

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 1

Aircraft General

DIMENSIONS

Width : 35.79 m Lenght : 39.5 m

Wingtip radius : 22.9 m (do not turn away from an obstacle within 7.4 m of the nose)

EMERGENCY EXIT LIGHTS

Three positions : - OFF (prevents unwanted illumination and unwanted battery usage)
 - ARMED (emergency exit lights will illuminate with loss of DC Bus 1 or AC power off)
 - ON

OVERWING EMERGENCY EXITS

4 overwing exits automatically lock when : - 3 of 4 main doors are closed
 - either engine is running
 - ground/air logic sense airborne or both thrust levers above 53%

OXYGEN

Flight Crew oxygen :

One oxygen bottle in the aft E&E bay, must be pressurized 1100psi for the first flight 1000psi thereafter.
Oxygen mask has 3 modes : - Emer (100% oxy under pressure) (use if halon is discharged in flight deck)
 - 100% (100% oxy on demand)
 - Norm (air/oxy mixture on demand)

Pax oxygen : - Automatic deployment above 14'000 ft or manual deployment by crew with pax oxygen switch.
 - Chemical oxygen generation for approx 12 minutes.

COCKPIT DOOR ACCESS SYSTEM

3 lights : - Red, indicates door is locked and lock system is operating
 - Amber, indicates correct code has been entered and awaiting flight crew response
 -> flight crew can either unlock door or deny entry
 -> without response the flight deck door will automatically unlock
 - Green, indicates door automatically unlocks

Dead bolt system : 3 positions : Unlocked, Locked Key Operable, Locked Key Inoperable

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 2

AIR CONDITIONING & PRESSURISATION

OVERVIEW

Bleed air supplies the following systems:

- Air conditioning
- Pressurisation
- Engine / Wing Anti-ice
- Engine Starting
- Hydraulic tank pressurisation
- Water tank pressurisation

Bleed air is supplied normally by the engine 5th stage low pressure area, additionally 9th when demand is high. Any over pressure or over temperature will cause the valve to close and illuminate the **BLEED TRIP OFF** light.

Duct Pressure is measured after the bleed air valve and before the pack valve.

ISOLATION VALVE

- 3 positions :
- Close, isolates both sides of the bleed air system
 - Auto, opens the valve if any bleed or pack switches are moved to OFF, otherwise valve is closed
 - Open, isolation valve is open

OUTFLOW VALVE

Cabin pressurisation is controlled by the outflow valve. Maximum differential pressure is 9.1 psi. The outflow valve can be controlled by 3 DC motors, 2 Automatic controlled and 1 Manually controlled. There is 2 positive pressure relief valves, and one negative pressure relief valve.

PACKS

Air from the left pack is supplied to the flight deck, any excess air is returned to the mix manifold.

Air from the right pack supplies the mix manifold

The mix manifold air is then passed through the trim air system and distributed to the forward and aft cabin.

Trim air is used to adjust zone temperatures. The 3 zones are the flight deck, the forward cabin and the aft cabin.

If a pack is not operating, the other pack will regulate in high flow (except on ground or in flight with flaps extended)

If a pack fails or is turned off, the other pack will produce air to satisfy the coolest zone temperature demand.

If the trim air system is failed, each pack will operate in isolation of the other.

RECIRCULATION FANS

Recirculation fans reduce the load on the air conditioning system. Air from the cabin and E&E bay is drawn and circulated around the cargo bay before being filtered and returned to the mix manifold.

GROUND AIR SUPPLY

Ground air conditioning: feeds in the mix manifold, temperature control from the ground unit.

External air cart: feed in the pneumatic bay, permits engine air start, temperature can be controlled in flight deck.

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 3

ANTI-ICE

ENGINE ANTI ICE

Engine anti ice is taken from the 5th and 9th stages of the engine compressor, upstream of the bleed air valve. The engine anti ice valve is electrically controlled and air pressure operated. Engine start switches must be selected CONT during engine anti ice operation.

