S 的 deviation 信號和 course 有何關係?

答: 無關。(註:但有些飛機 course 的設定, 若超過 track 正負 90 度時會自動轉成 back beam 的信號狀態。)

130. ILS receiver 可能和那些系統接收器合併?

答: 和 VOR receiver 合併組成為 VHF NAV receiver, 和 GPS receiver 合併組成為 Multi-mode receiver(MMR).

#### **DISTANCE MEASURING EQUIPMENT:**

131. 測距儀系統(DME), 使用何種無線電電波頻率?

(In what frequency band does the DME equipment operate ?)

答: In the UHF band, between 962 and 1024 megahertz(receive) or between 1151 and 1213 megahertz(transmit).

132. 飛機的那一部位, 是裝設測距儀天線較好位置?

(What is the preferred location for a DME antenna ?)

答: Along the center line of the belly of the aircraft as far from any other antenna as is practical.

133. 測距儀的資料顯示在那些儀表？及這些儀表所顯示的資料為何？

(What are the indicator which show the information of the instrument landing system ? and what kind of data can be displayed ?)

答: The DME data can displayed on the DME indicator, digital distance radio magnetic indicator(DDRMI), or on the primary flight display(PFD), navigation display(ND).

The DME indicator and DDRMI show the slant range of the DME ground station, and the status of the DME interrogator. The PFD show the slant range of DME ground station paired with the ILS, the ND show the slant range of DME ground station paired with the VOR.

134. 那些系統在工作在 L BAND 頻率範圍？

答: DME, ATC and TCAS.

135. DME interrogation 和 reply 信號的頻率差是多少？

答: 63Mhz.

136. 那些系統決定了 DME 系統的電台頻率？

答: VOR 或 LOC 的頻率決定。

137. DME 如何算出距離？

答: The DME measure distance by transmitting a pulse pair signal to a ground station and counting the time it takes to receive a reply signal. The distance is then the propagation velocity of the pulse pairs times the time divided by two (because the pulse pair must traverse the distance twice , down and back).

138. DME 天線的位置？

答: 機腹。

139. DME 的距離指示為何？

答: slant range.

140. DME 的主要元件？

答: DME interrogator and antenna.

141. 那一個 radio navigation 系統有掃描電台的能力？

答: DME.

142. 在典型的飛機上，何處可以看到 DME 的指示？

答: HSI or RMI.

143. 在 EFIS 飛機上，何處可以看到 DME 的指示？

答: PFD, ND or RMI.

144. 那些 avionics 系統中，使用 DME 的信號？

答: FMC and Autoflight.

145. 在 RMI 指示器中，DME 若是 no computer data(NCD)則指示為何？

答: dash(- - -).

146. 在 EFIS 飛機何時可以看到 DME 的指示在 PFD？

答: LOC paired with DME.

147. DME 的天線可以和那一個系統互換？

答: ATC 系統。

#### **AIR TRAFFIC CONTROL (ATC) :**

148. 雷達回答器(ATC)，使用何種無線電電波頻率？

(In what frequency band does the ATC equipment operate ?)

答: in the UHF band, 1030 megahertz for receiving, and 1090 megahertz for transmitting.

149. 雷達回答器，使用何種天線？

(What kind of antenna is used for the ATC transponder ?)

答: A UHF stub antenna.

150. 如何定位次級搜索雷達操作模式？

(How to determine the mode of operation of the secondary surveillance radar ?)

答: It is determined by the interrogation pulse spacing between the P1 and P3, the mode A pulse spacing is 8 microseconds, the mode C pulse spacing is 21 microseconds.

151. 那兩種天線輻射空中交通管制的詢問脈波？及脈波的類型？

(What are two types of antenna radiate interrogation pulses for the air traffic control operations ? and what kind of pulses radiate by these two antennas ?)

答: An omni-directional antenna and a rotating directional antenna are used for the ATC ground station. The interrogation pulse P2 radiates by the omni-directional antenna, and interrogation pulse P1,P3 radiate by the rotating directional antenna.

152. 航機上屬於次級搜索雷達的裝備為何？及它能提供的訊息為何？

(What is the secondary surveillance radar airborne equipment ? and what kind of code information that sent by the transponder ?)

答: The transponder, it send the specific identify of an aircraft, altitude, and an abnormal situation affecting the aircraft , such as radio failure, in flight emergency, etc.

153. 雷達回答器可運作的模式為何？及這些模式可傳遞的資料為何？

(What are the operating modes of a transponder ? and what kind of information that carried by these modes ?)

答: The operating modes include mode A, C, and S. Mode A provides identification and position information, mode C provides the pressure altitude information, mode S transmit an aircraft registration and type, and other information such as weather reports, ATIS, and clearances to a specific aircraft.

154. 雷達回答器控制板上的 ”高度” 及 “識別” 開關的作用為何？  
(What are the functions of the ALT and IDENT switches on the air traffic control panel ?)

答: The ALT switch enable the transponder to reply with coded altitude information, from the selected air data computer, the IDENT switch that causes the transponder to transmit a special pulse(SPI) that enables the ground station to identify the airplane on the ground station scope.

155. 那些導航系統間，有抑制 (suppression) 信號相互連接?

答: All DMEs and all ATCs and TCAS.

156. ATC Reported 至 Ground Station 的高度(altitude)是來自那一個系統?

答: ADC 系統。

157. Ground Station 如何知道飛機的 Bearing?

答: The primary surveillance radar is a conventional radar system that transmits pulse of RF energy and listens between transmission for an echo of the energy from the target within range. The echo signals are processed and display on a radarscope.

The distance to the target is determined by time the period between the transmission of the pulse and its received echo. The direction of the target's determined by knowing the direction in which the antenna is pointing when the echo is received.

158. Mode C ATC 的主要的 component ?

答: ATC control Panel , ATC Transponder and ATC antenna.

159. Mode C ATC 的天線的位置?

答: 機腹。

160. 在 ATC 系統回應下，它的 3 個 pulses P1,P2,P3，請問其大小關係?各來自那一個天線?

答:  $P2 < P1 = P3$  , P1 and P3 from directional antenna , P2 from omnidirectional

antenna.

161. ATC Mode C altitude reported 是用什麼編碼方式?

答: Gray code (Giham code).

162. ATC Mode C reported 什麼信號到 Ground?

答: coded Altitude.

163. TCAS 必須要有那種 mode 的 ATC 才可以裝置?

答: Mode S.

164. 那一個 mode ATC 有 24 bits address ?

答: Mode S.

165. DPSK 的全名?

答: Differential Phase Shift Keying.

166. DPSK 中 1 如何表示? 0 如何表示?

答: 180 度 phase-shift means logic 1 , no phase-shift means logic 0.

167. ATC code 通常由何處輸入?

答: ATC Control Panel.

168. 當按下 ATC Control Panel “IDENT” push-button, ATC 資料格式會多了什麼信號的 pulse?

答: Special Position Identification.

169. 那一個 mode 的 ATC 是 data link 的傳輸?

答: Mode S.

170. ATC transponder mode C ,mode S, mode A 的 replay 和 interrogation 的頻率分別為何?

答: 全相同, Reply 1090Mhz, interrogation 1030Mhz.

## **TRAFFIC ALERT and COLLISION AVOIDANCE SYSTEM:**

171. 防撞系統，使用何種無線電電波頻率？

(In what frequency band does the TCAS equipment operate ?)

答: in the UHF band, 1030 megahertz for transmitting, and 1090 megahertz for receiving.

172. TCAS 的 4 個不同警告等級？

答: 1. Resolution Advisory , symbol-red square.  
2. Traffic Advisory, symbol-amber circle.  
3. Proximity Traffic , symbol-solid white diamond.  
4. Other Traffic , symbol-open white diamond.

