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ИНОСТРАННЫЙ ЯЗЫК

ПОСОБИЕ
по английскому языку

Техническое обслуживание и ремонт самолета
Airbus A320

*для студентов II курса
направления 162300 (25.05.01)
очной формы обучения*

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Topic I
AIRBUS A320 AIRCRAFT HISTORY

The Airbus A320 is a short to medium range commercial passenger aircraft manufactured by Airbus.

It was the first airliner with a digital fly-by-wire flight control system, where the pilot controls flight surfaces through the use of electronic signals rather than mechanically with pulleys and hydraulic systems.

After the initial success of the A300, Airbus targeted the market segment that was occupied by the 1960s designed Boeing 727 & 737. Airbus designed an aircraft with a fuel burn of only around 50% of the 727.

The A320 first flew in 1984 and was commercially launched in 1988. Unlike the earlier Airbus A300, it sold strongly from the outset and has been the fastest-selling airliner in the world for several years.

The A320 is perhaps best known as the first airliner to introduce a fly-by-wire flight control system - where control inputs from the pilot are transmitted to the flying surfaces by electronic signals rather than mechanical means. Apart from a small weight saving, the advantage of Airbus' fly-by-wire is that as it is computer controlled, an inbuilt flight envelope protection makes it virtually impossible to exceed certain flight parameters such as G limits and the aircraft's maximum and minimum operating speeds and angle of attack limits.

Also integral to the A320 is the advanced electronic flightdeck, with six fully integrated EFIS color displays and innovative sidestick controllers rather than conventional control columns. The A320 also employs a relatively high percentage of composite materials compared to earlier designs. Two engines are offered, the CFM56 and IAE V2500.

The A320 program was launched in March 1982, first flight occurred on February 22 1987, while certification was awarded on February 26 1988. Launch customer Air France took delivery of its first A320 in March that year.

The initial production version was the A320-100, which was built in only small numbers before being replaced by the definitive A320-200 (certificated in November 1988) with increased max takeoff weight, greater range and winglets. The stretched A321 and shortened A319 and A318 are described separately. All four share a common pilot type rating. Mid 2000 A320 family production was at a monthly rate of 22, to be increased to 30 units a month by the end of 2002.

Vocabulary

1. Shot range – ближнемагистральный
2. To manufacture - изготавливать
3. Fly-by-wire – электрическая система управления полетом
4. Pulley – шкив
5. Protection – защита
6. Advantage – преимущество
7. To operate – работать, функционировать, эксплуатировать
8. Flightdeck – кабина экипажа

Exercise 1. Answer the following questions

1. When did A320 first flow?
2. What are the advantages of A320?
3. What types of engines are offered?

Exercise 2. Give the definitions of the words below

To manufacture, range, to design, fly-by-wire, advantage, to compare, production

Exercise 3. Translate into English the following sentences using the text above

150-местный Airbus A320 оказался самым продаваемым самолетом компании Airbus Industrie за всю ее историю. Это первый в мире самолет, на котором была установлена электродистанционная система управления. Управление плоскостями осуществлялось не напрямую от штурвала, а путем снятия показаний с ручек, установленных по бокам кабины, и затем передачи импульсов гидравлическим приводам.

В отличие от всех остальных разрабатываемых в это время компанией широкофюзеляжных самолетов, это был первый узкофюзеляжный самолет. Для начальных поставок были созданы две модификации: A320-100 и A320-200 с пассажировместимостью 130 и 150 пассажиров соответственно. В дальнейшем вместимость обоих лайнеров стала ровна 150.

Первый полет был осуществлен 22 февраля 1987 года. На основе данной модели были созданы удлиненный A321 и укороченные A318 и A319. Модификация A320neo отличается новыми, более экономичными двигателями, позволяющими увеличить дальность полета более чем на 500 миль, пониженным уровнем шума и выбросов.

Topic II
Aircraft ground handling and maintenance

In aviation, aircraft ground handling defines the servicing of an aircraft while it is on the ground and usually parked at a terminal gate of an airport.

Ground handling addresses the many service requirements of an airliner between the time it arrives at a terminal gate and the time it departs on its next flight. Speed, efficiency, and accuracy are important in ground handling services in order to minimize the turnaround time (the time during which the aircraft must remain parked at the gate).

Most ground services are not directly related to the actual flying of the aircraft, and instead involve other tasks. The major categories of ground handling services are described below.

Cabin service. These services ensure passenger comfort. The cabin cleaning is the main job in the cabin service. They include such tasks as cleaning the passenger cabin and replenishment of on-board consumables or washable items such as soap, pillows, tissues and blankets.

Catering includes the unloading of unused food and drink from the aircraft,

and the loading of fresh food and drink for passengers and crew. Airline meals are typically delivered in Airline service trolleys. Empty or trash-filled trolley from the previous flight are replaced with fresh ones. Meals are prepared mostly on the ground in order to minimize the amount of preparation required in the air.

Ramp service includes services on the ramp or apron, such as: guiding the aircraft into and out of the parking position; lavatory drainage; airstart units (for starting engines); air cargo handling; refueling, which may be done with a refueling tanker truck or refueling pumper; ground power (so that engines need not be running to provide aircraft power on the ground); deicing, etc.

Passenger service includes services inside the airport terminal such as: providing check-in counter services for the passengers departing on the customer airlines; providing gate arrival and departure services.

Field operation service dispatches the aircraft, maintains communication with the rest of the airline operation at the airport and with Air Traffic Control.

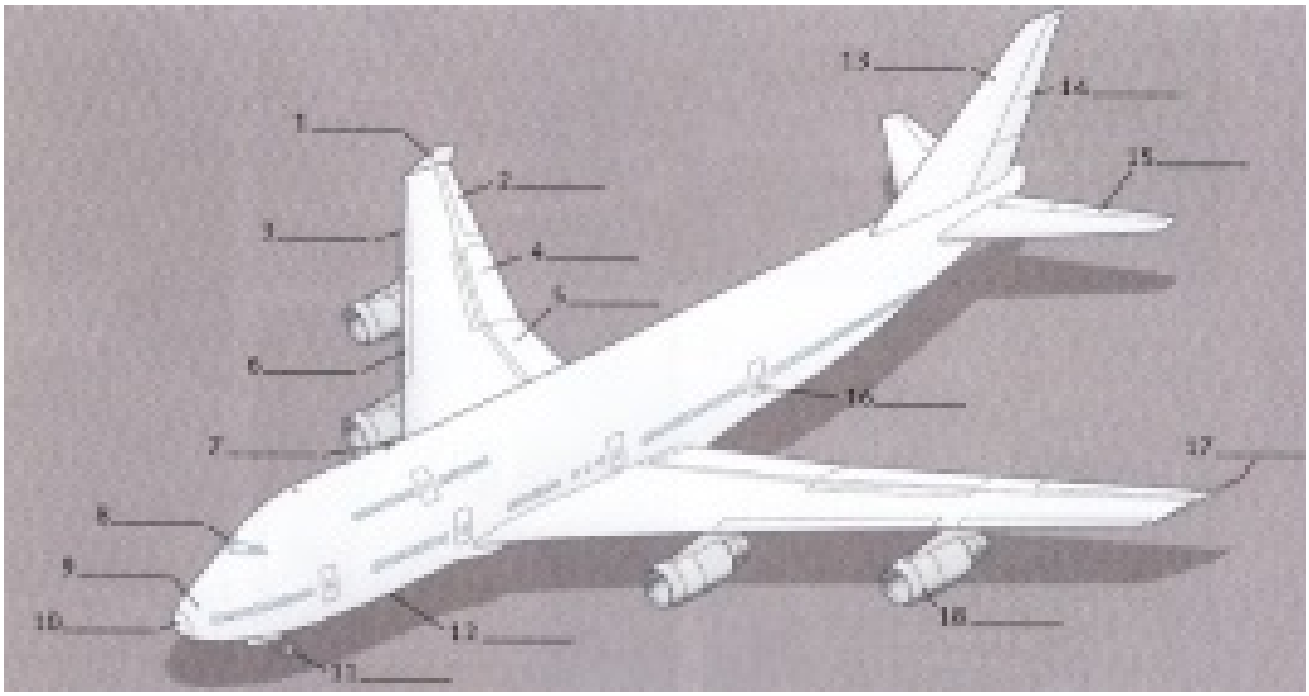
Airplanes are prepared for flight by ground personnel. These are people who maintain aircraft. Every flight of a modern jet liner must be very thoroughly prepared by its ground crew. They are maintenance engineers, technicians, mechanics and other aviation specialists who test, maintain and repair aircraft's major parts and systems. The primary duty of an aircraft maintenance engineer, his technicians and mechanics is to keep their airplane always trimmed and ready for flight.