WING ANTI ICE

Wing anti ice system is a supply duct heating the three inboard slats only. The valve system is AC operated. The valves automatically close when T/O power is set during T/O or when the duct temperature reaches 125°

PROBE HEAT

Each probe is powered from their associated AC transfer bus. In the event of a loss of all AC power the captain pitot probe is heated by the AC standby bus (All other probes are not heated).

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 4

AUTO FLIGHT

OVERVIEW

AFDS = Autopilot + Flight Directors + Autothrottle

When CMD A is engaged, FCC A controls the flight directors and uses hydraulic system A to control the aircraft. The reverse is true with CMD B.

The flight directors will function independently in certain cases: Dual Channel approach, T/O or G/A below 400ft.

The autopilot will disengage when :

- Pressing the CMD switch or A/P disengage bar
- Activating the control wheel trim switch
- Stab trim autopilot cutout switch in the cutout position
- Left or Right IRS failure
- Interruption of electrical power in the related AC transfer bus
- Loss of hydraulic pressure in the related system

AFDS MODES

Autothrottle :

- N1
- GA
- RETARD
- MCP SPD
- FMC SPD
- THR HLD
- ARM

Roll modes :

- LNAV
- HDG SEL
- VOR/LOC

Pitch modes :

- TO/GA
- VNAV (PTH/SPD)
- V/S
- ALT ACQ
- ALT HOLD
- MCP SPD
- G/S
- FLARE

LNAV engagement criteria in flight :

- Active route entered in the FMC
- within 3nm LNAV engages with any heading
- outside 3 nm LNAV the aircraft must be on a 90° intercept or less and it must occur prior to the next wpt

TO/GA during takeoff :

- Pressing TO/GA will command the autothrottle to the N1 set in the FMC and FD will show 10° nose down
- At 60kt FD shows 15° nose up
- At 84kt THR HLD is annunciated and the autothrottle servos are inhibited
- At liftoff the FD shows 15° nose up until sufficient climb is achieved then command pitch to maintain V2+20
- Below 400ft bank is limited to 8°
- At 800ft ARM is annunciated
- At thrust reduction altitude N1 is annunciated and thrust is reduced to the climb thrust set in the FMC
- At autopilot engagement TO/GA terminates and pitch mode reverts to MCP SPD

TO/GA Go-Around mode is available below 2000ft RA or above 2000ft RA with flaps not up or G/S capture.

DUAL CHANNEL APPROACH

Limitations: 2 autopilots, flaps 30°/40°, headwind below 25kt, crosswind below 20kt, tailwind below 10kt

Sequence:

- When cleared for approach engage CMD A and CMD B, SINGLE CH stays annunciated
- LOC capture occurs before half a dot
- G/S capture occurs at 2/5 of a dot, N1 thrust limit changes to G/A
- Below 1500ft RA:
 - The second autopilot couples with the flight controls and CMD is annunciated
 - A test of the ILS deviation monitor is made and G/S LOC flashes amber
 - FLARE is armed, Autopilot G/A is also armed but not shown
- 800ft RA is the lowest altitude at which the second autopilot must be engaged for an autoland
- At 400ft RA the stabilizer is automatically trimmed nose up to aid in case of a go around
- At 350ft RA if the FLARE is not armed the AP disengage
- At 50ft RA FLARE mode is engaged, FD retracts from view
- At 27ft Autothrottle RETARD is engaged and commands idle, then disconnects 2s after touchdown

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 6

AC ELECTRICS

There is two basic principles of operation for the 737 electrical system:

- No parralleling of the AC sources of power.
- The source of power being connected to a transfer bus automatically disconnects the existing one.

ENGINE DRIVEN GENERATORS

Primary AC power is supplied by 2 engine driven IDG (Intgrated Drive Generators) which supply three-phase, 115 volt, 400hz alternating current.