173. TCAS 的天線是屬於那一類型？由幾個元件組成？

答: 屬方向性, 4 個 antenna 組成。

174. 一般飛機加裝 TCAS 系統，它的指示會和那一個儀表共用？

答: Vertical speed indicator(VSI).

175. 在 EFIS 的飛機中，TCAS RA 等級警告指示會在 PFD 的何處？

答: ATT 或 V/S.

176. TCAS 的方向性天線必須裝在何處？

答: 機背。

177. TCAS 的輸入信號，由那些系統提供？

答: RA, IRS(INS) , ATC Transponder , landing gear(Position) Lever and program pin discrete.

178. TCAS 可偵測到那種 ATC mode(模式)的飛機？

答: Mode C and S.

179. TCAS 和 GPWS 警告等級的關係？

答: GPWS 等級較高。

180. 在 TCAS 系統中，何謂 whisper shout sequence?

答: A series of increasing power mode c interrogation.

It is a method to minimize ATCRBS synchronous interference and aid the operation of TCAS in high traffic density airspace.

181. 在 EFIS 的飛機中，那裡可以看到 TCAS 的資料? 及資料內容?

答: PFD and ND.

The TCAS forbidden attitude and vertical speed symbols are shown on the PFD, and the intruder symbols are shown on the ND.

#### **LOW RANGE RADIO ALTITUDE:**

182. 無線電高度表，使用何種無線電電波頻率？

(On what frequency does the radio altitude transceiver operate?)

答: about 4300 megahertz.

183. 無線電高度系統中，AID bias 的目的為何？

(What is the purpose of the applying the AID bias following the initial installation of the radar altimeter system ?)

答: Most radar altimeter systems require an adjustment after initial installation to read zero foot altitude at the point of touchdown. Compensation for antenna cable lengths and the antenna height above the ground at the point of touchdown may be made by applying an aircraft installation delay(AID) bias. The AID bias is selected from a chart, and may be applied by jumpering connector pins on the rear of the R/T rack connector on some typical installation.

184. Radio Altimeter 的頻率範圍?

答: 4.2 GHZ - 4.3 GHZ.

185. Radio Altimeter 的最大指示範圍?

答: 2500 FT above the ground.

186. 何謂 HEIGHT ?

答: Height is the vertical distance between surface and aircraft . Indication is at the Radio Altimeter.

187. 在 EFIS 的飛機上 , 何處有 Radio Altimeter 的資訊?

答: primary flight display(PFD).

188. Radio Altimeter 的天線的位置?

答: 機腹。

189. 那些 avionics 系統使用 Radio Altimeter 的信號?

答: Autoflight system, GPWS, TCAS and weather radar.

190. 組成 Radio Altimeter 系統的主要元件?

答: RA transceiver, one transmit antenna, one receiver antenna and RA indicator.

191. Radio Altimeter 最常使用的調變方式?

答: FM.

192. Radio Altimeter 的兩個基本工作方式原理?

答: Constant modulation period and constant frequency difference.

193. 請問 LRRA 是 AM 或 FM 或 SSB 的調變?

答: FM.

194. DH 是配合那一個系統使用?

答: Radio altimeter system.

## **WEATHER RADAR:**

195. 氣象雷達系統 , 使用何種無線電電波頻率 ?

(In which frequency does the weather radar transceiver operate ?)

答: about 7345 megahertz.

196. 氣象雷達系統有那些操作模式?

答: Weather, Weather + Turbulence, Map(ground), turbulence and test modes.

197. 氣象雷達系統主要的組成元件為何?

答: Weather radar control panel, transceiver, wave guide, antenna and indicator.  
( note: a wave guide switch is necessary for dual weather radar system).

198. 在 EFIS 的飛機上, 氣象雷達的資料可以在那裡顯示?

答: Navigation display(ND).

199. 氣象雷達系統須要什麼信號做天線的 stabilization 的控制?

答: Airplane attitude data.

200. 比較兩種氣象雷達天線 Parabolic 及 flat plate 的不同?

答: (1)Parabolic antenna: energy striking the reflector from a point source situated at the focus will produce a plane wave of uniform phase travelling in a direction parallel to the axis of the parabola.  
(2)Flat plate antenna: strips of waveguide vertically mounted side by side with the road wall facing forward. Staggered off-centre vertical slots are cut in each waveguide so as to intercept the wall currents and hence radiate.  
The flat plate has the higher gain/ narrower beam/ least side lobe power.

201. 氣象雷達的 turbulence 是用什麼原理測得?

答: Doppler effect.

202. 在 EFIS 的飛機氣象雷達的 turbulence 用何顏色表示?

答: Magenta.

203. 飛機氣象雷達的 frequency band?

答: X band.

204. Wave guide 和 coaxial cable 那個 skin effect 較小?

答: Wave guide.

## 七、自動駕駛系統 (Autoflight systems)

### 1. 自動駕駛與飛行導向器之間的不同？

(What is the difference between autopilot and flight director ?)

答: The autopilot computer compute the necessary servo commands which operate the control surface. The flight director provide command to the pilot to operate the control surface. Typically, pilot use the autopilot to control the airplane, and the flight director becomes a monitor of autopilot operation.

### 2. 轉移瓣的功能為何？

(What is the function of the transfer valve ?)

答: The tranfer valve is an electrically controlled hydraulic valve which operate a piston assembly called the autopilot actuator.

### 3. 自動駕駛致動器移動量的感測元件為何？

(What is the sensing element that senses the amount of movement of the autopilot actuator ?)

答: The linear voltage differential transducer(LVDT).

### 4. 那些項目屬於“自動飛行系”？

(What can be comprised by the term” automatic flight”?)

答: An one/two/three autopilot channels, a yaw damper system, an automatic trim system, an automatic thrust system, and flight envelope protection.

### 5. 自動駕駛有多少個 channels？是那些自動駕駛 channel？

(How many autopilot channels can be installed in an autopilot system ? and what are the autopilot channels ?)

答: Three channels, the channels include pitch, roll, and yaw.

### 6. 自動駕駛系如何控制飛行操縱？

(How the aircraft is controlled by the autopilot channels ?)

答: Through the primary flight control, pitch servo actuators are deflecting the elevator, roll servo actuators are deflecting the ailerons, and yaw servo

actuators are deflecting the rudders.

7. 偏航阻尼器的功能作用為何？

(What is the function of the yaw damper system ?)

答: The yaw damper system can move the rudder only a few degrees, these movement is used to dampen out oscillations about the yaw axis(dutch-roll).

8. 何謂 Dutch roll ? 如何產生？

答: All aircraft having a swept-wing configuration are subject to a yawing-rolling oscillation popularly known as “dutch roll”.

A sudden gust or a short uncoordinates rudder deflection produces a yawing motion. It will roll in the same direction, the direction stability will then begin to reduce the yaw to the extent that the A/C will overswing and start a yaw, and a roll to opposite direction the resulting motion begins a combination of rolling and yawing oscillation.

9. 自動安定面調整器的功能作用為何？

(What is the function of the automatic stabilizer trim system ?)

答: To trim the stabilizer automatically to a neutral position to the elevator, if permanent defection signal to the elevator is necessary to control the pitch attitude. Normally, the stabilizer trimming is accomplished by using elevator position as a trim signal.

10. 那些是接合自動駕駛及飛行導向器的內鎖條件？

( What can be the engage interlock for the autopilot / flight director engagement ?)

答: Check conditions of all inputs for the desired AP/FD modes are valid, the internal test of the AP/FD computers are valid, and the preconditions of the servo actuators are valid.

11. 那些是自動駕駛及飛行導向器的俯仰模式？

( What can be the pitch AP/FD modes ?)

答: The pitch AP/FD modes include basic and upper modes.

The basic mode is attitude or vertical speed mode.

The upper modes are speed, altitude hold, level change, vertical speed, VNAV or profile, glide slope or flight path angle, flare, and altitude acquisition modes.