Vocabulary

1. Requirement – требование
2. Accuracy – точность
3. turnaround – оборот (трансп. средства) с учётом времени на погрузку и выгрузку
4. Ramp – a defined area on a land airport, intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance
5. In order to – для того, чтобы…
6. Apron – площадка с искусственным покрытием
7. Air Traffic Control – управление воздушным движением (УВД)

Exercise 1. Use the words in the box to label the picture below

A nose	**G** slat	**M** tyre
B windscreen	**H** winglet	**N** engine
C aerial	**I** fuselage	**O** emergency exit
D aileron	**J** rudder	**P** radome
E spoiler	**K** elevator	**Q** light
F flap	**L** tail fin	**R** outboard slat



Pic. 1 Main parts of the aircraft

Topic III
Pre-flight inspection

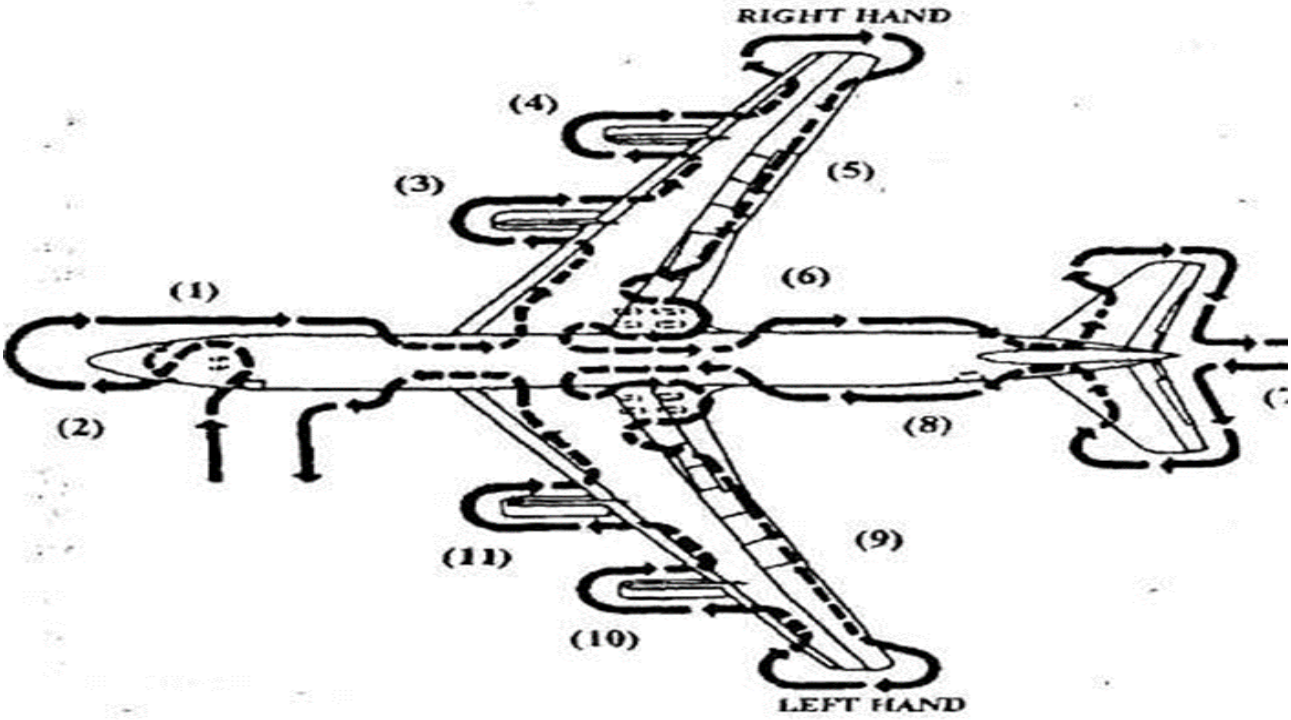
Beginning his pre-flight inspection tour the maintenance engineer makes sure that:

1. Nose gear is secure and all blanks are removed.
2. Start equipment and all ground supplies are properly connected.
3. All engines intakes are clear.
4. All cowlings and all panels are secure.
5. All engines exhausts are clear.
6. Main undercarriage is locked and chocks are in position.
7. Control locks are removed.
8. All doors and panels are secure.
9. All exhaust are clear.
10. All cowlings and all panels are secure.
11. All intakes are clear.

Having completed his tour the maintenance engineer reports to the captain about the results.

Exercise 1. Answer the questions

1. What is the purpose of the pre-flight inspection tour?
2. Who is responsible for the pre-flight inspection?
3. Do any technicians accompany the engineer during the tour?
4. Are the results of the tour discussed at the pre-flight briefing?
5. To whom does the engineer report the results of the tour?



Pic. 2 Pre-flight inspection

Exercise 2. Unscramble the words in brackets to complete the description of a pre-flight check.

Before flying, the pilot carefully (khcecs) _____ the aircraft. He looks at the external (causrfes) _____for signs of damage. A plane may be damaged by a bird (ritske) _____ or (gnilghtin) ____ strike or contact with any other (gorfein) ____objects, or by service (sveichle) ___on the ground. Bent or distorted panels may be a visual indication of hidden (madgae) _____ to the airframe.

He then checks the nose (crundagerirae) ____for excessive (arew) ____ or cuts on the tyres. He inspects the (deliagn)_____edge of the wing for damage and checks the fastenings on the (eeginn) ____ cowling. He examines the visible fan (sladeb) ____ on the engines.

Moving along the (slegeafu)___to the tail he does the same visual checks over all surfaces before ensuring that all cargo (rodos) _____and access (stacheh) _____ are securely fastened.

Topic IV
The cockpit

The cockpit comprises the area above the floor structure between frames 1 and 12. Access to the cockpit is gained via the left forward passenger/crew door and the cockpit door. The cockpit is equipped with adjustable seats for two crew members, a third occupant seat and optional a folding seat for a fourth occupant. Various furnishings and equipment are fitted in the cockpit for the comfort, convenience and safety of the occupants. The cockpit furnishings consist of: crew members seats, heat and sound insulation panels, lining and furnishing panels, equipment racks.

The controls of most aircraft systems are located on the **overhead panel**. The overhead panel is divided into two main sections: a FWD section including the system panels, an AFT section including mainly the circuit breaker panel.

The Flight Control Unit (FCU) includes the EFIS controls, and is used for control and monitoring of the Auto Flight System (AFS). It is located on the **glareshield**. The "Master Warning" and the "Master Caution" lights are also located on the glareshield.

Six identical and interchangeable Cathode Ray Tubes (CRTs) or Liquid Crystal Displays (LCDs) are located on the main instrument panel of the A318, A319, A320 and A321 aircraft. The 2 centrally located DUs are dedicated to the Electronic Centralized Aircraft Monitoring (ECAM). The other 4 displays are the Electronic Flight Instrument System (EFIS) DUs. Standby instruments or the Integrated Standby Instrument System (ISIS) and landing gear control panels are also located on this **main instrument panel**.

The **center pedestal** ergonomic design of the SA family aircraft gives the flight crew efficient access to multiple system controls without compromising safety. The panels are: Switching panel, ECAM control panel (ECP), Multipurpose Control Display Units (MCDU), Radio Management Panels (RMPs), Audio Control Panels (ACPs), Thrust levers and thrust reverser levers, Pitch trim wheel, Engine start panel, Air Traffic Control, Traffic Collision Avoidance System panel (ATC/TCAS), Flap/slat control handle, Speed brake control panel, Parking brake control panel, Cockpit door lock panel, Landing gear gravity extension handle, Printer, Multifunction disk drive unit, Pa handset at the rear of the pedestal.

The Conventional Aircraft control yoke is noticeably missing in the Airbus Single Aisle aircraft. The Side Stick Controller (SSC) replaces the Conventional Aircraft yoke. There is one SSC for each pilot mounted in the **side consoles**. The Aircraft nose wheel is steerable. The flight crew operates the Nose Wheel Steering (NWS) by using the NWS handwheel mounted outboard of the SSC on the same side console. Behind the most forward side console are installed several other compartments along the outboard sides of the cockpit. These side consoles are used as stowage space for documents, oxygen masks, fire extinguisher and microphone and headset connections.

Vocabulary

1. Frame – шпангоут, рама, каркас
2. To equip – оборудовать
3. Adjustable – регулируемый
4. To fit – оборудовать, оснащать, вставлять
5. Via – через (пр.)
6. Overhead panel – верхняя панель (над головой)
7. FWD - forward
8. AFT – after

Exercise 1 Match the words to the picture. Write a-h

1 upper ECAM display
2 lower ECAM display
3 autopilot
4 radio management panel (RMP)
5 primary flight display (PFD)
6 Secondary flight display
7 speed, altitude and attitude display

Pic.3 Instrument panel

Exercise 2. Read a conversation from the flight deck of an Airbus A320. Choose a, b or c to complete the sentences.

PNF – pilot non-flying, C – controller, PF – pilot flying

PNF Brest, M246. Request descent.
C V 246. Cleared, descent FL 150.
PF What the …? The lights have gone. And we've lost the autopilot… and autothrust. I have manual control.
PNF The engines sound OK. The primary flight displays have gone.
PF I can't see the standby horizon, but I can just make out the horizon outside. I've got control of the attitude. Call Centre and tell them what's happening. Declare an emergency and tell them what's happened.
PNF MAYDAY, MAYDAY, MAYDAY. M246. We have a system failure – our lights are not working and our displays are down.
I don't think they're receiving us because the radio's lost its power.
PF OK let's try to get the system going again.
PNF So, if I shine my flashlight on the ECAM… that's better.
PF Try rebooting the system.
PNF The instructions are on the lower screen.
PF I've got control and communications. Follow the instructions step by step.
PNF OK, I can only access the instructions one at a time.
PF First, read the instruction. Then follow it. Check it before you delete it.
PNF OK, so… instruction number one says ….
… Number eight didn't help.
PF What's the next instruction?
PNF So…let's try number nine…Ah! The system's back on line. We've got power.
PF Right. First, try to contact ATC so they know our situation. Ask for a holding pattern. Then we can try to see what went wrong.