- Each IDG:
- Supply power to their respective **AC TRANSFER BUS** via GCB (Generator Circuit Breaker)
 - Can supply power to the opposite AC Transfer Bus when the opposite IDG is inoperative via the **TIE BUS**

TIE BUS

The TIE BUS connects the 2 AC TRANSFER BUS and can supply them with AC from any source (IDG, APU or Ground Power)

- The BUS TIE BREAKER (BTB) 1 & 2 opens when 2 sources are connected to prevent parrallel operation.
- When only ONE source of AC is connected to the TIE BUS : the BTB closes and the TIE BUS energizes both the AC TRANSFER BUS 1 & 2

BUS TIE BREAKER operation example:

If APU if connected, and NO IDG are in operation then:

- BTB closes and APU supplies power to AC TRANSFER BUS 1 & 2

If one IDG is connected then:

- The BTB opens and the IDG supplies power to its related AC TRANSFER BUS
- APU supplies power to the other AC TRANSFER BUS.

If the other IDG is connected then:

- the BTB opens and isolates the TIE BUS
- APU is automaticaly disconnected and **APU GEN OFF BUS** light illuminates.
- Each IDG supplies its related AC TRANSFER BUS

AC TRANSFER BUS

AC TRANSFER BUS 1 supplies power to:

- Main BUS 1
- Galley BUS (C + D)
- Ground Service BUS 1
- TR 1
- AC Standby BUS

AC TRANSFER BUS 2 supplies power to:

- Main BUS 2
- Galley BUS (A + B)
- Ground Service BUS 2
- TR 2 & 3

AUTOMATIC GENERATOR ON-LINE

In case the airplane takes off with the APU powering both transfer busses.
If the APU is either shut down or fails, the IDG are automatically connected to their related transfer busses.
This action occurs only once in flight and only under the circumstances described above.

LOAD SHEDDING:

During flight, if ONLY ONE power source becomes available the electrical system automatically removes some buses to decrease electrical load, one at a time, in order:

- Galley BUS 2
- Main BUS 2
- Galley BUS 1
- Main BUS 1
- IFE
- (If power becomes available again, these busses are automatically connected again)

APU Load Shedding: in flight if the APU is the only power source:

- ALL Galley Busses AND ALL Main Busses are shed
- If overload still exists both IFE bus are shed

AC SYSTEM ANNUNCIATOR LIGHTS

On the Ground Power and Bus Switching Panel:

- **TRANSFER BUS OFF**
 - > Related TRANSFER BUS not energized
- **SOURCE OFF**
 - > Related TRANSFER BUS not energized by the selected source
 - > Generator does not connect to the bus
 - > Connected Source has been replaced by different Source
- **GEN OFF BUS**
 - > Related TRANSFER BUS not being supplied with power by its IDG
- **APU GEN OFF BUS**
 - > APU Generator available but not connected (light extinguishes when connected)
- **GRD POWER AVAILABLE**
 - > Ground power available (does not extinguish if ground power is selected)

DC ELECTRICS

TRANSFORMERS RECTIFIERS

The main source of DC power are 3 Transformer Rectifiers (TR) which change 115 volts AC in 28 volts DC.

TR 1 - is supplied by AC TRANSFER BUS 1 and is the normal power source for DC BUS 1

TR 2 - is supplied by AC TRANSFER BUS 2 and is the normal power source for DC BUS 2

TR 3

- is normally supplied by AC TRANSFER BUS 2 but AC TRANSFER BUS 1 can be used as backup

- is used as an auxiliary DC if TR 1 or TR 2 fails, it is also the normal source for the battery bus

If any of the TR fails, the remaining TRs can supply the necessary power for normal operations.

In flight an amber **TR UNIT** light will illuminate if TR1 is failed or if TR2 and TR2 are both failed.

On the ground the any TR fault will cause the light to illuminate.

CROSS BUS TIE RELAY

Isolates DC BUS 1 and DC BUS 2

Upon Glideslope capture on an ILS approach the CROSS BUS TIE RELAY opens to isolate the navigation receivers and flight control computer. this prevents removal of all approach informations because of only 1 electrical failure

The relay also opens if the BUS TRANSFER switch is on the OFF position.

