# Disclaimer

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**At all times use approved company publications and aircraft manufacturer manuals as sole reference for procedures and data ! This info is provided as background information only and may never be used in any way in the operation of any aircraft !** This info may not be current or compatible with your aircraft type, equipment and your company procedures and limitations.

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# Engine Failure

OPS

## REJECT

- Call-out (e.g. "STOP", "REJECT", "ABANDON",…)
- Stop the aircraft : - close Thrust Levers (disconnect A/T)
  - apply maximum Brakes (*)
  - extend Speed Brakes
  - set maximum Reverse Thrust (*)
- Set Parking Brakes, stow Reversers and Speed Brakes
- Inform ATC about the rejected takeoff
- Advise cabin crew via public address
  (e.g. "ATTENTION, CABIN CREW ON STATION" - 2x)

(*) MAN - Maximum brakes and maximum reverse thrust at low speed may be neither necessary nor useful. Apply reverse thrust consistent with conditions and maintain maximum brakes until certain the airplane will stop on the runway.

## NON-NORMAL PROCEDURE (Engine fire)

- Recall Items : - Thrust Lever IDLE
  - Start Lever CUTOFF
  - Engine Fire Warning Switch
    PULL and (if required) ROTATE
- Wait 30 seconds - Meanwhile look outside of the window and request visual feedback from Tower
- If the fire warning persists, ROTATE to remaining bottle

## EVACUATION

- Accomplish the NNC [EVACUATION]

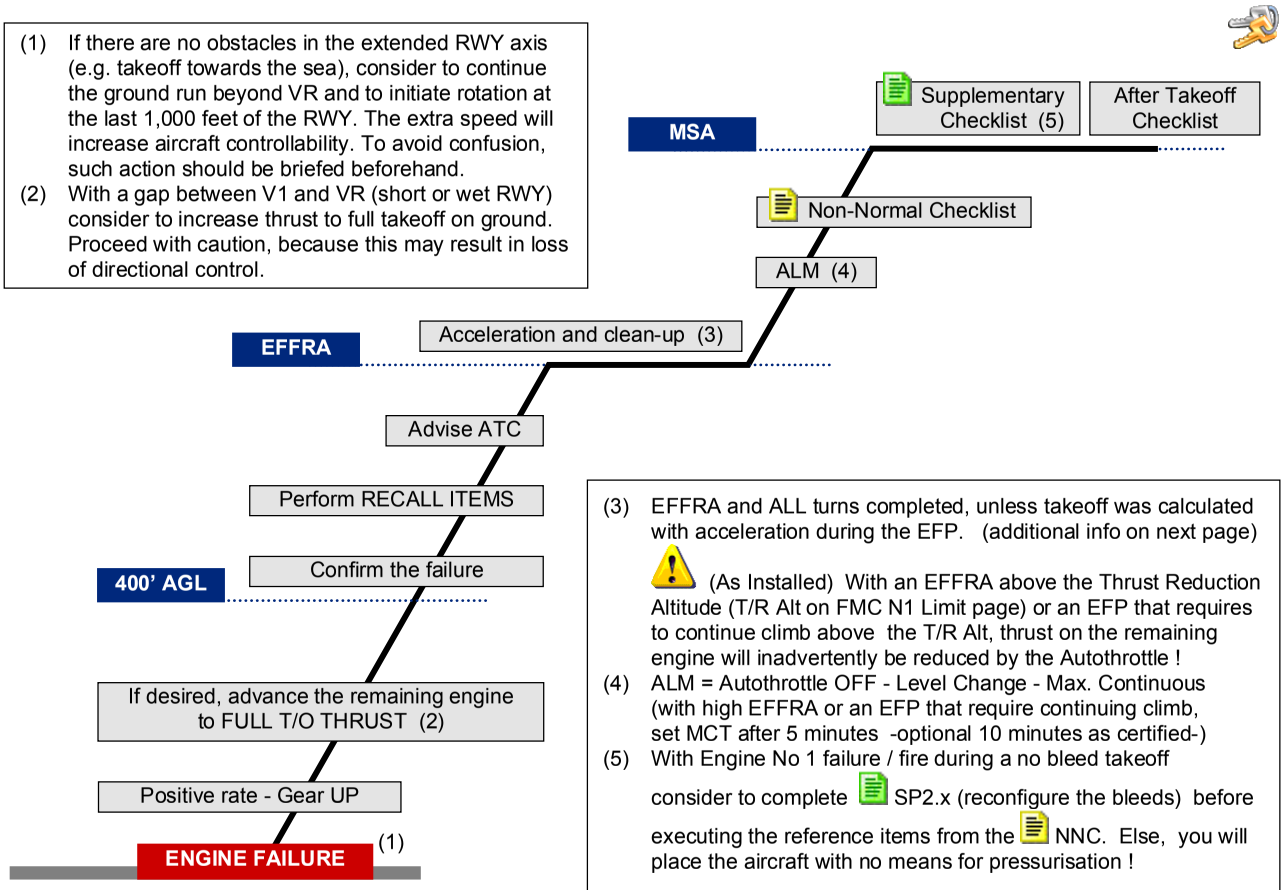
It is suggested that the Captain performs an inspection of the cabin to make sure everybody has abandoned the airship. The FO descents and directs all passengers away from any danger.