12. 那些是自動駕駛及飛行導向器的側滾模式？

(What can be the roll AP/FD modes ?)

答: The roll AP/FD modes include basic and upper modes.

The basic mode is attitude hold or heading hold mode. The upper modes are heading select, LNAV or NAV, VOR/LOC, and APPR or LAND modes.

13. 自動駕駛運作在操縱盤操縱模式時的功能作用為何？

(What are the functions that when the A/P is engaged in control wheel steering mode ?)

答: If there is no mechanical input sensed by the force transducers(or dynamometrics rods), then the actual pitch & roll angle at the moment on engagement is maintained. If inputs from the pilots to the control column/wheel will sensed by the force transducers (or dynamometrics rods), and the electrical signals are used to gain with aid of the A/C a new attitude.

14. Versine 信號的作用為何？它是那個 Channel 來提供？

(What is the function of the versine signal(turn compensation)? and which computer provides the versine signal ?)

答: During a bank the roll channel produce a nose up command(versine signal) to the pitch channel, which signal compensates for the loss of lift during turn.

15. Turn coordination 的功能作用為何？

(What are the functions of turn coordination ?)

答: To counteract the yaw moment forcing the nose of the aircraft to the outside of the turn, an appropriate deflection of the spoilers on the inside wing, or a deflection of the rudder to the inside of the circle is necessary. For this function some airplane is integrated in the yaw damper system.

16. 航機在自動駕駛操縱盤操縱模式時和航機在只有液壓動力時有何不同？

(What is the difference between the A/C in control wheel steering(CWS)

mode and the A/C only with hydraulic power assistance ?)

答: In the CWS mode, the A/C will maintain a new attitude after releasing the control/column, the A/C only with hydraulic power assistance will not maintain a new attitude after releasing the control wheel/column, due to the natural stability of the aircraft construction.

17. 在自動駕駛致動器上有那些附件,及它的作用 ?

(What are the components that can be found on the autopilot actuator, and what is the function ?)

答: The arm(actuator) solenoid valve, detent solenoid valve, transfer valve, LVDT, and hydraulic pressure switch.

When arm(actuator) solenoid valve is energized that control the hydraulic pressure go into the autopilot actuator and pressurizes the transfer valve and detent solenoid. Before the detent solenoid valve energizes, the transfer valve control the hydraulic pressure to the main piston to synchronize with the control surface position, after the main piston and the internal output crank(provides rotary movement to the control surface) are synchronized, the detent solenoid valve energizes, this pressurizes the detent pistons and they touch the sides of the internal output crank, and a hydraulic pressure switch send a signal to AFS computer to show the autopilot actuator is ready to operate.

18. 馬赫配平的功能作用為何 ?

(What is the function of mach trim ?)

答: As the airplane gets nearer to mach one, the airflow at the wing root becomes sonic, cause a turbulent zone. This results in loss of lift near the wing root and the center of the lift moving after(nose-down). The mach trim system restores balance by trim the stabilizer or elevator.

19. 說明一般自動駕駛系統之 Autoland scenario( example for MD A/C)

答: (1). LOC, G/S capture, LAND armed, rudders operate in parallel mode.  
(2). 1500 ft radio altitude, DUAL LAND engaged, electrical bus isolation, crab angle provided by rudder for cross wind compensation.  
(3). 150 ft radio altitude, "ALIGN" mode initiated crab angle removed a

- forward runway alignment is initiated to maintain the localizer center.
- (4). 50 ft radio altitude, “FLARE” mode initiated, A/T retard, G/S signal removed & gain programming start, A/C descent rate reduced from 12 ft/sec to 2~3 ft/sec.
  - (5). At touch-down, main wheel spin up, “ROLLOUT” mode initiated wing level & nose lower, localizer centering is maintained by the rudder.

20. 說明無線電高度信號在自動駕駛系統中之功用。

答: The radio altitude signal are used automatic landing, the functions are :

- (1). Trigger different upper modes.(e.g. align, flare and rollout...)
- (2). Gain programming

Approximately 350 ft above ground level, the glide path and localizer receiver canals are reduced to compensate the width of the beam narrows nearer to the ground.

- (3). Provides a safe & comfortable landing

Approximately soft radio altitude, the “FLARE” phase is initiated the glide-slope signal is disconnected, the rate of descent is reduced in proportion to the height.

21. INS 或 IRS 在自動駕駛系統中之主要功用？及提供了那些信號？

答: For autopilot system inner loop stabilization signal and deflection command signal processing. Under automatic flight control systems, the INS or IRS is the primary sensing element which provided :

- (1). Pitch and Roll attitude.
- (2). Pitch, Roll & Yaw rate.
- (3). Heading(magnetic and true) and Track.
- (4). Drift angle, Flight path angle.
- (5). Normal, Lateral, Longitudinal & vertical acceleration.
- (6). Ground speed, Vertical speed and Wind speed/direction.

22. 何謂 Automatic gain control?

答: Keep the gain of the receiver constant as station of difference signal strength are received.

23. Autopilot 是否為 full flight phase ?

答: 不是 full flight phase.

24. Autothrust 是否為 full flight phase ?

答: 是 full flight phase.

25. Autopilot engaged, the Autothrust modes(speed, thrust and retard) 由那一個 channel 控制?

答: Autopilot 的 pitch channel modes.

26. 在 CWS mode,當 release control column/wheel, 則進入那一個 mode?

答: Attitude hold mode.

27. 如何做 Turn Compensation?

答: Up deflection of the elevator or autothrottle.

28. Autopilot 的 flight level change(climb phase) ,那個信號控制 elevator 和 thrust?

答: Speed control elevator, climb thrust control thrust.

29. Flight director 的基本二種使用方式?

答: (1) Command indication for manual guidance of the A/C by the pilot.

(2) Supervision over the automatic flight command.

30. 在 A/P engaged 前,何謂 autopilot 的 synchronization?

答: A/P actuators are always synchronized to the actual position of the control surfaces. This make it possible , to engage the A/P , without having unexpected deflections of the control surface.

31. FMC 的功能的為何?(至少 3 種)

答: Performance computation, Guidance computation and Navigation computation (or Thrust management).

32. FMC 的那個 database 須要每隔 28 天 updating ?

答: Navigation Database.

33. 何謂 FMC 的 independent mode?

答: 二部 FMC 資料相互獨立無法交換資料, Each FMC only processing the own MCDU entries, 無 Crosstalk 的功能。

34. 一般 Autopilot disconnect 是那一等級的警告?

答: 最高等級的警告(Red Warning).

## 八、 電力系統 (Electrical power systems)

### 1. 靜態換流器的功能為何？及它在航機上的運用？

(What is the function of the static inverter, and the purpose of the static inverter ?)

答: The static inverter produces an AC voltage of 115V/400 Hz from the battery power(DC 28V). The static inverter supplies the important AC components after failure of normal power supplies.

### 2. 變壓整流器的功能為何？及它在航機上的運用？

(What is the function of the transformer rectifier unit, and the purpose of the transformer rectifier unit ?)

答: The transformer rectifier unit produces from the three phase AC 115V to a DC 28V. Normally, the main DC buses are supplied by the TRUs. Those DC buses supplies the power for the relays, motors, and lamp indications.

### 3. 在航機的直流電力系統中，有那兩種類型的電瓶可被選用？

(What two types of airplane battery can be used for the DC power systems?)

答: The lead-acid battery or the nickel-cadmium battery.

### 4. 那些參數必須在限定範圍內，發電機才能進行並接？

(What are the parameters that must be within limits before the generators paralleled and switched together ?)

答: The frequency, voltage, and phase angle.

### 5. 甚麼原因避免地面電源間，或是地面電源和飛機電源間的並聯運行？

(What is the reason of electrical power paralleling operations are prevented between ground power sources, or ground power to the ships power ?)