STANDBY POWER

The standby power system provides 115 volts AC and 24 volts DC to essential systems in the event of a loss of all engine or APU driven AC sources.

NORMAL STANDBY OPERATION (Partial loss of AC power)

- AC Standby BUS is powered by AC Transfer BUS 1
- DC Standby BUS is powered by TR 1,2,3
- Battery BUS is powered by TR 3

ALTERNATE STANDBY OPERATION (Complete loss of AC power)

- Automatic switching to Alternate Standby occurs if power is lost to either AC Transfer BUS 1 or DC BUS 1
- Both 24 Volts Nickel Cadmium Main Battery and Aux Battery supply standby power for 60 minutes
 - AC Standby BUS is powered by a single static inverter.
 - DC Standby BUS, Battery BUS, Switched Hot Battery BUS, Hot Battery BUS powered by battery.

STANDBY POWER SWITCH has 3 positions:

AUTO position:

- The standby power control unit automatically switch to battery power in case of loss of normal AC power.

OFF position:

- The AC and DC standby busses and the battery bus are disconnected from all power sources.

BAT position:

- Overrides automatic switching and places AC Standby BUS, DC Standby BUS, Battery BUS and Switched Hot Battery BUS under battery power.

BATTERY SWITCH has 2 positions

- The Battery Switch ON position energizes the SWITCHED HOT BATTERY BUS regardless of the Standby power switch position.
- The Battery Switch OFF position removes the Battery from the power system except from the HOT BATTERY BUS. The Hot Battery BUS is always connected to the battery.

ELECTRIC PANEL AMBER LIGHTS:

- > **BAT DISCHARGE** : Excessive battery discharge rate (normal during APU start)
- > **TR UNIT** : On ground : one TR has failed / In flight : TR 1 failed or TR 2 & 3 have failed
- > **ELEC** : DC or Standby system failed

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 7

ENGINES & APU

ENGINE OVERVIEW

CFM 56-7B produces a maximum of 26k lbs of thrust, can be derated to 24k and 22k

- 2 independent rotors:
- The N1 rotor connects the Fan, LP compressor and LP turbine
 - The N2 rotor connects the HP compressor, the HP turbine and the accessory gearbox

Fitted to the gearbox are the IDG, Air Starter, Engine Hydraulic pump, Engine Fuel pump, EEC, HMU...

Two ignitions system per engine: Left and Right, Right ignition system is connected to the AC standby bus.

- EGT limits:
- 950° T/O (5 minutes maximum)
 - 925° Maximum continuous
 - 725° Engine start

EEC

EEC have two modes of operations: Normal and Alternate

- Normal protects provides ground start protection:
- Hot start (rapid rise in EGT)
 - Wet start (no rise in EGT in 15s)
 - Engine stalls and EGT exceedances of 725°

Should a failure occur the EEC reverts to Soft Alternate mode and Master Caution ENG illuminates.

Soft Alternate mode uses the last sensed environmental condition to calculate engine limit values.

The Hard Alternate mode is engaged when the thrust levers are retarded to idle or by pushing the EEC switches.

ENGINE START SWITCHES

- GRD : opens start valve, closes engine bleed air valve, arms igniter to provide ignition when start lever is moved to idle detent (both igniters for inflight starts), releases to OFF at start valve cutout.
- OFF : Normally off, automatic ignition if a rapid decrease in N2 occurs or if inflight N2 is lower than normal idle.
- CONT : provides ignition to the selected igniters (both igniters in case of auto ignition)
- FLT : provides ignition to both igniters

ENGINE START LIMITATIONS

Observe initial EGT rise + EGT within limits.

Abort start :

- if EGT fails to rise within 10 sec. of selecting IDLE or EGT rising quickly or approaching limits
- if no N1 rotation before the engine start lever is raised to IDLE
- if no oil pressure by the time the engine is stabilized at idle.
- If no increase in, a very slow increase in N1 or N2 after EGT indication.