1. There is a problem with the:

a) Fuel system
b) Electrical system
c) Pressurization system

2. The pilots solve the problem by:

a) Reading instructions on the ECAM screen
b) Reading instructions in the manual
c) Getting help from maintenance on the ground

3. The pilots decide to:

a) continue their original flight plan
b) land immediately
c) enter a holding pattern

Topic V
Flight Controls. General description

The primary flight control surfaces perform the **Roll, Pitch** and **Yaw control**.

Roll Control is achieved by an aileron and four roll spoilers on each wing. They are electrically controlled and hydraulically powered.

Pitch Control is achieved by two elevators hinged on the *trimmable horizontal stabilizer* (THS). They are electrically controlled and hydraulically powered. The THS is hydraulically operated and controlled electrically or manually by a cable run from the pitch trim wheel on the pedestal to the hydraulic control valve on the THS actuator.

Yaw Control is provided by a single surface rudder. It is electrically or mechanically controlled and hydraulically powered.

LAF (Load alleviation Function). Wing gust load alleviation is achieved by deflection of the ailerons and spoilers 4 & 5 and is computed by the EFCS (Electrical Flight Controls System) computers. This function is installed on the first A320 versions only.

Speed brake control is achieved by the spoilers 2 to 4 on each wing. They are electrically controlled and hydraulic-ally powered.

The *secondary flight controls* consist of flaps, slats and the ground spoiler system.

Ground Spoilers Lift dumping is achieved by all 5 spoilers on each wing. They are used to reduce the lift on the wing in the landing phase or during aborted take-off.

The flaps provide lift augmentation during take-off and landing. The flaps are divided in two sections on each wing and are electrically controlled and hydraulically operated.

The slats system also provides lift augmentation during take-off and landing. The slats system consist of five sections on each wing leading edge. The control and operation is similar to the flaps.

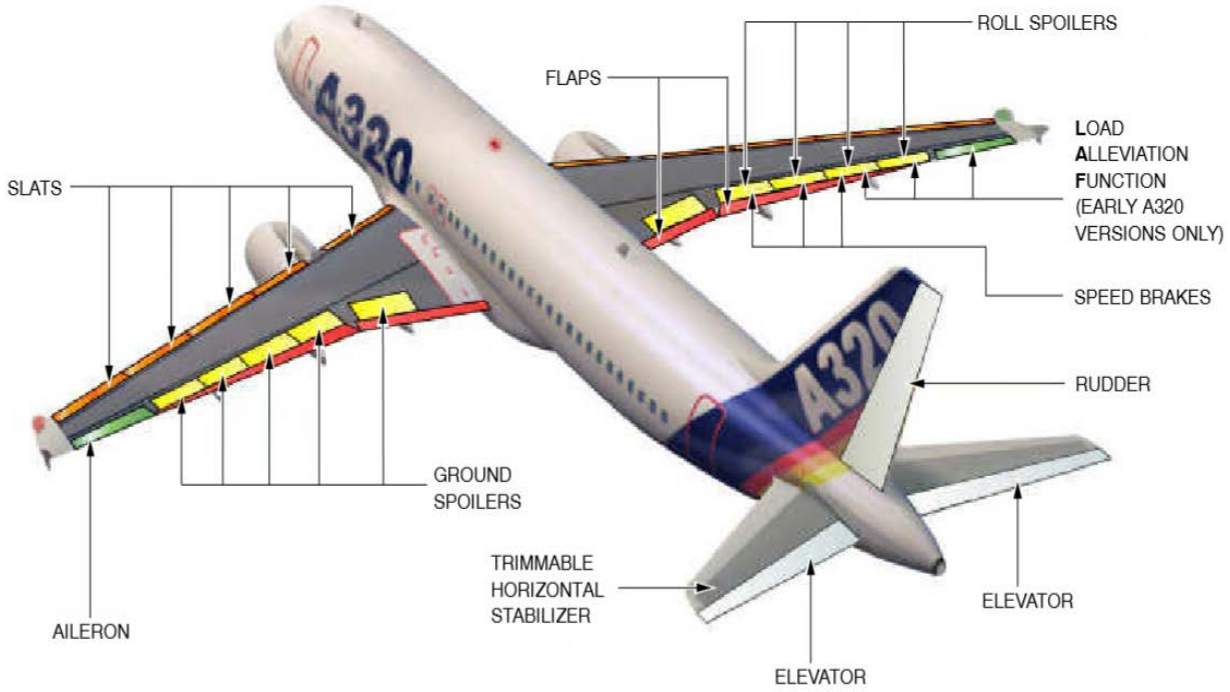
The main advantages of this philosophy are an improvement in redundancy, in

handling qualities and thus in performances.

Vocabulary

1. Roll – крен
2. Pitch – тангаж
3. Yaw – рысканье самолета
4. To trim – балансировать, регулировать

Exercise 1. Look at the picture and describe the purpose of each element



Pic.4 Control Surfaces

Exercise 2. Translate into English.

1. Крыло – основная часть самолета, создающая при движении его в воздухе подъемную силу и обеспечивающая поперечную устойчивость ЛА.
2. Основным способом улучшения взлётно-посадочных характеристик самолета является оснащение крыла специальной механизацией.
3. Управление и балансировка по каналу тангажа осуществляется с помощью руля высоты и стабилизатора.
4. Руль направления обеспечивает управление самолетом по курсу и путевую балансировки самолета.
5. Эксплуатация системы управления самолетом для летного состава заключается в осмотре, предполетной проверке работоспособности, эксплуатации в полете, приведении в исходное положение систем после полета, а также в действиях в случае отказов.

Topic VI
Fly – by – wire

For the earliest aircraft, flight control system were solely mechanical (using rods, cables, pulleys). The pilot in the cockpit made use of a control stick and pedals to carry out the three basic aerodynamic movements – roll, pitch and yaw. As aircraft got bigger, system became hydraulic (using pumps, pipes, valves and actuators), so that pilots could move the important control surfaces without having to rely on their own strength. The development of these hydraulic systems was also an important way for the engineers to keep the weight of the aircraft down. As aircraft continued to grow in size and with the development of large passenger jets, this requirement to keep weight dawn led to the development of fly-by-wire systems. Fly-by-wire means that the aircraft is controlled by an electrical system. Nowadays fly-by-wire systems are digital and large aircraft are controlled by a computerized command system. The world's first digital fly-by-wire aircraft was the Airbus A320, which made its maiden flight in 1987.

Exercise 1. Translate into English

1. Одной из наиболее важных систем самолета является система управления рулевыми поверхностями.
2. Основной задачей системы управления является выполнение команд, поступающих от пилота для изменения или сохранения каких-либо параметров полета.
3. Благодаря применению электронных систем управления полетом совместно с бортовыми компьютерами у авиаконструкторов появилась возможность уменьшить массу конструкции самолета, повысить надежность системы управления ВС и предотвратить возможность опасных аэродинамических явлений.
4. Система электродистанционного управления (ЭДУ) рулевыми поверхностями – система, в которой управление полетом осуществляется с помощью электрических сигналов без механической проводки от органов управления в кабине экипажа до управляющих поверхностей самолета.
5. Для управления ВС типа Airbus, используются боковые ручки управления.

Topic VII
The hydraulic system

The aircraft is equipped with three continuously operating hydraulic systems, BLUE, GREEN and YELLOW. Each system is supplied from its own hydraulic reservoir. Normal system operating pressure is 3000 PSI .There is no possibility to transfer hydraulic fluid from one system to another.

The green system (System 1) is pressurized by an engine driven pump installed at engine 1. The blue system (System 2) is pressurized by an electric pump. A Ram Air Turbine (RAT) driven pump is provided for emergency use. The yellow system (System 3) is pressurized by a pump driven by engine 2. An electric pump allows the

yellow system to be pressurized. This enables ground operations when the engines are stopped. A handpump can be used to supply the yellow system in order to operate the cargo doors when no electrical power is available.

Each system is supplied by its own hydraulic reservoir. The reservoirs are pressurized using HPC-air of engine no 1 or bleed air from the pneumatic system (Engine or APU) or from a ground connection.