## NO EVACUATION

- Advise cabin crew to resume normal operations
  (e.g. "RESUME NORMAL OPERATION" - 2x)
- Advise ATC about intentions
- Request the fire equipment nearby (hot brakes)
- Vacate the runway or remain in position for brake cooling

(1) If there are no obstacles in the extended RWY axis (e.g. takeoff towards the sea), consider to continue the ground run beyond VR and to initiate rotation at the last 1,000 feet of the RWY. The extra speed will increase aircraft controllability. To avoid confusion, such action should be briefed beforehand.

(2) With a gap between V1 and VR (short or wet RWY) consider to increase thrust to full takeoff on ground. Proceed with caution, because this may result in loss of directional control.




(3) EFFRA and ALL turns completed, unless takeoff was calculated with acceleration during the EFP. (additional info on next page)

(As Installed) With an EFFRA above the Thrust Reduction Altitude (T/R Alt on FMC N1 Limit page) or an EFP that requires to continue climb above the T/R Alt, thrust on the remaining engine will inadvertently be reduced by the Autothrottle !

(4) ALM = Autothrottle OFF - Level Change - Max. Continuous (with high EFFRA or an EFP that require continuing climb, set MCT after 5 minutes -optional 10 minutes as certified-)

(5) With Engine No 1 failure / fire during a no bleed takeoff consider to complete SP2.x (reconfigure the bleeds) before executing the reference items from the NNC. Else, you will place the aircraft with no means for pressurisation !

## ACCELERATION DURING OR AFTER EFP TURNS

The engine failure route may comprise one or more turns. Depending on your company procedures, acceleration to flaps up speed before or during these turns may or may not be allowed.
If acceleration is not allowed in EFP turns and the EFFRA is reached before all turns are completed, you may not level-off to accelerate. Use the available thrust to continue climb above the EFFRA.

Now, whether acceleration during EFP turn(s) is allowed or not is independent from the laptop perf tool you are using or the software application that was used to calculate the paper printed weight book. Two airlines using the same laptop perf tool (such as the Boeing Onboard Performance Tool) may have different procedures for acceleration during EFP turns !

In fact, it depends on the obstacle database that is used behind the software. The cone of obstacles accounted for during an EFP turn is defined by an inside border (the track flown at low gross weight, a specific bank angle and the speed at $V_2$) and an outside border (the track flown with heavy weight, a specific bank angle and the speed at $V_2$ + margin).
When acceleration during EFP-turns is allowed, the outside border will be taken wider and the cone will hold more obstacles, which may result in an additional performance penalty.

OPS Verify the introduction section of your laptop perf software or printed weight book.

## ENGINE FAILURE AFTER V1

The engine failure procedure is calculated for an engine failure at $V_1$. The cone of obstacles starts from this specific point on the runway.
For an engine failure on ground but after $V_1$ (i.e. between $V_1$ and $V_R$), the EFP and EFFRA can be flown, but are theoretically not valid anymore.

In case an engine fails after takeoff, the best escape route is up to pilot's sound judgment !

Either you rejoin the EFP or you remain on the SID if you are sure that obstacles on the departure route are cleared. Remember that your climb gradient on two engines was 4 times more than what you have now on single engine ! Compare the minimum required climb gradient for the SID with your actual altitude and performance.
Some airlines publish a so called "SID Deviation Point" ; when an engine fails on the SID before reaching this point, the pilot should rejoin the EFP. After this point the pilot can stay on the SID and adequate obstacle clearance on the departure route is guaranteed.

Unless your destination is also your takeoff alternate, you will probably not continue to your destination on one engine. So, why should you continue on the SID ? A turn towards a nearby holding fix or a turn towards the takeoff alternate aerodrome are other options to consider.