APU

- APU altitude limits :
- 10'000 ft supply of both electrical power & bleed air
 - 17'000 ft supply of bleed air
 - 41'000 ft supply of electrical power

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 8

FIRE PROTECTION

OVERVIEW

The engines, APU, FWD and AFT Cargo compartments and the Lavatory are provided with fire protection.

The engine and APU fire / overheats detection systems are powered by the battery bus.

The cargo smoke detection system is powered by the DC bus 1/2.

The wheel well fire detection system is powered by the AC transfer bus 2.

The engine, APU and cargo extinguishing system are powered by the hot battery bus.

The wheel well does not have an extinguishing system.

ENGINE

Each engine has two loops A and B to sense an overheat or fire condition.

Both loops must sense a fire or overheat condition to issue a caution or warning.

A fault monitoring system monitors both loops and can isolate a faulty loop.

Pulling a fire switch will :

- close both the fuel and spar shutoff valves
- close the engine bleed air valve
- trips the generator control relay breaker
- close the hydraulic shutoff valve
- deactivate the related engine hydraulic pump LOW PRESS light
- disable thrust reverser for that engine
- arm one discharge squib on each extinguisher bottle

APU

APU has only one fire / overheat loop. Pulling the APU fire switch closes the APU fuel shutoff valve, closes the APU bleed air valve, closes the APU inlet door, trips the APU generator relay and breaker and arm the APU extinguisher.

CARGO

The cargo compartment has a dual loop smoke detection system.

There are 4 detectors in the FWD cargo, 6 in the AFT. One detector has to sense smoke before an alert is issued.

Illumination of the **DETECTOR FAULT** light indicates one or more loops have failed.

WHEEL WELL

Single loop fire warning system. No extinguishing system.

LAVATORY

Smoke and heat detection. Extinguishing system is automatically activated by heat, no indications in flight deck.

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 10

FLIGHT INSTRUMENTS

ADIRS

Air Data Inertial Reference System includes :

- 2 ADIRU (Air Data Inertial Reference Unit)
- 4 ADM (Air Data Module)
- 1 ISDU (Inertial System Display Unit)
- 1 MSU (Mode Selector Unit)
- 6 Static ports (2 Capt, 2 F/O, 2 Alt)
- 3 Pitot probes
- 2 Alpha vanes
- 1 Total Air Temperature probe

A DEU (Display Electronic unit) failure will prompt a DSPLY SOURCE message.

PFD OVERVIEW

White bug : T/O = Vref +15kt Approach = Vref +20kt

Upper red band : Indicates the maximum speed as limited by VMO/MMO, gear or flap placard speed

Upper amber band : When flaps are up, indicates 1.3g capability to high speed buffet
When flaps are extended, shows placard speed of the next logical flap setting

Lower amber band : Below 20'000 ft indicates 1.3g capability to stick shaker
Above 20'000 ft indicates 1.3g capability to low speed buffet
When the airspeed decreases to the lower amber bar the readout turns amber and flashes
Also an aural alert "Airspeed low!, Airspeed low!" sounds

Lower red band : Indicates speed at which stick shaker occurs

Pitch Limit Indicator : Shows pitch limit to stall when flaps are extended or at low speeds

Expanded LOC : Displayed when within 1/2 dot and 5° of MCP course

ALERTS

ALT DISAGREE : Capt & F/O Altitude disagree by more than 200ft for 5 seconds

IAS DISAGREE : Capt & F/O IAS disagree by more than 5kt for 5 seconds

AOA DISAGREE : Capt & F/O AOA disagree by more than 10° for 10 seconds

TERRAIN (On navigation display & VSD)

Red : Terrain is more than 2000 ft above the airplane

Amber : Terrain ranges from 500 ft below (250ft with gear down) to 2000ft above the airplane

Green : Terrain is more than 500 ft below (250ft with gear down) the airplane

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 12

FUEL SYSTEM

LIMITATION

Max Fuel temperature : +49°

Min Fuel temperature : -43° or 3° above fuel freezing point, whichever higher

FUEL PANEL

SPAR VALVE (hot battery bus) & **ENG VALVE** (battery bus) : monitors position of related valve

Crossfeed **VALVE OPEN** (battery bus) will illuminate bright blue if the valve is in transit or in uncommanded position

Fuel temperature gauge (AC power) : display temperature of fuel in tank N°1

FILTER BYPASS : Fuel is about to bypass the filter (11.5 PSI = Light illuminates / 15 PSI = bypass valve opens)

FUEL PUMPS

6 Pumps in total, 2 pumps per tank.

Pumps are powered so that in case of loss of one generator, one pump is still powered in each tank.