答: Because its not possible to synchronize the auxiliary and ground power units to the engine driven generators.

### 6. 那裡是發電機電力調整的調節點？及調節點的功能？

(Where is the point of regulation that uses for generator power regulation?  
and the purpose of the point of regulation?)

答: The location of the point of regulation is on the generator side of the generator breaker. A current transformer is installed on the point of regulation to measure current for generator distributions, protections, and indications.

7. 那些故障可造成發電機控制內部的磁場繼電器的跳脫？

(What are the faults that trip the field relay in the generator control ?)

答: 超壓、低壓和短路。

( The faults include overvoltage, undervoltage, and shorts(differential protection)) .

8. 航機使用外部電源(或地面電源車)時，必須滿足那些條件方可使外部電源“可使用”(AVAIL)燈亮？

(What are the conditions which should be satisfied for turn on the external power “AVAIL” lights, when the airplane gets a power source from ground power unit ?)

答: 電壓-頻率-相位順序在許可範圍內以及接腳 E 及 F 接受。

(These conditions include voltage-frequency-phase rotation within the range, and the interlock pin E & F no faults and connected(insures that the external power plug is properly installed) ).

9. 發電機控制組的功能作用為何？

(What are the functions of the generator control unit(GCU) ?)

答: 控制發電機的正常功能，包括發電機之斷電器，磁場繼電器以及匯電板斷電器或轉換器。

( It controls the correct function of the generator system, and including control the generator breaker, field relay and the bus tie breaker or transfer contactors.)

10. 試說明電瓶在飛機的電力系統中，提供那三項功能？

(What three purposes does the storage battery serve in the operation of the aircraft electrical system ?)

答: (1).啟動飛機引擎/APU。

(2).飛行中發電機失效時，提供緊急電源。

(3).濾波功能。

*(The storage battery is used primarily for starting the aircraft engines/(or APU). However, if generator power is lost in flight, the storage battery is used to provide emergency power. In addition, the battery acts as a capacitor to filter ripple voltage output from the generator(s). )*

11. 為甚麼家庭及工廠的電力供應是六十赫芝交流電，而大型飛機是使用 400 赫芝的交流電？

*(Explain why commercial electrical systems for a home or factory use 60 hertz AC power while electrical systems for heavy aircraft use 400 hertz AC power.)*

答: 由於頻率較高，電感反應也較高，所以 400 Hz 比 600 Hz 較有效率，變壓器及馬達電樞所需用之鐵心較小較輕。

*(AC generators that produce a 400-hertz output are more efficient and lighter in weight than 60-hertz generators due to requirements for less iron, and thus less weight, in transformer cores and armatures. Less iron is required due the fact that inductive reactance increases directly with frequency. )*

12. 交流發電機系統中，電壓調整器如何保持恒定的電壓輸出？

*(How does the voltage regulator maintain a constant voltage output from the regulator ?)*

答: 發電機輸出電壓隨著引擎轉速及其負載而變化，因此，當發電機輸出電壓增加時，電壓調節器將增加通過發電機磁場激磁繞組之電流量，以降低輸出電壓。

*(As we know, generator output voltage varies with engine speed and applied load. Therefore, as the generator output voltage increases, the voltage regulator will increase the current flow through the generator field circuit, which in turn, reduces the output voltage.)*

13. 分流器的作用為何？及它在電力系統中可能裝設的地方？

*(What is the purpose of the shunt and where may it be connected in the electrical system ?)*

答: 分流器的功能使用來分攤電路上大部份之電流流量，只讓小部份電流通過

電流表。

*(The current flowing through the very small resistance of the shunt develops a voltage drop which is applied to the ammeter in the cockpit to indicate the amount of current being drawn.*

*A shunt may be connected in series with the battery to indicate charging current demanded by the battery or in series with the generator to indicate the amount of current being drawn from the generator.)*

14. 比較變壓整流器(TRU)及換流器(Inverter)的功能？

*(Compare the function of a TRU versus an inverter.)*

答: 變壓整流器是將 115 伏特之交流電轉換成 28 伏特直流電，而換流器是將 28 伏特直流電轉換成 115 伏特交流電。

*( Transformer-rectifier units convert an 115-volt AC input to a 28-volt DC output. The inverters convert a 28-volt DC input into a 115-volt AC output. A TRU consists of a step-down transformer to convert the 115-volt AC input to a 28-volt AC output, then fed to a full-wave bridge rectifier which converts the AC input to a DC output which is fed to the DC electrical busses and the battery charging circuits.)*

15. 比較靜態換流器與旋轉式換流器在運作上的不同？

*(How does the operation of a static inverter differ from that of a rotary inverter ?)*

答: 旋轉式換流器採用恆速直流馬達帶動交流發電機產生交流電。  
靜態式換流器採用內部之多諧式振盪器產生交流電。

*( There are two types of inverters, a rotary inverter and a static inverter. Rotary inverters consist of a constant-speed DC motor, which is mechanically coupled to drive an AC generator. Solid-state static inverters have an internal multi-vibrator oscillator which produces an AC voltage at the desired frequency. The AC from the inverter is applied to an AC bus bar for load distribution.)*

16. 相及相位角的定義？又三相系統的相位角為何？

*(Define phase and phase angle. What is the phase angle in a three-phase system ?)*

- 答: (1)在一交流電源間不同電壓波之編號謂之”相”。
- (2)兩個交流電流或電壓間之轉變度數之差異謂之”相位角”。
- (3)三相系統裡每一相之間有 120 度之相位角。

*( The term “phase’ is used to related the number of separate voltage waves in an alternating-current supply. The phase angle is the difference in degrees of rotation between two alternating currents or voltages. In a three-phase system, each phase differs from the other by 120 degrees.)*

17. 發電機並聯的作用為何？及平衡電路的作用為何？

*(What is meant by paralleling generators and what is the function of an equalizer circuit ?)*

- 答: 當飛機有一架以上之發電機時使用並聯線路將所有發電機接至匯電板繼電器。當發電機並聯在一起時平衡電路是用來監控另外一架發電機之輸出電壓並調整其電壓使每一架發電機分攤相等之負載。

*(Aircraft that have more than one generator use a paralleling circuit, whereby all operating generators are connected to the AC bus-tie relay. When the generators are paralleled, the equalizing circuits in the voltage regulators monitor the outputs of the other generators on the bus and adjust the voltage of the other generators so that each share the same load.)*

## 九、 作業程序及法規 (Procedures & regulations)

### 1. 試說明執行 CAT II 進場的必要項目為何？

(What are the requirements are necessary for the airplane to perform a category II approach ?)

答: (1)符合 CAT II 之氣象情況以及經過認證之 CAT II機載裝備。

(2)認證過之機場設施，飛航組員與維修人員。

*(At CAT II weather conditions, an airplane category II equipment has been certificated in operation, a category II certificated airport, and a special training programs must be certificated for the flight crews and for the maintenance people.)*

### 2. 何謂 RVR ? 何謂 DH ?

(What is the RVR for a category II/III approach ? What is the DH for a category II/III approach ?)

答: (1)RVR：機場能見度。

(2)DH：決定高度。

以 CAT II舉例來說： RVR1200 呎， DH100 呎。

*(The runway visual range which is how far can be seen at the runway at particular time and time, it is the lower limits of visibility for safe landings. A CAT II approach , the RVR must be at least 1200 feet. The decision height is the height above the altitude of the runway, if the pilot can see to land at this point, then he may legally land his airplane. If he cannot see to land when reaches that point, he must go around. A CAT II approach , the decision height is above/equal 100 feet and less 200 feet. )*

### 3. CAT II 進場與 CAT III 進場有何差異？

(What are the difference between the CAT II approach and CAT III approach ?)