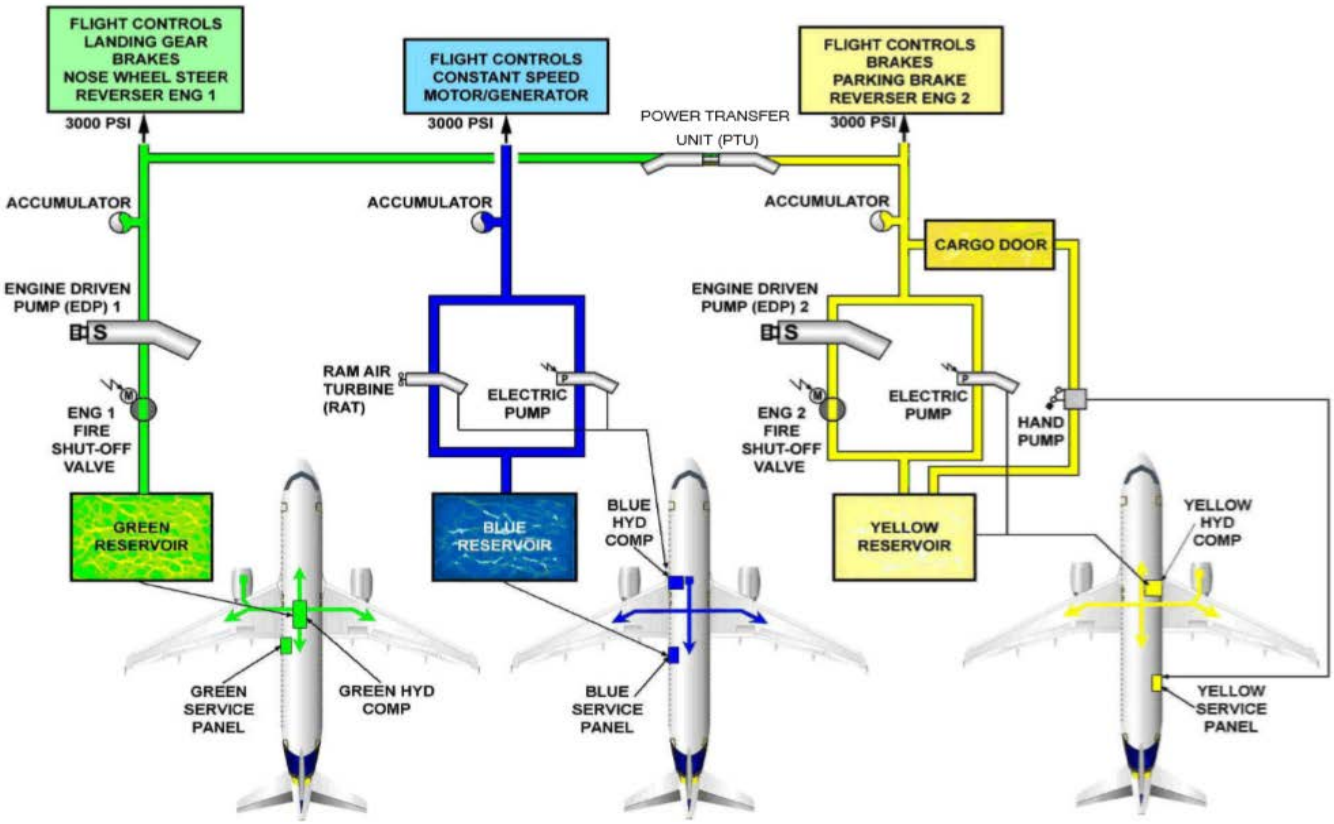
On the green and yellow systems, a fire valve is positioned upstream of the engine driven pump to isolate the system.

A bidirectional PTU (Power Transfer Unit) enables the green system to be powered by the yellow system or vice versa, without fluid transfer. In flight, with only one engine running, the PTU is automatically activated when the differential pressure between the green and yellow system is higher than 500psi (34bar). On ground, when the engines are shut down, the PTU allows the green system to be pressurized using the yellow electric pump.

Vocabulary

1. Ram Air Turbine – воздушная турбина набегающего потока
2. To shut down – выключать

Exercise 1. Look at the picture below and try to explain the operating principle of the system.



Pic. 5 Hydraulic System General Layout

Exercise 2. Translate into English

1. Каждая из трех независимых систем гидравлического воздействия в системе управления призвана не только обеспечивать ту или иную

функциональную систему самолета, но и является резервной системой гидропитания других систем в случае отказа в работе.

2. Гидросистема самолета работает достаточно надёжно. Неисправность гидросистемы и отказы агрегатов составляют 3,1 % общего числа отказов.

3. Три ТО гидросистемы предусмотрено выполнение следующих основных работ: проверка чистоты масла и работы насосных станций, проверка герметичности системы наддува гидробака и внутренней герметичности ссистемы, осмотр трубопроводов, агрегатов и их соединения в крыле, фюзеляже, хвостовом оперении и пр.

Topic VIII
The engine and nacelle

The engine is a dual-rotor, variable stator, high bypass ratio turbo fan power plant for subsonic services. The principal modules of the engine are: low pressure compressor (fan stator and fan rotor); high pressure compressor; turbine frame; combustion chamber; high pressure turbine; low pressure turbine; accessory drives (gear box).

The 9 stage high pressure compressor is driven by 1 stage high pressure turbine, and the integrated front fan and booster is driven by 4 stage low pressure turbine. An annular combustor converts fuel and compressor discharge air into energy to provide engine thrust part through primary exhaust and to drive the turbines. The accessory drive system extracts energy from the high pressure rotor to drive the engine accessories and the engine mounted aircraft accessories. Reverse thrust for braking the aircraft after landing is supplied by an integrated system which acts on the fan discharge airflow.

The cowls enclose the periphery of the engine so as to form the engine nacelle. Each engine is housed in a nacelle suspended from a pylon attached to the wing lower surface. The nacelle consists of the demountable powerplant, the fan cowls and the thrust reverser cowls. The nacelle installation is designed to provide cooling and ventilation air for engine accessories mounted along the fan and core casing. The nacelle provides: protection for the engine and the accessories; airflow around the engine during its operation; lighting protection.

Vocabulary

1. Nacelle – гондола
2. Gear box – коробка передач
3. Cowl – капот, кожух

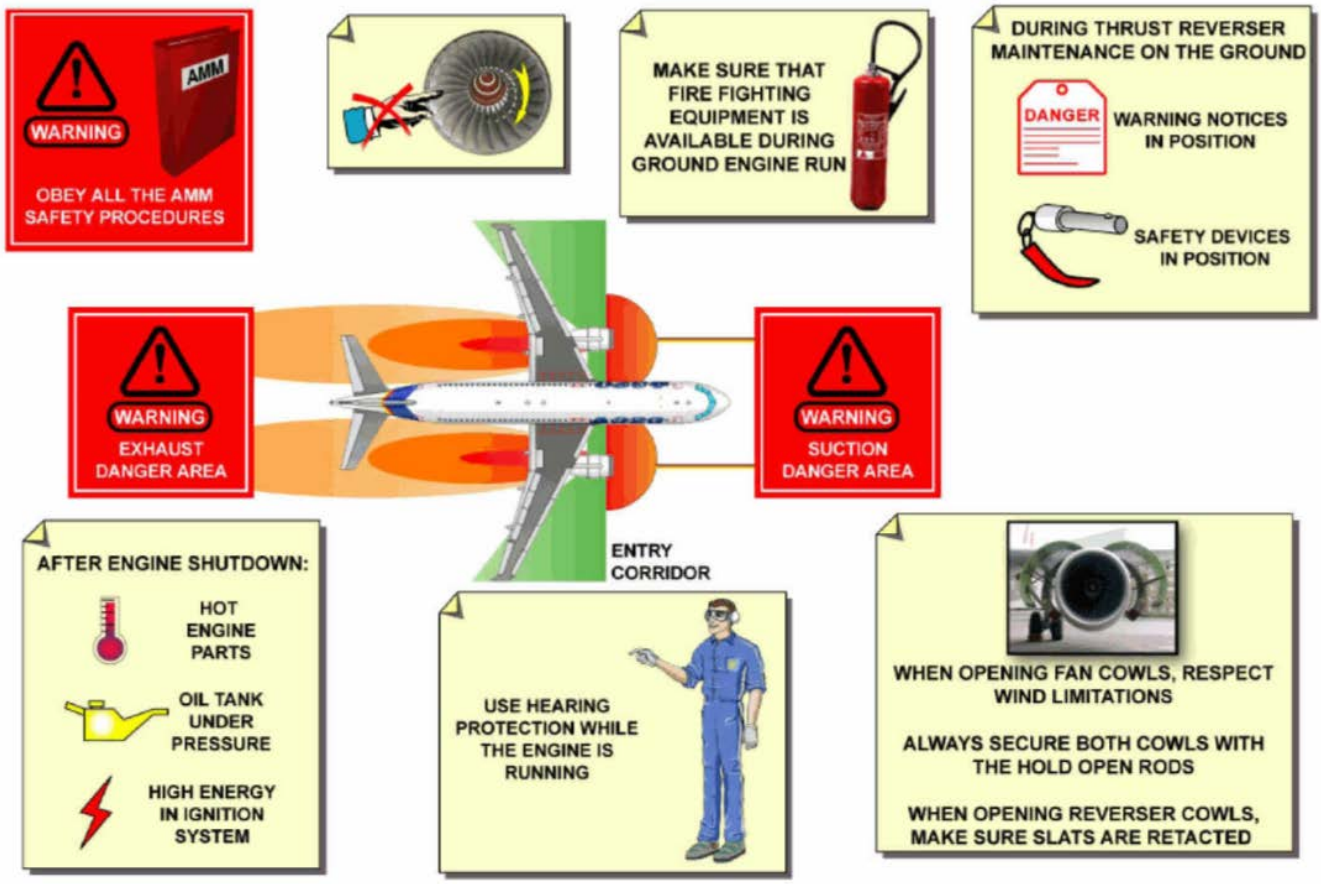
Exercise 1. Translate into English

1. В зависимости от конструктивной схемы и характера рабочего процесса двигатели классифицируются на поршневые и газотурбинные. В свою очередь газотурбинные двигатели подразделяются на: турбореактивные, турбовинтовые, двухконтурные турбореактивные, турбовентиляторные.

2. Принцип работы газотурбинного двигателя следующий: компрессор, приводимый в действие турбиной, сжимает и подает воздух в камеру сгорания, где он смешивается с топливом и превращается в нагретый газ с запасом энергии.

Exercise 2. Look at the picture and try to explain the safety procedures when you work on aircraft.