Fuel flow is measured after the fuel passes through the engine shutoff valve and the HMU.

Main tank: Both **LOW PRESS** light illumination will cause Master Caution
One **LOW PRESS** light will cause Master Caution on Recall

Center Tank: Continuous illumination of 1 **LOW PRESS** light for more than 10s will cause Master Caution
After 15s the pump will automatically shut down

Center tank scavenge pump : Operates when the N°1 FWD Pump Switch is ON, and the N°1 tank is half full
Transfers any remaining centre tank fuel to the main tank N°1

Engine suction feed : When main tank fuel pump pressure is low (ex. loss of AC power), each engine can draw fuel from its associated tank through a suction feed that bypasses the pumps

APU Fuel Feed : APU is supplied from the left side of the fuel manifold
If AC fuel pumps are off the APU is suction fed from tank N°1

CDS ALERTS

CONFIG : There is more than 726 kg in the center tank and the center tank fuel pumps are off

IMBAL : Difference between main tanks is more than 453 kg, alerts remains until difference reduces to 91 kg

LOW : Indicates fuel quantity in associated main tank is less than 453 kg

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 13

HYDRAULIC SYSTEM A

3 Systems: SYSTEM A, SYSTEM B, STANDBY SYSTEM

SYSTEM A & B operates independantly

SYSTEM B and STANDBY are connected through a hydraulic servicing line

The Bleed air supplies air pressure to System A & B reservoir.

Fuel in the main wing tank help cool the hydraulic fluid A & B with help of a Heat Exchanger.

An engine driven pump supplies about 6 times the volume of hydraulic fluid of an electric driven pump.

SYSTEM A

Powered by Engine 1 hydraulic pump and an electric pump powered by IDG 2. It supplies power to :

- Primary flight controls (Ailerons, Elevator & Feel, Rudder)
- Engine 2 thrust reverser
- Autopilot A
- Two flight spoilers on each wing
- Ground spoilers
- Nose wheel steering
- Alternate Brakes
- Landing Gear
- Power Transfer Unit

LOSS OF SYSTEM A

With the loss of system A the following systems are inoperative :

- Autopilot A
- 2 Flight spoilers on each wing and all ground spoilers
- Normal landing gear extension and retraction

Considerations :

- Single autopilot = CAT III not available
- Plan a manual gear extension
- Once extended the gear will not retract again (decreased G/A performance, additional fuel burn)
- Ground spoilers unavailable, increased landing distance

POWER TRANSFER UNIT

When System B pressure is low, In flight with flaps 1 - 15, PTU control valve opens and supplies power from system A to system B with help of standby fluid.

The purpose of the PTU is to supply power to operate the autoslats and the leading edge flaps and slats.

SYSTEM A FLUID LEAK

Hydraulic fluid to the engine 1 hydraulic pump is supplied by the system A reservoir via a standpipe.

Should a leak occur in the engine 1 hydraulic pump the system A level would decrease to about 20%.

Should a leak occur in the system A electric hydraulic all system A pressure is lost.