## ENGINE FAILURE IN FLIGHT

The B737 **7-steps** to handle an engine failure in cruise :

1- Disconnect the **Autothrottle**

Autopilot LNAV and VNAV (one engine INOP) remain available.
Use rudder trim.

2- **Select MCT** on the remaining engine

Refer to PI [Engine INOP / MCT] or select ENG OUT on the FMC CRZ page

3- Perform **recall items** (if any)

4- **Maintain cruise FL** while airspeed decreases till single engine drift down speed

This will take several minutes
Refer to PI or to the FMC Engine Out page for drift down speed

5- Accomplish the **NNC** [ENGINE FIRE / FAILURE …]

6- **Descend to** single engine net level off altitude

Refer to the FMC Engine Out page
or PI [Engine INOP / MCT / Driftdown Speed - Level Off Altitude]

Verify terrain obstacle height - Set the altimeter to local QNH in case the local QNH is below 1,013.25 hPa / 29.92 ″Hg

7- **Select LRC** on the remaining engine

FPPM 3.3.x [Enroute Engine Inop / Single Engine - MCT - LRC]

## ENGINE FAILURE ON FINAL

The B737 **7-steps** to handle an engine failure on final approach :

1- **F**ailure announcement ; "Engine failure" - "Engine fire" - …

2- **F**orward Thrust Lever (remaining engine)

FCTM 5.x [Engine Failure on Final Approach]

(CL) If it is decided to continue approach, retract flaps to 15.

(NG) If it is decided to continue approach and sufficient thrust is available on the remaining engine, continue approach with Flaps 30/40.
If approach is continued, but a safe profile cannot be maintained or continuance with F30/F40 is not in line with your company policy, continue with the following steps :

3- **F**laps 15

4- **F**ive degrees body attitude is required for a 3 degree slope (CL) - 2.5° (NG)

5- **F**ly (CL) Outer bug (400) Outer bug + 5 kts (*)
(NG) Top bug (white bug) (800-900-BB2) Top bug + 5 kts (*)

(*) This 5kt margin is required to obtain an approach speed equal to Vref F15 in order to provide adequate maneuver margin (particularly in case of go-around) and to avoid tail strike.

6- **F**lap Override on the (E)GPWS to INHIBIT

7- **F**ield length verification

When inbound to a short runway and configuration was changed to Flaps 15 (higher speed and increased tendency to float during flare) consider to go-around, especially at high landing weights or when not established on profile and speed. Only 1 engine reverser is available.

Consider to delay the recall items for engine failure / fire until full stop, especially when below 400 feet AGL.

### GO-AROUND

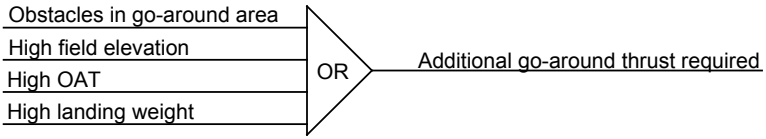
Maintain Flaps 15 until speed is at and above (300-500) Outer bug (400) Outer bug + 5 kts (600-700-BBJ) Top bug (800-900-BB2) Top bug + 5 kts !

### ENGINE FIRE ON SHORT FINAL DURING CAT II-III APPROACH

In case of engine fire without loss of thrust and airplane configured Flaps 30/40, consider to :

Continue approach
No actions until full stop (do not retard Thrust Lever in flight)
Emergency evacuation (as required)

## ADDITIONAL THRUST REQUIRED FOR GO-AROUND




- Verify obstacles in go-around area :

  FPPM 1.4.x [Engine Inop / Single Engine go-around Climb Gradient]

- With the APU available :

  Select bleeds OFF (both operating and failed engine)
  Operate the Left Pack on the APU

- With the APU not available :

  Configure for SP 2.x [Unpressurized Takeoff and Landing]

  Adjust go-around thrust setting with N1 + 0.9%

## WING ANTI-ICE

- The Isolation Valve should never be opened in case of an engine fire that cannot be extinguished.
- Never apply wing anti-ice when the APU is the only bleed source !
- Set-up for "wing anti-ice" cannot be combined with "Additional go-around thrust".

## PRESSURIZATION

| | |
|---|---|
| - Bleed on the operating engine can supply : | - pressurization<br>- wing anti-icing (both wings) |
| - Bleed from the APU can be used for : | - pressurization only |

## OVERWEIGHT LANDING

With one engine inoperative, disregard maximum landing weight limitation and land overweight ! An ASR/TFIR must be filed.