答: 差異敘述如下：

(1)機載裝備

(2)機場設施

- (3)飛航組員訓練
- (4)維修人員訓練
- (5)機場能見度/決定高度。

*(The difference include the airplane equipment, airfield facility, pilot training, maintenance training and the RVR/DH for the CAT II/III approach.)*

4. 那些是飛行 RVSM 必要的飛機系統設備？

(What are the aircraft systems/equipment that are necessary for RVSM operations ?)

- 答: (1)兩套獨立高度量測系統  
(2)一套次級搜索雷達高度報告識別器  
(3)一套高度警告系統  
(4)一套自動高度控制系統。

*( Two independent altitude measurement systems, one SSR altitude reporting transponder, an altitude alert system, and an automatic altitude control system.)*

5. RVSM 的空域為何？

(What is the RVSM airspace ?)

- 答: 高度在 29000 至 41000 呎之間垂直隔離為 1000 呎之空域或航道。

*( RVSM airspace is any airspace or route between FL 290 and FL 410 inclusive where are separated vertically by 1000 ft(300m).)*

6. RNP-10 的必要條件？

(What is the RNP-10 requirements?)

- 答: 所有在 RNP-10 空域飛行之飛機，在 95% 之航程內，其左右、前後航跡誤差不得超過 10 哩。

*(All aircraft operating in RNP-10 airspace shall have a 95% cross-track error of less than 10NM, also have a 95% along-track positioning error of less than 10 NM.)*

7. 有 INS / IRU 設備的航機，它飛航 RNP-10 的時數限制？及開始計時的狀況？

(How long is the RNP-10 flight time limit, when the aircraft equipped inertial

navigation systems(INS), inertial reference units(IRU), radio navigation positioning updating ? and in which condition, the time starts ?)

答: 飛航時限可到達 6.2 小時。當 INS/IRS 置於 NAV mode 時開始計時，假如在航道上系統資料有校正更新，則 6.2 小時之 RNP-10 時限應重新調整。

( Up to 6.2 hours of flight time. Time starts when INS/IRS system is placed in the navigation mode, if systems are updated en route, the 6.2 hour RNP-10 time limit must be adjusted after the update to account for the accuracy of the update.)

## 十、維修資源管理(MRM, Maintenance resource management)

### 主管題

1. 什麼是維修資源管理(MRM)？  
維修資源管理是航空公司或航空器維修廠在執行飛機維護工作時,為增加人員間溝通效果、提高工作效率與安全性而採取之計劃措施。
2. 如何評鑑一個公司實行維護資源管理之成效？  
維護資源管理之執行成效可藉由維護誤失之降低、及人員與單位之合作與整體績效的提升來評鑑。
3. 維護資源管理是藉由什麼方式來提高飛機維護之安全性？  
藉由增進飛機維護人員間及與飛航組員間以及部門間的協調合作與資訊交流。
4. 如何評鑑一個維護部門的維護安全性已提高？  
安全性之評鑑標準在於降低職業傷害與地面事故,及提高飛機之可靠性與適航性。
5. 別的同業有很好的維護資源管理制度,我們能不能照章全抄的拿來在自己公司內施行？  
不行！維修資源管理的推行計劃因各公司之組織架構 企業文化不同而有差異。完全套用別的公司之制度,而不對現有的組織權責加以適當修正,勢必徒勞無功。
6. 維修資源管理的訓練內容包括哪些項目？  
包含五個項目：
  - (1) 人因誤失的認知
  - (2) 加強溝通技巧
  - (3) 協調團隊合作
  - (4) 工作分派
  - (5) 績效管理與培養危機意識

7. 對公司之維護資源管理訓練略述，諸如：
- (1) 人因誤失
  - (2) 溝通技巧與團隊合作
  - (3) 事件檢討範例及教案
  - (4) 主管統御與領導
  - (5) 長官與部屬間以及單位間之協調聯繫方式
  - (6) 其他
8. 貴公司現行之維護資源管理目標與政策為何？諸如：
- (1) 維修人員技術高
  - (2) 維護品質好
  - (3) 確保顧客安全滿意之航機適航標準
9. 貴公司現有之維護資源管理檢討機制有哪些？
- (1) 每日工具箱會議
  - (2) 每月可靠性檢討會
  - (3) 品質管理月檢討會
  - (4) 行動方案月檢討會
  - (5) 績效指標月檢討會
  - (6) 每半年管理審查會議
  - (7) 人為疏失防止委員會
  - (8) 每月航、機務會議
  - (9) 每月適航檢查月檢討會
10. 貴單位對維護資源管理有何計劃作為來提高作業績效或工作安全性？  
自由作答

#### 員工題

11. 何謂人因誤失之 Dirty Dozen？
- (1) 溝通不良
  - (2) 過度自信

- (3) 專業知識不足
- (4) 分心
- (5) 團隊合作不佳
- (6) 疲勞
- (7) 資源不足
- (8) 工作壓力
- (9) 缺乏主見
- (10) 心理壓力
- (11) 缺乏警覺
- (12) 自訂工作標準

12. 如何防止溝通不良？

- (1) 使用連絡簿、維護記錄本、工作單等與別組的人員溝通，以消除疑慮。
- (2) 與接班人討論工作該如何完成，或何項工作以完成。
- (3) 千萬不要猜測任何事情，或任意假設狀況。

13. 如何避免過度自信造成的誤失？

- (1) 自我訓練以期發現缺點與問題。
- (2) 任何未執行的工作絕不可以簽銷。

14. 如何避免專業知識不足造成的誤失？

- (1) 確實依規定接受合適種類之訓練。
- (2) 使用新版技令，或最新修訂之技術文件。
- (3) 詢問技術代表或具有該項專職技術之人員。

15. 如何避免分心造成的誤失？

- (1) 永遠需將一件工作做完後，再去做其他事情，或者是將未上妥之接頭鬆開。
- (2) 將未完成之工作劃上標記。
- (3) 儘可能使用保險絲或扭力封膠。
- (4) 在返回工作崗位繼續工作時，最好從中斷處倒退三個步驟，再重覆檢查及執行工作。
- (5) 使用詳細之檢查表來實施檢查。

16. 如何防止團隊合作不佳？
  - (1) 與團隊成員討論工作如何進行、由誰來做、何時開始？
  - (2) 要確定團隊成員都瞭解任務情況，並同意能確實做到。
  
17. 如何避免疲勞造成的誤失？
  - (1) 多注意並檢查身體是否有任何病症。
  - (2) 在身體及精神最耗弱時，應避免安排繁雜工作。
  - (3) 有規律的睡眠及運動。
  - (4) 請別人檢查你所完成的工作。
  
18. 如何防止維護資源不足？
  - (1) 在工作開始之前先確認執行有無問題，並申請緊急需求項目。
  - (2) 檢查缺料狀況，先行申請預期待需求之器材。
  - (3) 事先瞭解器材之來源及管理方式，以供自己儲存或借用。
  - (4) 確立停飛標準程序，並適時辦理停飛。
  
19. 如何避免工作壓力造成的誤失？
  - (1) 不要給自己太大工作壓力。
  - (2) 將自己所憂慮的事情與有關人員溝通。
  - (3) 尋求他人的協助，要求額外支援。
  - (4) 除非工作確已完成，否則拒絕不切實際的要求。
  
20. 如何避免缺乏主見造成的誤失？
  - (1) 即使不是嚴重的缺點，也應登錄在維護記錄本內，並確實簽證飛機實際狀況。
  - (2) 拒絕妥協你的標準。
  
21. 如何避免心理壓力造成的誤失？
  - (1) 要瞭解心理壓力對工作的影響。
  - (2) 立即停止你的工作，並以理性的態度去面對問題。
  - (3) 擬一份合理的改善措施，並確實去執行。
  - (4) 安排休假，或者暫停工作做短時間的休息調適。
  - (5) 與朋友討論此一問題。