A leak in engine 1 hydraulic pump would not prevent operation of the PTU

HYDRAULIC SYSTEM B

SYSTEM B

Powered by Engine 2 hydraulic pump and an electric pump powered by IDG 1. It supplies power to :

- Primary flight controls (Aileron, Elevator & Feel, Rudder)
- Engine 2 thrust reverser
- Autopilot B
- Autoslats, Leading edge flaps and slats
- Trailing edge flaps
- Two flight spoilers on each wing
- Normal brakes
- Alternate Nose Wheel Steering
- Landing Gear Transfer Unit
- Yaw Damper

LOSS OF SYSTEM B

With the loss of system B the following systems are inoperative :

- Autopilot B
- 2 Flight spoilers on each wing
- Yaw damper
- Normal leading edge and trailing edge flaps

Considerations :

- Single autopilot = CAT III not available
- Plan an alternate flap extension
- Performance : plan a flaps 15 landing, leading edge devices can not be retracted

LANDING GEAR TRANSFER UNIT

In case of engine 1 failure during takeoff, with the landing gear lever selected up and either main landing gear not up and locked system A assists landing gear retraction via the landing gear transfer unit.

SYSTEM B FLUID LEAK

Any leak downstream of the system B reservoir will cause the loss of system B pressure. However there remains sufficient fluid for the operation of the PTU.

STANDBY HYDRAULIC SYSTEM

STANDBY SYSTEM

The standby system is linked to the system B reservoir.

If a leak occurs in the standby system, the system B reservoir level will decrease to approx 72%.

A standby electric pump provides backup hydraulic power to :

- Engine 1 & 2 thrust reversers
- Standby rudder
- Leading edge flaps & slats (extension only)
- Standby yaw damper (loss of system A & B)

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 14

LANDING GEAR

GEAR WARNING LIGHT

Illuminates red when : - Gear is in transit

- Gear lever position disagree with landing gear position
- Gear is not down and locked below 800ft RA with either thrust lever in idle

LANDING GEAR TRANSFERT UNIT

The landing gear retraction normally uses hydraulic system A.

The landing gear transfert unit uses hydraulic system B to aid in retraction in certain conditions:

- Aircraft is airborne
- Engine N°1 RPM is below a limiting value (engine 1 failed)
- Landing gear lever is selected up
- Either main landing gear is not up and locked

BRAKES / AUTOBRAKES

Normal brakes use hydraulic system B for operation. If system B is not available, alternate brakes uses system A. If hydraulic system A & B are lost, then the brake accumulator can supply limited pressure for brake operation.

Autobrake provide automatic maximum braking in the event of an RTO, or preselected braking during landing. Autobrake is only available with normal brakes. Antiskid system is available with normal and alternate brakes.

Autobrake RTO will engage only above 90kt wheel speed.

ANTI SKID SYSTEM

The anti skid system prevent locked wheel by comparing wheel speed of the two inbord main wheels and the two outboard main wheels. When a locked condition is sensed, brake pressure to the slower wheel is released.

The anti locking system is available only above 25 kt.

The anti skid system releases brake pressure to a wheel sensed in a skid situation.

Protection against hydroplaning is available to wheels 1 & 3, it is detected when wheel speed is 50kt below GS.

BOEING 737-800

TECHNICAL REVIEW - CHAPTER 15

WARNING SYSTEMS

WARNING PRIORITY : 1) Actual windshear 2) EGPWS 3) Predictive windshear 4) TCAS

EGPWS

The EGPWS contain a worldwide database of terrain and runways of 1060m (3500ft) or longer.

Look ahead terrain alerts based on the terrain database :

"CAUTION TERRAIN" : caution (40-60 seconds from projected impact)

"TERRAIN TERRAIN PULL UP" : hard warning (20-30 seconds from projected impact)

"TOO LOW TERRAIN" : alert issued when descending below a safe radio altitude while far from a runway

Radio altitude alerts based on radio altitude closure rate and baro altitude / glideslope / airspeed data :

"PULL UP" : hard warning (follows sink rate alert if excessive descent rate continues)

"TERRAIN" : caution (excessive terrain closure rate)

"DONT SINK" : caution (excessive altitude loss after takeoff or go around)

"GLIDESLOPE" : caution (deviation below glideslope, volume and repetition increases with deviation)

"SINK RATE" : caution (excessive descent rate)

"TOO LOW FLAPS" / "TOO LOW GEAR" : caution (unsafe terrain clearance at low airspeed and gear/flaps down)

Any hard warning "PULL UP" alert should prompt the crew to execute the terrain escape maneuver.