You may start: *Here is an overview of main safety precautions related to the engines. Make sure that…*



Pic. 6 Safety Precautions

Topic IX
The Auxiliary Power Unit

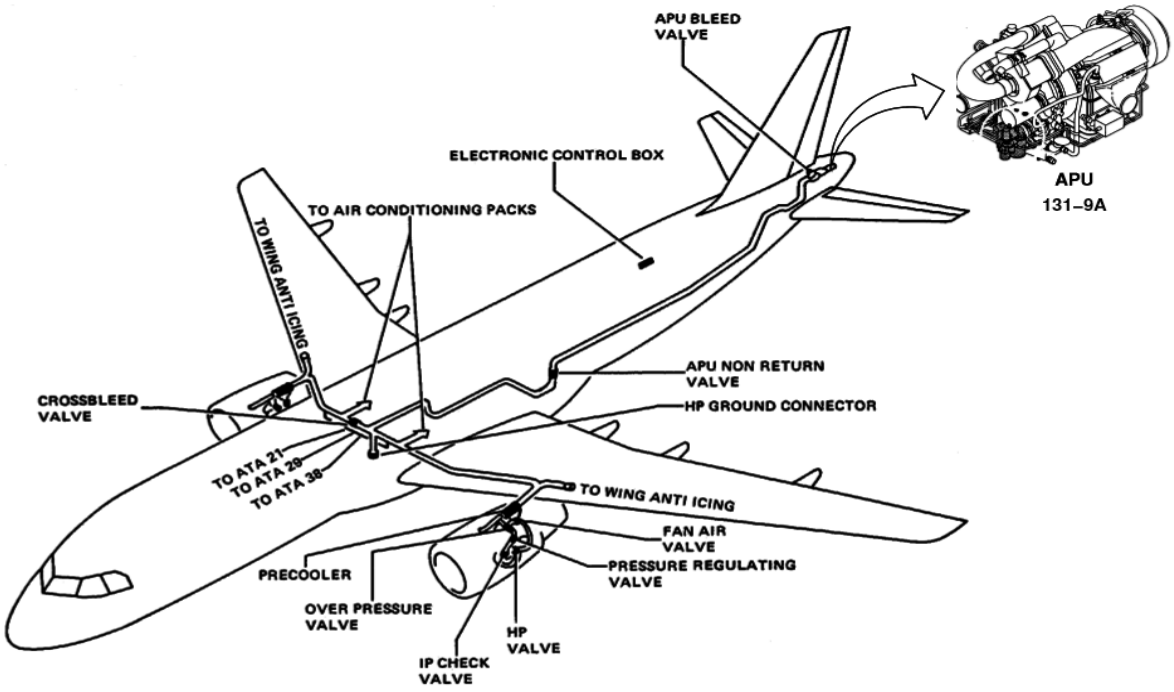
The APU is a small turbine engine especially designed to provide electrical power and air when the main engines are not running. It incorporates a sophisticated control system which, when it receives a start signal from the cockpit starts itself, maintains a constant speed under varying loads and monitors its own operation continually, ready to stop if a malfunction occurs. Under normal conditions the APU is considered as nonessential equipment. However, there are certain conditions when the APU is considered essential equipment on the Minimum Equipment List (MEL) as defined by the aircraft specifications.

The purpose is to provide compressed air and electrical power to the aircraft on the ground and during flight:

− Electrical power supply to aircraft systems;

− Compressed air supply to aircraft systems (Environmental Control System (ECS), Main Engine Start (MES), Wing Anti—icing).

The APU is suspended in the tail cone by seven tie rods connected through vibration isolators to 3 mounts. Air enters through an opening covered by an air intake flap at the bottom of the fuselage skin. The flap is opened by an electric actuator. Both the intake and exhaust systems are acoustically treated to reduce the noise. The APU compartment is fire proofed. It has its own extinguisher located just forward of the fire wall. Access to the APU is through two large doors beneath it.



Pic. 7 The APU location

Vocabulary

1. To incorporate – включать в себя
2. Sophisticated – сложный, запутанный
3. Purpose – цель, назначение

Exercise 1. Translate into English

1. Силовая установка предназначена для создания тяги и включает в себя двигатели, воздушные винты, гондолы двигателей, топливную и масляную системы, системы управления двигателями и винтами и др.

2. Запуск двигателя осуществляется сжатым воздухом. Система запуска состоит из двух частей: воздушной и электрической. Электрическая часть системы запуска предназначена для обеспечения воспламенения смеси в цилиндрах двигателя.

3. Топливная система самолета предназначена для размещения топлива и питания двигателя топливом на всех режимах его работы.

4. Масляная система самолёта предназначена для подачи смазки к трущимся деталям двигателя и их охлаждения.

5. Охлаждение двигателя осуществляется потоком воздуха, создаваемым воздушным винтом.

Topic X
Fuel-System description

Fuel system keeps the fuel in the main fuel tanks and the center tank, which are open to atmosphere through the vent surge tanks. It controls and supplies the fuel in the correct quantities to the fuel tanks during refuel operations. The fuel system supplies the fuel to the engines and to the APU to decrease the temperature of the Integrated Drive Generators. Also it gives indications in the cockpit of the usual system operation, of the failures that could cause an unusual condition. The fuel system is controlled by one FQIC (Fuel Quantity Indicating Computer) and two FLSCU (Fuel Level Sensing Control Units).

The system is designed to operate within: altitude range 0 to 39000 ft, ambient temperature range of - 40 to + 50C at zero altitude and - 70 to – 30C at 39000ft, fuel temperature range of −54 to +50C, the upper temperature limit subject to fall off with increasing altitude to + 40C at 36000 ft.

Fuel Pump System. Each main tank has two centrifugal booster pumps capable of supplying the engines with fuel at the required pressure and flow rate. The wing tank pumps are located in a collector box formed by root Rib 1 and Rib 2. Each pump has an intake pipe fitted with a strainer. A bypass pipe with suction valve enables the engine to get fuel by suction if the pumps do not work.

Scavenge System. The scavenge jet pumps are installed in the wing tank and in the center tank. The wing tank pumps moves fuel which has entered the wing surge tank back in the outer cell of the wing. The center tank jet pumps move the fuel to the related center tank main pump inlets.

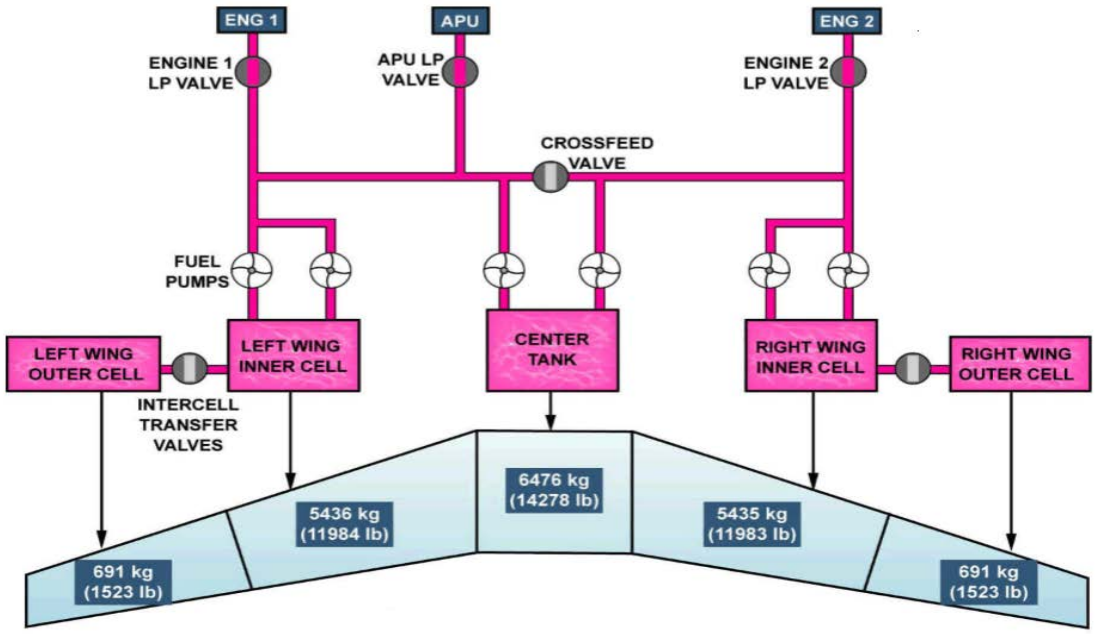
Crossfeed System. A crossfeed line routed through the fuselage center section provides interconnection of the L and R engine feed systems; and consists of the crossfeed valve, which is normally closed, together with its electrical control circuit and indication. The valve is installed in the engine fuel feed pipeline in the center section connecting the LH and RH engine fuel feed lines. An electrical actuator with twin motors operates the valve.

In case of engine/APU fire the fuel supply to the engines (or APU) is shut off by the LP valves which are electrically actuated by operation of the related ENG FIRE (or APU FIRE) push−button. The valves are normally in the open position, when the engines/APU are running. At every engine/APU off, the valves are closed.

APU Feed System. The APU takes its fuel from a connection in the main engine feed system which supplies the APU at the required pressure. The APU feed line incorporates a supplementary fuel pump powered by the aircraft batteries, and an LP fuel shut−off valve. The APU usually takes its supply from the left hand engine feed line. When the cross feed valve is open, the right−hand engine feed line can also supply the APU fuel supply line. The operation of the pump is fully automatically.