- (6) 請同仁協助查看你的工作。
- (7) 適度的運動以疏解緊張情緒。

22. 如何避免缺乏警覺造成的誤失？

- (1) 思考如果事件發生時，可能產生的後果。
- (2) 檢查目前所執行之工作，是否會與其他狀況衝突？
- (3) 請求同仁複查自己已完成的工作，是否會有任何問題產生？

23. 如何防止自訂工作標準？

- (1) 永遠按照技令指示執行工作；如果確有改進措施時，按程序修訂技令、工作程序或標準規範，落實於具體文字敘述以供依循。
- (2) 應瞭解『自訂工作標準』不會將工作做得更好，且通常都有潛在的危險因素。

24. 就你所知，公司最近是否有發生因人因誤失導致的損壞或安全問題？  
自由作答，可測知該公司資訊管道是否暢通。

25. 你知道貴單位主管對維護資源管理有何計劃作為來提高作業績效或工作  
安全性？  
自由作答

## 十一、實作檢定項目 (Practical test guide)

### (一) 剝線及線路接點製作夾線(strip and crimp a terminal on wire)

主要考試內容：考生需能

- (1) 依據手冊之規定，執行剝線及完成接點之製作。
- (2) 執行一段含有 shield 之信號線之剝線。
- (3) 利用 solder sleeve 完成信號線尾端的 shield ground。
- (4) 回答剝線及線路接點製作基本知識。

### (二) 線束安裝(使用綁線及卡夾)(install a wire bundle by using wire lace and clamps)

主要考試內容：考生需能

- (1) 選取不同區域所適用之線，執行線夾安裝。
- (2) 執行一段在非加壓艙且高振動區域線束之整理。
- (3) 將一段 coax cable 裝在已裝妥之線束上。
- (4) 回答線束安裝之基本知識。

### (三)故障排除(含線路量測及電錶使用)(electric circuit/wiring troubleshooting)

主要考試內容：考生需能

- (1) 依據提供之線路圖及量測工具，判斷及說明發生故障之位置。本項考試內容請參照：
  - A. 電子艙電子裝備冷卻系統簡介 (introduction - electrical and electronic equipment cooling system) (如附件一)。
  - B. 電路測試儀表模板位置圖 (如附件二)。
  - C. 線路圖 (forward equipment cooling circuit) (如附件三)。
- (2) 回答有關系統之基本知識。

### (四) 工具認識及選取 (identify correct tools)

主要考試內容：考生需能

- (1) 說明靜電環之使用及測試方法(wrist strap)。
- (2) 依據提供之 manual 找出某型號電器接頭所代表之意義及說明施工時所需正確工具等資料(例如：contact size, remove/insertion tool, crimp

tool 等)。

(五) 電器接頭認識、製作及拆裝標準程序(electric connector standard practice)

主要考試內容：考生需能

- (1) 執行 receptacle contact 之退出及插入。
- (2) 執行 plug 之安裝及檢查。
- (3) 找出 receptacle 某 contact 之位置。
- (4) 回答有關電器接頭基本知識。

(六) 線路手冊參照及應用(wiring manual application)

主要考試內容：考生需能

- (1) 使用 manual 找出 (例如：D40298P) 料號、位置等資料。  
(註：本項考試得依據考生所熟悉之維護機型，選擇合適之廠家手冊，  
例如：波音或空中巴士)。
- (2) 回答相關基本知識。

(七) 線束修護檢查 (a wire/wire bundle repair and inspection)

主要考試內容：考生需能

- (1) 使用防水 splice 完成電線修護。
- (2) 使用一般 splice 完成電線修護。
- (3) 回答執行電線修護之基本知識。

附件一：

## 電子艙電子裝備冷卻系統簡介 ( Introduction - Electrical and Electronic Equipment Cooling System )

### 電子裝備冷卻(EQUIPMENT COOLING)

The electrical/electronic (E/E) equipment cooling system is designed to remove the heat generated by electrical and electronic equipment.

#### (1)系統介面(System Interfaces)

The circuit monitor the equipment cooling system for proper operation and provide warning light to indicate malfunctions or normal operation. Indications will also be provided on the equipment cooling control panel and P5 overhead panel.

#### (2)電子裝備冷卻 - 過熱時 (Equipment cooling – overheat)

##### A. Description

The overheat detection system consists of three smoke detectors and associated relays. These components, working in conjunction with the equipment cooling control panel, provide overheat detection/protection.

##### B. Operation

Under normal conditions, normal or alternate mode is determined via the equipment cooling control panel. Normal mode is established when power is applied. The alternate mode is established when the alternate (ALTN) position is selected on the panel.

##### C. Overheat Indication

The following conditions can cause an overheat indication:

1. Under normal conditions, when smoke is detected by one of the supply smoke detectors, an inhibit relay is energized for prohibiting an overheat indication. If after 20 sec smoke is still detected, an overheat

indication is initiated.

2. When an overheat condition exists, the OVHT light on the equipment cooling panel and EQPT OVHT light on P5 overhead panel will be illuminated.
3. Depressing the OVHT light switch selects the ALTN position. The overboard exhaust valve will go to the SMOKE position.

#### D. Maintenance Practices

The equipment cooling system may be tested by utilizing the test switch. When activated, the OVHT light will go on and the EQPT OVHT light on the P5 overhead panel will be provided.

### **(3)電子裝備冷卻 – 煙霧時 (Equipment cooling – smoke)**

The equipment cooling system contains three smoke detectors (two supply, one exhaust). Activation of any detector will cause the smoke light to illuminate on the P5 equipment cooling panel.

When smoke is detected in the supply system, If the normal mode is selected, the overboard exhaust valve actuator will be commanded to the SMOKE clearance position. It will latch in the SMOKE position if the airplane is in flight.

When the airplane lands the latching circuit for the SMOKE clearance position will be disabled and the overboard exhaust valve actuator will return to its NORM position if the smoke condition no longer exists.

In both systems, if the smoke condition clears, the detectors will reset themselves and the air conditioning packs will go back to normal flow.

### **(4)Forward equipment smoke detection circuit**

#### A. Supply System Smoke

When smoke is detected in the forward equipment cooling supply system, K369 energizes and provides ground level signals which cause the following events:

Activates the SMOKE light on the equipment cooling panel, if the auto test is not in progress, and activates the FWD EQPT SMOKE light on the P5 overhead panel

Relay (K10360) will be latched OFF until the smoke condition does not exist and the auto test relay (K10511) energizes to the test position and then back to normal. Cycling of the auto test relay removes power from the supply smoke shutdown relay (K10360) for three seconds which will allow it to relax to prevent an erroneous overheat indication (relay K10360).

The overboard exhaust valve actuator will be commanded to the SMOKE position (relay K10442) if the alternate cooling/overheat switch (ALTN SW) is in the NORM position. The actuator will be latched to the SMOKE position if the airplane is in the air (relay K148). P5 overhead panel "OVBD EX VAL OPEN" light will be activated (relay K10086).

If the supply smoke shutdown relay (K10360) is energized for more than 20 sec and the ALTN SW is in NORM position the OVHT light inhibit relay (K10507) will relax and the OVHT light on the equipment cooling panel and the "EQPT OVHT" light on the P5 overhead panel will be activated.

## B. Exhaust System Smoke

When smoke is detected in the forward equipment cooling exhaust system, K10509 energizes and provides a ground level signal, which causes basically the same events as smoke detected in the supply system except the supply smoke shutdown relay (K10360) will not energize.

Overboard Exhaust Valve - The overboard exhaust valve actuator, as previously stated will be commanded to the SMOKE position if smoke is

detected in the forward equipment cooling system. The actuator will also be commanded to the SMOKE position for (see relay K415), the airplane is in the air and the ALTN SW is in the NORM position.