WINDSHEAR WARNING

Predictive windshear alerts are based on the weather radar.

The weather radar starts scanning below 2300ft RA, the system starts issuing alerts below 1200ft RA.

On the ground the weather radar start scanning when the thrust levers are advanced for takeoff.

"MONITOR RADAR DISPLAY" : caution (aircraft is within 3nm of windshear)

"WINDSHEAR AHEAD" : hard warning (aircraft is within 1.5 nm of windshear, or within 3nm on ground)

Below 1500ft RA ,the EGPWS issues alerts when it detects excessive windshear at the aircraft current position.

Hard warning two tone siren followed by "WINDSHEAR WINDSHEAR"

TRAFFIC COLLISION AVOIDANCE SYSTEM

Traffic advisory : "TRAFFIC TRAFFIC" indicated by an amber circle, 40s from the point of closest approach

Resolution advisory : "CLIMB/DESCENT/[...]" indicated by a red square, 25s from the point of closest approach

Other indications : Proximate traffic, indicated by a white diamond, traffic within 6nm and 1200ft

TCAS Inhibits :

"INCREASE DESCEND" commands are inhibited below 1500ft RA

"DESCEND" commands are inhibited below 1100ft RA

All resolution advisories are inhibited below 1000ft RA, all aural traffic advisories are inhibited below 500ft RA.

All TCAS alerts are inhibited by EGPWS or Windshear alerts.

LANDING GEAR CONFIGURATION WARNING

The following configuration will activate the landing gear horn :

- Landing gear not down and locked, flaps 1°-10°, thrust levers below 20° (34° OEI), altitude below 800ft RA
-> Horn can be silenced (except below 200ft RA)
- Landing gear not down and locked, flaps 15°-25°, thrust levers below 20° (34° OEI), altitude below 800ft RA
-> Horn cannot be silenced
- Landing gear not down and locked, flaps 30°-40 °, regardless of altitude and thrust lever position
-> Horn cannot be silenced

TAKEOFF CONFIGURATION WARNING

The following configuration will activate the intermittent takeoff config warning :

- Flaps not in takeoff range (1° - 25°) or LE / TE flaps in skew, assymetry, uncommanded position
- Speedbrake lever not DOWN or spoiler control valve not closed
- Parking brake is set
- Stabilizer trim not in takeoff range

BOEING 737-800

OPERATIONAL REVIEW

KEY DEFINITIONS

TAKEOFF SEGMENTS

- 1) From liftoff until gear retraction -> Gear down, flaps extended, T/O thrust, climb $V_2 \sim V_2+20$
- 2) From gear retraction until MFRA -> Gear up, flaps extended, T/O thrust, climb $V_2 \sim V_2+20$
- 3) From MFRA until flap retracted -> Gear up, flaps retracting, T/O thrust, bug up acceleration segment
- 4) From flap retracted until 1500ft AGL -> Gear up, flaps up, Max continuous thrust, climb at up speed to MSA

RUNWAY REQUIREMENTS

Takeoff Run Available (TORA)

- The runway length declared available and suitable for the ground run of an airplane taking off.

Takeoff Distance Available (TODA = TORA + Clearway)

- The length of the TORA plus the length of the clearway.

Accelerate-Stop Distance Available (ASDA = TORA + Stopway)

- The TORA plus the length of the stopway for the acceleration and deceleration of an airplane aborting a takeoff.

Landing Distance Available (LDA)

- The length of runway that is declared available and suitable for the ground run of an airplane landing.
- Excludes the length of the displaced threshold.

ICAO MAXIMUM HOLDING SPEEDS

Up to 14000 ft :	230kts
14000 ft to 20000 ft :	240kts
20000 ft to 34000 ft :	265kts
Above 34000 ft :	M0.83

DEFINITIONS

FINAL APPROACH FIX (FAF) — A specified point on a non-precision instrument approach which identifies the commencement of the final segment.