Vocabulary

1. Booster - усилитель
2. Suction valve – клапан всасывания
3. To scavenge - откачивать



Pic.8 Tank Location A318−320

Exercise 1. Translate into English.

1. Топливная система предназначена для питания двигателя топливом в количестве, необходимом для нормальной его работы в процессе запуска, разгона и эксплуатационных режимах при любых условиях окружающей среды.

2. Топливная система самолета обеспечивает: заправку самолета топливом и хранение запасов топлива на самолёте в его баках; подачу топлива к двигателям и к ВСУ; аварийный слив топлива; дренаж топливных баков и включает баки, трубопроводы, насосы, краны, клапаны, приборы измерения и контроля.

3. При техническом обслуживании топливной системы самолета необходимо особо соблюдать указания по технике безопасности. Работы по замене агрегатов, трубопроводом и другие работы, связанные с возможностью открытой течи топлива, необходимо выполнять при обесточенной электросети самолета. Не допускается попадание топлива в электропроводку и агрегаты электрооборудования самолета.

4. Надежная и экономически эффективная эксплуатация современного ГТД зависит как от качества проектирования и изготовления его механической части, так и от качества и характеристик используемого в двигателе электронного оборудования, а точнее, его всережимной цифровой системы управления двигателем (FADEC).

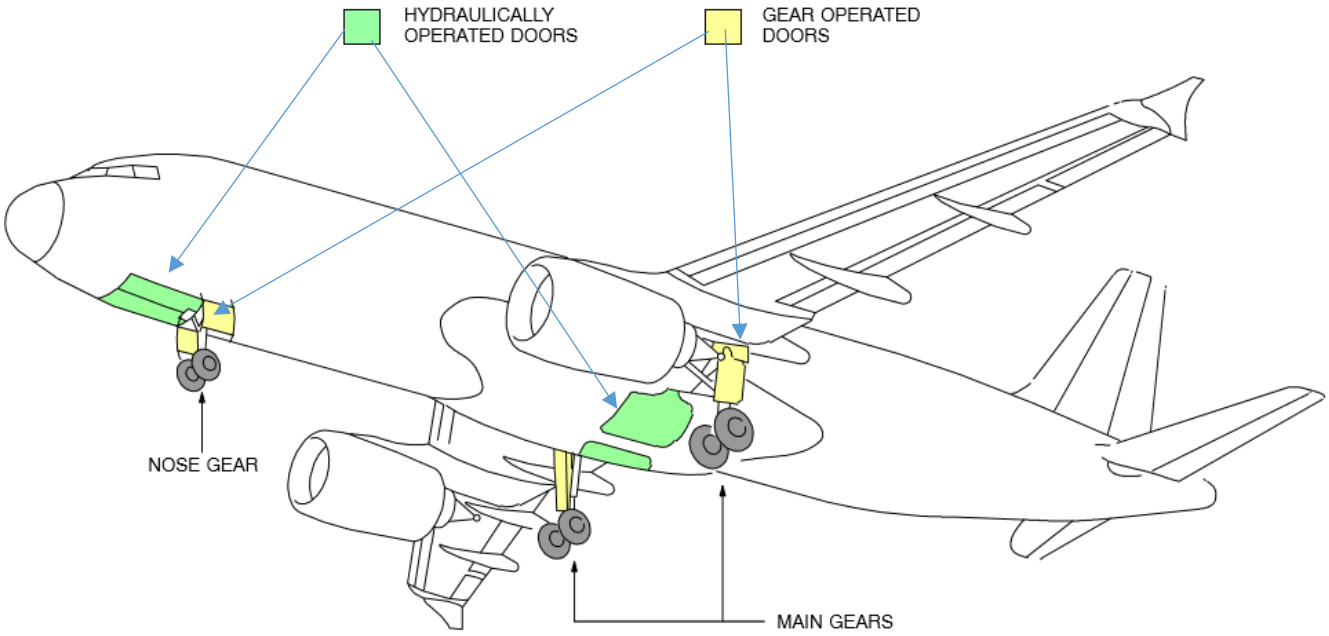
Topic XI
LANDING GEAR

The Landing Gear (L/G) System consists of:

- two Main Landing Gears (MLG) and their related Main Landing Gear Doors;
- a Nose Landing Gear (NLG) and its related Nose Landing Gear Doors;
- two Extension and Retraction Systems for the Landing Gears and their related doors;
- Landing Gear Wheels and their related Braking Systems;
- a Nose Landing Gear Steering System;
- a Landing Gear Indication and Warning System.

The Landing Gear supports the aircraft on the ground. The Main Landing Gears are oleo–pneumatic shock absorbers which absorb taxi and landing loads.

During flight, the Landing Gears retract into the landing gear bays of the aircraft belly. When the L/G is extended or retracted, the related doors close to fit with the aerodynamic contour of the aircraft.



Pic. 9 Landing Gears and Doors

The purpose of the MLGs is to support the aircraft on the ground and absorb loads during taxiing, take off and landing by means of a Shock Absorber and a Torque-Link Damper. And it includes the following parts: a MLG Shock Absorber, a Side Stay Assembly which includes a Lock Stay, a Retraction Actuator, a Torque-Link Damper, Electrical and Hydraulic Dressings. The Shock Absorber is a telescopic oleo–pneumatic unit, which includes the sliding tube. It is in the main fitting to transmit the landing, take–off and taxiing loads to the wing.

The Nose Gear is attached on the aircraft structure between FR19 and FR20. It includes a: Leg Assembly with a Shock Absorber, Wheel Steering Assembly, Drag Strut Assembly and a Lock-Stay which locks the gear in the down position, Gear Actuating Cylinder. The nose gear is of the direct acting type with an integral shock

absorber. It retracts forward into the fuselage and is assisted by the aerodynamic forces in the downlocking direction during gear extension.

SAFETY PRECAUTIONS. BEFORE PERFORMING ANY WORK IN THE AREA OF THE LANDING GEARS, BE SURE THAT ALL THE FOLLOWING SAFETY PRECAUTIONS ARE OBSERVED: Wheel Chocks are in position, the hydraulic system is de-pressurized, Safety Sleeves and Safety Pins are fitted on the Landing Gear and Landing Gear Doors, Ground Door Opening Handles are in open position.

Exercise 1. Translate into English

1. Уборка всех опор и закрытие их створками осуществляется гидроцилиндрами.
2. Отсек шасси закрывается большой створкой и щитком. Створка управляется двумя гидроцилиндрами. В открытом положении она удерживается давлением жидкости в гидроцилиндрах, в закрытом – двумя замками: передним и задним.
3. Снятие колес передней и главных ног шасси производится при установке их на домкраты или при установке самолета на подъемники.

Topic XII
D-Check Maintenance and Overhaul

Before each and every flight the landing gear oleos, tires and brakes are inspected by mechanics and flight crew. Generally, the so-called D-check full overhaul will become due before expiry of this period. Depending upon the airplane type, the D-check is due every six to eight years, at which time it is completely disassembled, checked, repaired as necessary and reassembled. This likewise holds good for the landing gear. During the course of this operation the landing gear is examined to locate the smallest signs of damage such as tiny fractures or any indication of corrosion. The aircraft is first jacked up for the removal of tires and brakes; the landing gear legs, which weigh many tons, are then removed to a specialist workshop. Next, the landing gear legs are thoroughly cleaned and completely disassembled into their numerous components, which are then individually cleaned.

Any paint is then removed from components using an appropriate mechanical or chemical process. As in all its maintenance and repair operations, any aircraft company places great emphasis on environmental protection. The company also has large airframe paint shops in which old paint is removed using a variety of environmentally-friendly processes. In particular, any spent process water is trapped and reprocessed for further use.

Topic XIII
Faults and Repairs

Next on the list is a search for any damage and corrosion using a variety of non-destructive test processes, plus careful optical checks of all components. In addition to checks for corrosion and fractures, specialists check the dimensions and chromed surfaces of all components. However small it may be, each and every component is

subjected to the careful eye of an experienced technician and licensed inspector before it is released for repeat service.

When an inspection locates corrosion, the affected area is abraded just enough to remove all the damaged zone, but as little as possible of the underlying material. Only a certain defined allowable maximum of material may be removed; if more is necessary, then the component must be removed and replaced by a serviceable component. Moving components are linked by bushes made of a special bronze alloy, with main bolts holding moving parts together. Bushes are machined to the required dimensions and fitted; work is undertaken to the highest standards of mechanical precision and exactly within close tolerances.

The company has a chrome-plating shop for landing gear leg exposed parts, moving interfaces and bearings; the same workshop uses appropriate anti-corrosion processes to protect other components at risk. For example, in operation a wheel axle temperature can exceed 250ºC and is therefore coated with a special heat-resistant layer. The components are then subjected to a multi-lacquer process that protects them from the aggressive media to which they are exposed in everyday use.

After cleaning and repair, the roughly 10,000 components making up a single landing gear are again assembled into a complete working system. However, before it is again installed on the aircraft it is given a full functional test on a rig. For the technicians, the really exciting moment is when, following installation on the aircraft, the landing gear is given a full check. The big jet is positioned in a dock, with all its weight resting on hydraulic jacks and the landing gear mechanism retracted within a compact bay. Then the landing gear doors open, followed an instant later by the unfolding landing gear mechanism.