When these items are satisfied, the overboard exhaust valve command relay (K10442) energizes, latches and commands the actuator to the SMOKE position. The latch is reset when the airplane is on the ground or by placing the ALTN SW to the ALTN position.

附件二：

**電路測試儀表模板位置圖**

附件三

**線路圖 ( forward equipment cooling circuit )**

## 十二、 附錄 A -中英航空名詞 (Appendix A - Chinese-English Term of Aviation)

Airborne equipment 航機裝備  
Air data computer(ADC) 空氣數據電腦  
Air Traffic Control(ATC) 空中交通管制  
Air speed indicator 空速指示器  
Alternate current(AC) 交流  
Altimeter 高度表  
Altitude(ALT) 高度  
Altitude rate 高度變化率  
Aluminum 鋁  
Ampere(AMP) 安培  
Amplitude modulation(AM) 調幅(振幅調變)  
Antenna(ANT) 天線  
Antenna coupler 天線耦合器  
Artificial horizon 人工地平儀  
Atmospheric pressure 大氣壓力  
Attitude(ATT) 姿態  
Attitude director indicator(ADI) 姿態導向指示器  
Attitude Indicator(AI) 姿態指示器  
Audio frequency amplifier 音頻放大器  
Audio control panel(ACP) 音頻控制板  
Automatic direction finder(ADF) 自動定向儀  
Auto-tuning 自動調諧  
Autopilot(A/P) 自動駕駛  
Autopilot actuator 自動駕駛制動器  
Back-course  
Base 基極(電晶體)  
Bearing 方位(飛機指向 VOR or ADF 電臺)  
Boom microphone 頭帶式麥克風  
Capacitance 電容  
Capacitor 電容器  
Channel spacing 波道間隔

Circuit 線路、電路  
Coaxial cable 同軸電纜  
Cockpit 座艙  
Cockpit voice recorder(CVR) 座艙通話記錄器(黑盒子)  
Coefficient of lift 升力係數  
Collector 集極(電晶體)  
Computed air speed(CAS) 計算空速  
Command bar  
Communication(COMM)通信  
Compass 羅盤  
Conductor 導體  
Current 電流  
Detector 檢波器  
Dielectric 介質  
Digital air data computer(DADC) 數位空氣數據電腦  
Digital flight data recorder(DFDR) 數位飛行數據記錄器(黑盒子)  
Direct current(DC) 直流  
Directional antenna 定向天線  
Directional loop antenna 定向環形天線  
Directional gyro(DG) 方向陀螺儀  
Distance measuring equipment(DME) 距離計算儀  
Dynamic pressure 動壓  
Electrolytic 電解的  
Electrode 電極  
Electromagnetic(em) 電磁的  
Electromagnetic field 電磁場  
Electronic equipment compartment(E/E) 電子(設備)艙  
Electronic flight instrument system(EFIS) 電子式飛行儀表系統  
Electrostatic field 靜電場  
Emitter 射極(電晶體)  
Extremely High Frequency(EHF)  
Farad 法拉  
Flight Data Recorder(FDR) 飛行數據記錄器(黑盒子)  
Flight deck 駕駛艙

Flight director 飛行導向器  
Flight director computer 飛行導向電腦  
Flight interphone  
Flight mode annunciator(FMA) 飛行模式指示器  
Flux valve 磁流瓣  
Frequency band 頻段  
Frequency modulation(FM) 調頻(頻率調變)  
Front-course 前航線  
Full-wave rectifier 全波整流器  
Glide slope(G/S) 下滑斜度  
Glide slope path 下滑斜路  
Glide slope transmitter 下滑斜度發射機  
Ground crew call horn 地勤人員呼叫號筒  
Ground speed (GS) 地速  
Ground station 地面電臺  
Ground test equipment 地面試驗設備  
Gyro 陀螺  
Half-wave rectifier 半波整流器  
Heading(HDG) 航向  
Headphone (頭帶式)耳機  
Hectopascal(hpa)  
Henry 亨利  
High Frequency(HF) 高頻  
Horizontal situation indicator(HSI) 水平位置儀  
Impact pressure 衝擊壓力  
Impedance 阻抗  
Inch of mercury(In-Hg) 水銀柱吋高  
Indicated airspeed(IAS) 指示空速  
Inductance 感抗  
Inertial navigation system(INS) 慣性導航系統  
Inertial reference system(IRS) 慣性參考系統  
Inner marker(IM) 內信標  
Instrument 儀表  
Instrument landing system(ILS) 儀器降落系統

Insulator 絕緣體  
Intermediate frequency amplifier 中頻放大器  
International standard atmosphere(ISA) 國際標準大氣  
Interrogator 詢問器(距離計算儀)  
Interrogation pulse 詢問脈波  
Ionosphere 電離層  
Jack (耳機)插孔  
Kilohertz(KHz) 千赫(芝)  
Lightning arrester 避雷器  
Line of sight 視線  
Localizer(LOC) 定位器  
Long tuning  
Loudspeaker 號筒式喇叭  
Low Frequency(LF) 低頻  
Mach(M) 馬赫  
Mach maximum operating(MMO) 最大操作馬赫  
Megahertz(MHz) 百萬赫芝  
Magnetic compass 磁羅盤  
Magnetic north(MN) 磁北  
Magnetic variation 磁差  
Manual-tuning  
Marker beacon 標誌信標  
Mean sea level(MSL) 平均海平面  
Megohmmeter 兆歐姆表  
Medium Frequency(MF) 中頻  
Microphone(MIC) 話筒(麥克風)  
Microsecond 微秒  
Microwave 微波  
Middle marker(MM) 中信標  
Millibar  
Mixer 混波器  
Modulation 調變, 調諧  
Morse code 摩爾斯電碼  
Multipurpose control display unit(MCDU) 多用途控制顯示器

Muting 弱音  
Navigation display(ND) 航行顯示器  
Nondirectional 無方向性  
Nondirectional antenna 無方向性天線  
Nondirectional beacon(NDB) 無方向性信標  
Nondirectional sense antenna  
Ohm 歐姆  
Ohm's law 歐姆定律  
Omnidirectional range 多向導航臺  
Oscillator(OSC) 振盪器  
Oxygen mask microphone 氧氣面罩麥克風  
Passenger address(PA) 乘客廣播  
Phase 相位(電)  
Pitch 俯仰  
Pitch attitude 俯仰姿態  
Pitot-Static Probe 動靜壓探測管  
Polarized 給與極性  
Pressure altitude 氣壓高度  
Primary flight display(PFD) 主飛行顯示器  
Push to take(PTT)  
Quadrantal error correction(QEC) 象限誤差修正  
Outer marker(OM) 外信標  
Radar 雷達  
Radar altimeter 雷達高度表  
Radial 幅射的(VOR 臺指向飛機)  
Radio Altitude(RA) 雷達高度  
Radio frequency(rf) 射頻  
Radio frequency amplifier 射頻放大器  
Radio magnetic indicator(RMI) 無線電磁向指示器  
Radio Navigation 無線電航行  
Radio Spectrum 無線電波帶  
Radio Wave 無線電波  
Raising runway  
Receiver 接收機(器)

Rectifier circuit 整流電路  
Relay 繼電器  
Remote indicating compass  
Resistance 電阻  
Roll 側滾  
Roll attitude 側滾姿態  
Runway 跑道  
Runway threshold 跑道限界  
Secondary surveillance radar 次級搜索雷達  
Service interphone 勤務電話  
Service interphone jack  
Servo valve 伺服瓣  
Single side band(SSB) 單旁波帶  
Slant range 斜距  
Sky Wave 天波  
Solenoid 電螺管(筒狀線圈)  
Solid state 固態  
Space Wave 空間波  
Squelch 雜音抑制(靜音)  
Squib 炸藥筒  
Static air temperture(SAT)  
Static inverter 靜態換流器  
Static pressure 靜壓  
Station identifier 電臺識別代碼  
Super High Frequency(SHF) 超高頻  
Surface Wave 表面波  
Tantalum 鉭  
Total air temperature(TAT)  
Total pressure 總壓  
Track(TRK) 航跡  
Traffic alert and collision avoidance system(TCAS) 防撞系統  
Transceiver 收發兩用機  
Transfer valve 轉移瓣  
Transformer 變壓器