It takes the company, i.e. Lufthansa Technik about five to six weeks to conduct a full landing gear overhaul for a widebody jet, faster than any other international maintenance and repair organization. Not too long ago, a job of this type could take up to 120 days, but this has since been drastically reduced by a continual process of optimizing work sequences, the processes employed and modern computer-based planning.

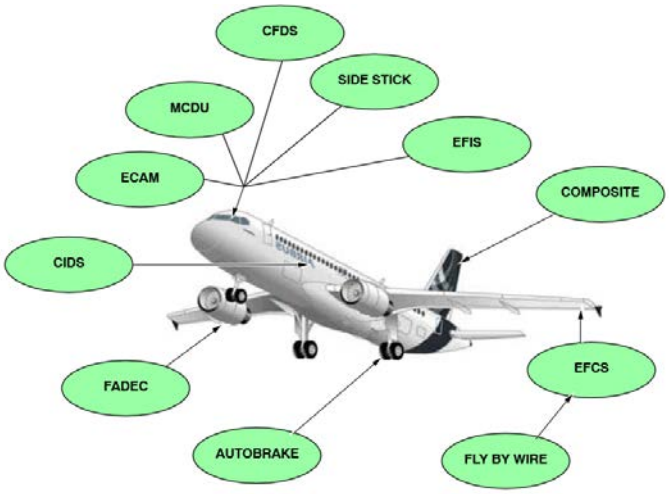
Exercise 1. Complete each sentence with a word from the box

aircrew	accessories	repairing	aisle	widebody	thrust	overhaul	turbofan

1. The pilot and the people who are responsible for flying plane are called as_____.
2. _____ is a long passage between rows of seats in a plane.
3. _____ is the force of an engine that makes a plane move forward.
4. The airplane needs _____ in a few places.
5. My job is to maintain, _____ and repair big _____ airplanes.
6. The aircraft is powered by two _____ engines.
7. The gas turbine provides the power to drive the compressor and _____.

Appendix 1 /A320 FAMILY HIGHLIGHTS

ECAM Aircraft system monitoring is now achieved by a Electronic Centralized Aircraft Monitoring system where system page is automatically displayed in case of failure.



EFIS The cockpit is equipped with Electronic Flight Instrument System, consisting of six CRT indicators.

CFDS A Centralized Fault Display System uses the Multifunction Control and Display Units (MCDU) as access keyboard to perform check and trouble shooting of various computers in most of the systems in the aircraft.

MCDU Two Multipurpose Control & Display Units are used as interface for the Flight Management System ATA 22, access to the CFDS, AIDS (Aircraft Integrated Data System) & ACARS (Aircraft Communication Addressing & Reporting System).

COMPOSITE Composite materials of different kind are used in a great extend, specially for flight control surfaces.

These materials are:
CFRP: Carbon Fiber Reinforced Plastic
GFRP: Glass Fiber Reinforced Plastic
AFRP: Aramid Fiber Reinforced Plastic
QFRP: Quartz Fiber Reinforced Plastic

FLY BY WIRE The conventional cables for the flight control surfaces are replaced by electrical wires, only the Stabilizer and the Rudder have a backup by cable runs.

SIDESTICK The conventional control column is replaced by two sidesticks for control of the aircraft. They send electrical signal to the flight control computers.

EFCS The aircraft is equipped with a Electrical Flight Control System controlled by computers.

FADEC Each of the Engines is controlled by a Full Authority Digital Engine Control providing power management, indications and engine limitation among other duties. Pilot control is achieved by means of electrical power levers on the pedestal.

CIDS The Cabin Intercommunication Data System (CIDS) is a microprocessor based system. It operates, controls and monitors the main cabin systems and can do different system and unit tests.

AUTOBRAKE The Landing Gear is equipped with Auto brake system and Carbon brakes. The system includes electronic control of Nose gear steering and brakes.

Appendix 2 Airbus-Abbreviations

A	**Ampere**	**AIDS**	Aircraft Integrated Data System
A/BRK	Auto Brake	**ALT**	Altitude, Altimeter
A/C	Aircraft	**AMU**	Audio Management Unit
A/D	Analog/Digital	**AOA**	Angle of Attack
A/S	Airspeed	**AOG**	Aircraft on Ground
A/THR	Auto thrust	**AP**	Autopilot
ABBR	Abbreviation	**APPR**	Approach
ABS	Auto Brake System	**APU**	Auxiliary Power Unit
ABS VAL	Absolute Value	**ARM**	Aircraft Recovery Manual
ABSORB	Absorber	**ARPT**	Airport
ABV	Above	**ASAP**	As soon as possible
AC	Alternating Current	**ASI**	Airspeed Indicator
ACARS	Aircraft Communication Addressing and Reporting System	**ASM**	Aircraft Schematic Manual
ACC	Active Clearance Control	**ATA**	Aircraft Transport Association
ACCEL	Acceleration	**ATC**	Air Traffic Control
ACCU	Accumulator	**ATE**	Automatic Test Equipment
ACM	Air Cycle Machine	**ATS**	Auto thrust System
ACP	Area Call Panel	**ATT**	Attitude
ACP	Audio Control Panel	**ATTN**	Attendant
ACT	Actuator	**AVAIL**	Available
ADC	Air Data Computer	**AVNCS**	Avionics
ADF	Automatic Direction Finder	**AEVC**	Avionics Equipment Ventilation Computer
ADI	Attitude Direction Finder	**AFS**	Automatic Flight System
ADIRS	Air Data / Inertial Reference System	**AGB**	Accessory/Angle Gear Box

ADM	Air Data Module	**CLB**	Climb
ADR	Air Data Reference	**CMD**	Command
BAT	Battery	**CMM**	Component Maintenance Manual
BFE	Buyer Furnished Equipment	**CP**	Cabin Pressure
BITE	Built-in Test Equipment		Control Panel
BMC	Bleed Monitoring Computer	**CPU**	Central Processor Unit
B/C	Business Class	**CSU**	Command Sensor Unit
BTL	Bottle	**DADC**	**Digital Air Data Computer**
BTMU	Brake Temperature Monitor Unit	**DAR**	Digital Aids Recorder
BTS	Bleed Temperature Sensor	**DC**	Direct Current
BRK	Brake	**DDRMI**	Digital Distance and Radio Magnetic
BRT	Bright, Brightness	**DFDR**	Digital Flight Data Recorder
BSCU	Braking/Steering Control Unit	**DIS**	Disengaged
C/B	**Circuit Breaker**	**DISC**	Disconnect
CAA	Civil Aviation Authority	**DMC**	Display Management Computer
CAB	Cabin	**DME**	Distance Measuring Equipment
CAD	Computer Assisted Documentation	**DMU**	Data Management Unit
CAM	Cabin Assignment Module	**DU**	Display Unit
CANS	Cancel	**E/E**	**Electric/Electronic**
CAPT	Captain	**E/WD**	Engine/Warning Display
CAS	Computed Airspeed	**ECAM**	Electronic Centralized Aircraft Monitoring
CAR	Civil Aviation Requirements	**ECB**	Electronic Control Box
CAS	Computed Air Speed	**ECP**	ECAM Control Panel
CAT	Clear Air Turbulence	**ECS**	Environmental Control System
CAT	Category	**EDP**	Engine Driven Pump
CBM	Circuit Breaker Monitoring	**EFCS**	Electrical Flight Control System
CAUT	Caution	**EFIS**	Electronic Flight Instrument System
CBMU	Circuit Breaker Monitoring Unit	**EGT**	Exhaust Gas Temperature
CC	Cargo Compartment	**CFDIU**	Centralized Fault Display Interface Unit
CCDL	Cross Channel Data Link	**CFDS**	Centralized Fault Display System
CDU	Control and Display Unit	**CFM**	Commercial Fan Motor

CG	Center of Gravity	**F/CTL**	**Flight Control**
CIDS	Cabin Intercommunication Data System	**F/O**	First Officer
CKPT	Cockpit	**FADEC**	Full Authority Digital Engine Control
EIS	Electronic Instrument System	**FREQ**	Frequency
ELEC	Electric, Electrical, Electricity	**FRV**	Fuel Return Valve
ELEV	Elevation	**FWC**	Flight Warning Computer
EPC	External Power Contactor	**FWD**	Forward
EPR	Engine Pressure Ratio	**FWS**	Flight Warning System
EPSU	Emergency Power Supply Unit	**FMA**	Flight Mode Annunciator
ESS	Essential	**FMGC**	Flight Management and Guidance Computer
ETA	Estimated Time of Arrival	**FMMV**	Fuel Manifold and Modulating Valve
ETOPS	Extended Twin Operation System	**FMS**	Flight Management System
EVAC	Evacuation	**FMU**	Fuel Metering Unit
EVMU	Engine Vibration Monitoring Unit	**FOB**	Fuel on Board
EMER	Emergency	**FOD**	Foreign Object Damage
ENG	Engage	**FPA**	Flight Path Angle
ENG	Engine	**F-PLN**	Flight Plan
EXT	Exterior, External	**FPPU**	Feedback Position Pickup Unit
FAP	**Forward Attendant Panel**	**FQI**	Fuel Quantity Indication
FAR	Federal Aviation Regulations	**FQIC**	Fuel Quantity Indication Computer
FAV	Fan Air Valve	**G/S**	**Glide Slope**
FBW	Fly by Wire	**GA**	Go-Around
FCDC	Flight Control Data Concentrator	**GCU**	Generator Control Unit
FCU	Flush Control Unit	**GEN**	Generator
FCV	Flow Control Valve	**GLC**	Generator Line Contactor
FD	Flight Director	**FG**	Flight Guidance
FDIU	Flight Data Interface Unit	**FIDS**	Fault Isolation and Detection System
FDR	Flight Data Recorder	**FIG**	Figure
FDRS	Flight Data Recording System	**FIN**	Functional Item Number
FDU	Flight Detection Unit	**FL**	Flight Level
FF	Fuel Flow	**FLP**	Flaps

FLSCU	Fuel Level Sensing Control Unit	**LAT**	Lateral, Latitude
FLT	Flight	**LAV**	Lavatory
FLXTO	Flexible Take-Off	**LCD**	Liquid Crystal Display
GMT	Greenwich Mean Time	**LDG**	Landing
GND	Ground	**LGCIU**	Landing Gear Control and Interface Unit
GPCU	Ground Power Control Unit	**LH**	Left Hand (Side)
GPS	Global Positioning System	**LPC**	Low Pressure Compressor
GPWS	Ground Proximity Warning Computer	**LPT**	Low Pressure Turbine
GS	Ground Speed	**LPTAC**	Low Pressure Turbine Active Clearance Control
HCU	**Hydraulic Control Unit**	**LRU**	Line Replaceable Unit
HF	High Frequency	**LT**	Light
HMU	Hydromechanical Unit	**LVDT**	Linear Variable Differential Transducer
HP	High Pressure	**MAC**	**Mean Aerodynamic Cord**
HPC	High Pressure Compressor	**MAGDE**	Magnetic Declination
HPT	High Pressure Turbine	**MAINT**	Maintenance
HPTACC	High Pressure Turbine Active Clearance Control	**MAN**	Manual
HPV	High Pressure Valve Horizontal Situation	**MCDU**	Multipurpose Control & Display Unit
HUD	Indicator Head Up Display	**MCT**	Maximum Continuous Thrust
IAE	**International Aero Engines**	**MDDU**	Multipurpose Disk Drive Unit
IAS	Indicated Air Speed	**MEL**	Minimum Equipment List
IDG	Integrated Drive Generator	**MEM**	Memory
IFR	Instrument Flight Rules	**MES**	Main Engine Start
IGN	Ignition	**MIN**	Minimum
ILS	Instrument Landing System	**MLG**	Mail Landing Gear
IPC	Intermediate Pressure	**MLS**	Microwave Landing System
JAR	**Joint Airworthiness Requirements**	**MLW**	Minimum/Maximum Landing Weight
KG	**Kilogram**	**MMEL**	Master Minimum Equipment List
KVA	Kilo Volt Ampere	**MMI**	Manual Magnetic Indicator
KV	Kilo Volt	**MON**	Monitor, Monitoring, Monitored
L/G	**Landing Gear**	**MSL**	Main Sea Level
LAF	Load Alleviation Function	**MSN**	Manufacturer Serial Number

MTB	Mean Time Between Failure	**P/B**	**Push Button**
MTO	Maximum Take-Off	**PA**	Pressure Altitude
MU	Management Unit	**PA**	Passenger Address
MZFW	Maximum Zero Fuel Weight	**PB**	Burner Pressure
N	**North**	**PCU**	Power Control Unit
N1	Low Pressure Rotor Speed	**PDU**	Power Drive Unit
N2	High Pressure Rotor Speed	**PERF**	Performance
NAV	Navigation	**PF**	Pilot Flying
NAVAID	Navigation Aid	**PFD**	Primary Flight Display
NBR	Number	**PMA**	Permanent Magnetic Alternator
ND	Navigation Display	**PMG**	Permanent Magnetic Generator
NDB	Non-Directional Beacon	**PN**	Part Number
NDT	Non Destructive Testing	**POS**	Position
NLG	Nose Landing Gear	**PPU**	Position Pickoff Unit
NM	Nautical Mile	**Pr**	**Regulated Pressure Transducer**
NORM	Normal	**PRAM**	Prerecorded Announcement and Music
NVM	Non Volatile Memory	**PRESS**	Pressure
NWS	Nose Wheel Steering	**PREV**	Previous
N/W	Nose Wheel	**PRIM**	Primary
OAT	**Outside Air Temperature**	**PRIM**	Primary
OBRM	On Board Replaceable Module	**PNF**	Pilot non Flying
OFV	Out Flow Valve	**PNL**	Panel
OK	Correct	**PRV**	Pressure Regulating Valve
OMS	Onboard Maintenance System	**PSI**	Pound per Square Inch
OPS	Operation	**PSU**	Passenger Service Unit
OPV	Overpressure Valve	**PTU**	Power Transfer Unit
OVHD	Overhead	**PWR**	Power
OVSP	Overspeed	**Pt**	Transferred Pressure Transducer
OXY	Oxygen	**PTP**	Programming & Test Panel
OVHT	Overheat	**PTT**	Push-to-Talk

POB	Pressure On/Off Brake	**SAT**	Static Air Temperature
QAD	Quick Attach Detach	**SATCO**	Satellite-Communication
QAR	Quick Access Recorder	**SD**	System Display
QFE	Field Elevation Atmosphere Pressure	**SDAC**	System Data Acquisition Concentrator
QNE	Sea Level Standard Atmosphere Pressure	**SDCU**	Smoke Detection Control Unit
QNH	Sea Level Atmospheric Pressure	**SDU**	Satellite Data Unit
QRG	Quick Reference Guide	**SEC**	Secondary
QTY	Quantity	**SEC**	Spoiler/Elevator Computer
RA	**Radio Altimeter / Radio Altitude**	**SEL**	Select, Selected, Selector, Selection
RACC	Rotor Active Clearance Control	**SELCAL**	Selective Calling System
RAD	Radio	**SFCC**	Slat Flap Control Computer
RAD	Ram Air Door	**SIC**	System Isolation Contactor
RAT	Ram Air Turbine	**SIGN**	Signal
RCV	Receiver	**SIL**	Service Information Letter
REF	Reference	**SIM**	Simulation
REG	Regulator	**SLT**	Slats
REV	Reverse	**S/O**	Shutoff
RCL	Recall	**SOL**	Solenoid
RH	Right Hand (Side)	**SOV**	Shut-Off Valve
RMP	Radio Management Panel	**SPD**	Speed
RNAV	Radio-Navigation	**SPLR**	Spoiler
ROM	Read Only Memory	**SPLY**	Supply
RPM	Revolution per Minute	**SRM**	Structure Repair Manual
RSVR	Reservoir	**SSMM**	Solid State Mass Memory
RTN	Return	**STBY**	Standby
RTO	Retest OK	**STD**	Standard
RTS	Return to Service	**STG**	Stage
s	**South**	**STRG**	Steering
S/F	Slat / Flap	**STS**	Status
S/N	Serial Number	**SV**	Servo Valve

SVCE	Service	**UTC**	Universal Time Coordinated
SW	Switch	**V**	**Voltage**
SYS	System	**V/S**	Vertical Speed
TA	Traffic Advisory	**V1**	Critical Engine Failure Speed
TAPRV	Trim Air Pressure Regulating Valve	**V2**	Takeoff Safety Speed
TAS	True Airspeed	**V3**	Flap Retraction Speed
TAT	Total Air Temperature	**V4**	Slat Retraction Speed
TAV	Trim Air Valve	**VACBI**	Video and Computer Based Instruction
TCAS	Traffic Alert and Avoidance System	**VBV**	Variable Bleed Valve
TCT	Temperature Control Thermostat	**VCU**	Video Control Unit
TURB	Turbine	**VENT**	Ventilation
TD	Time Delay	**VFE**	Maximum Flap Extended Speed
TEMP	Temperature	**VFEN**	Predictive VFE at next Flap/Slat Position
TGT	Turbine Gas Temperature	**VFR**	Visual Flight Rules
THR	Thrust	**VHF**	Very High Frequency
THS	Trimmable Horizontal Stabilizer	**VLS**	Lower Selectable Speed
TOGA	Take Off Go Around	**VSV**	Variable Stator Vane
TOT	Total	**VTR**	Video Tape Reproducer
TPIC	Tire Pressure Indicating Computer	**VMAN**	Maneuvering Speed
TPIS	Tire Pressure Indicating System	**VMAX**	Maximum Allowable Airspeed
TR	Transformer Rectifier	**VMO**	Maximum Operating Speed
TRF	Turbine Rear Frame	**VOR**	VHF Omnidirectional Range
TRK	Track	**VSC**	Vacuum System Controller
TLA	Throttle Lever Angle	**VSI**	Vertical Speed Indicator
TLT	Temperature Limiting Thermostat	**w**	West
TM	Torque Motor	**WAI**	Wing Anti-Ice
TO	Take-off	**WARN**	Warning
U/S	**Unserviceable**	**WDM**	Wiring Diagram Manual
UNLK	Unlock	**WPT**	Waypoint
UPR	Upper	**WTB**	Wing Tip Brake
USGAL	US Gallon	**WX**	Weather Radar

WXR	Weather Radar Transceiver	**XREF**	Cross reference
XCVR	Transceiver	**Y**	Yellow
XDCR	Transducer	**YC**	Tourist Class
XFEED	Crossfeed	**YD**	Yaw Damper
XFMR	Transformer	**ZC**	Zone Controller
XFR	Transfer	**ZFW**	Zero Fuel Weight
XMTR	Transmitter	**ZFWCG**	Zero Fuel Weight Center of Gravity
XPDR	Transponder		

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