Transistor 電晶體  
Transmitter 發射機(器)  
Transponder 雷達回答器/異頻響應機  
True airspeed(TAS) 真空速  
True north(TN) 真北  
Under-water Locator Beacon(ULB) 水下定位信標  
Ultra High Frequency(UHF)  
Velocity maximum operating(VMO) 最大操作速度  
Vertical gyro(VG) 垂直陀螺  
Vertical speed(V/S) 升降速率  
Vertical speed indicator(VSI) 升降速率指示表  
Very High Frequency(VHF) 極高頻  
Very High Frequency omnidirectional range(VOR) 極高頻多向導航臺  
VHF navigation 極高頻導航  
VHF NAV control panel 極高頻導航控制板  
Very Low Frequency 極低頻  
Volt 伏特  
Voltage 電壓  
Voltage standing wave ratio 駐波比  
Weather Radar 氣象雷達  
Zener diode 稽納二極體

### 十三、附錄 B - 縮簡字表 ( Appendix B - Abbreviation and Acronym List )

A/C	aircraft
AC	alternating current
ACARS	aircraft communications addressing and reporting system
ACMS	aircraft condition monitoring system
ACP	audio control panel
A/D	analog to digital
ADC	air data computer
ADF	automatic direction finder
ADI	attitude director indicator
AFCS	automatic flight control system
AFDS	autopilot flight director system
AGC	automatic gain control
AID	aircraft installation delay
ALPHA	angle of attack
ALT	altitude or alternate
AM	amplitude modulation
AMP	amplifier
ANN	annunciator
ANT	antenna
AOA	angle of attack
A/P	autopilot
APP	approach
ARINC	aeronautical radio incorporated
ARPT	airport
ARR	arrival
A/S	airspeed
A/T	autothrottle
ATA	air transport association
ATC	air traffic control
ATCRBS	air traffic control radar beacon system
ATE	automatic test equipment

ATIS automatic terminal information service  
ATT attitude or attendant  
AUTO automatic  
AUX auxiliary

BARO barometric  
BAT battery  
B/CRS back course  
BCD binary code decimal  
BFO beat frequency oscillator  
BITE built-in test equipment  
BNR binary numerical reference  
BRT brightness

C centigrade  
CAA civil aviation authority  
CAL calibrate  
CAPT captain  
CAS computed airspeed  
CAT category type of landing  
CB circuit breaker  
CCW counterclockwise  
CDU control display unit  
CDX control differential transformer  
CG center of gravity  
CH channel  
CHR chronograph  
CKT circuit  
CLB climb  
CLR clear  
CMD command  
COAX coaxial  
COMM communication  
CPU central processing unit

CRS course  
CRT cathode ray tube  
CRZ cruise  
CT control transformer  
CTR center  
CW clockwise  
CWS control wheel steering

D/A digital to analog  
DADC digital air data computer  
db decibel  
DC direct current  
DEL delete  
DEP departure  
DES descent  
DEST destination  
DEV deviation  
DFCS digital flight control system  
DFDAU digital flight data acquisition unit  
DFDR digital flight data recorder  
DH decision height  
DMA direct memory access  
DME distance measuring equipment  
DN down  
DTG distance to go

## E EAST

E/E electronic equipment (compartment)  
EEPROM electric erasable programmable read only memory  
EFIS electronic flight instrument system  
EGT exhaust gas temperature  
ELEX electronics  
ELT emergency locator beacon  
EMI electromagnetic interference

ENG engine  
ENT enter  
EPROM erasable programmable read only memory  
EQUIP equipment  
ESDS electrostatic discharge sensitive  
ET elapsed time  
ETA estimated time of arrival  
EXEC execute  
F fahrenheit  
FAA federal aviation administration  
FCC flight control computer  
FD flight director  
FF fuel flow or flip flop  
FL flight level  
FLTflight  
FM frequency modulation  
FMA flight mode annunciator  
FMC flight management computer  
FMS flight management system  
FO flight officer  
FOB fuel on board  
FPA flight path angle  
FPM feet per minute  
FREQ frequency  
F/S fast slow  
FT feet or functional test  
FWD forward  
GA go around  
GEN generator  
GMT greenwich mean time  
GND ground  
GPS globe positioning system  
GPSSU globe positioning system sensor unit  
GPWC ground proximity warning computer

GPWS ground proximity warning system  
G/S glide slope  
GS ground speed  
GW gross weight  
HDG heading  
HDG HOLD heading hold  
HDG SEL heading select  
HEX hexadecimal  
HF high frequency  
HG mercury  
HLD hold  
HR hour  
HYD hydraulic  
Hz hertz  
IAS indicated airspeed  
I/C inter-communication(interphone)  
ICAO international civil aviation organization  
IDENT identification  
IF intermediate frequency  
ILS instrument landing system  
IN inches  
INBD inboard  
IND indicator  
INFLT inflight  
INIT REF initialization reference  
INOP inoperative  
INST installation  
INSTR instrument  
INTinterphone  
INTLK interlock  
INV inverter  
I/O input output  
IRS inertial reference system  
IRU inertial reference unit

ISA international standard atmosphere

K kilo(one thousand)

Kg kilogram

KHz kilohertz

KT(S) knot(s)

L left

LAT latitude

LB pound

LCD liquid crystal display

LED light emitting diode

LH left hand

LNAV lateral navigation

LOC localizer

LON longitude

LRRA low range radio altitude

LRU line replaceable unit

LSB lower side band

LSK line select key

LT light or left

LVDT linear variable differential transformer

LVL CHG level change

M master or meter or month

M minus or mach

MAINT maintenance

MAN manual

MASI mach airspeed indicator

MAX maximum

MB millibar

MCDU multipurpose control display unit

MCP mode control panel

MD&T master dim and test

MHz megahertz

MIC microphone  
MIN minimum  
MISC miscellaneous  
MKR marker  
MLG main landing gear  
MM maintenance manual  
MMO mach maximum operating  
MSG message  
MSU mode select unit  
MUX multiplexer  
mw milliwatts

N north  
N1 low pressure rotor speed  
N2 high pressure rotor speed  
NA not applicable  
NAV navigation  
NC not connected  
NCD no computed data  
NDB navigation data base  
NEG negative  
NM nautical miles  
NORM normal

OAT outside air temperature  
OBS observer  
OC on course  
OOOI out of on in  
OSS over station sensor  
OVHD overhead  
OV HT overheat  
PA passenger address  
PB pushbutton  
PCU power control unit

PES passenger entertainment system  
PLA power lever angle  
PNL panel  
POS position  
POT potentiometer  
PPOS present position  
PPS pulse per second  
PRI primary  
P/RST push to reset  
PRT printer  
P/S pitot static  
PSI pounds per square inch  
PSU passenger service unit  
PTT push to talk  
PWR power  
QAR quick access recorder  
QRH quick reference handbook

R red or right  
RA radio altitude or resolution advisory  
RAM random access memory  
RAT ram air temperature or ram air turbine  
RCP radio communication panel  
RDDMI radio direction distance magnetic indicator  
REC receiver  
REF reference  
REV reverse or revision  
RF radio frequency  
RH right hand  
RMI radio magnetic indicator  
RNAV radio navigation  
ROM read only memory  
RPM revolutions per minute  
RST reset

R/T receiver transmitter

RTE route

RVR runway visual range

RWY runway

S south

SAT static air temperature