

DCA21FA174

OPERATIONAL FACTORS/HUMAN PERFORMANCE

Attachment 12

Rhoades Aviation, Inc. Aircraft Operations Manual Vol 1 [Excerpts]

May 4, 2022

Recommended Technique for an In-Flight Engine Shutdown

Any time an engine shutdown is required in flight, good crew coordination is essential. Airplane incidents have turned into airplane accidents as a result of the flight crew shutting down the incorrect engine.

When the flight path is under complete control, the crew should proceed with a deliberate, systematic process that identifies the correct engine and ensures that the operating engine is not shut down. Do not rush through the shutdown checklist, even for a fire indication. The following technique is an example that could be used:

The PF then verbally coordinates confirmation of the affected engine with the PM and then slowly retards the thrust lever of the engine that will be shutdown.

Coordinate activation of the start lever as follows:

- PM places a hand on and verbally identifies the start lever for the engine that will be shutdown
- PF verbally confirms that the PM has identified the correct start lever
- PM moves the start lever to cutoff.

If the NNC requires activation of the engine fire switch, coordinate as follows:

- PM places a hand on and verbally identifies the engine fire switch for the engine that is shutdown
- PF verbally confirms that the PM has identified the correct engine fire switch
- PM pulls the engine fire switch.

Bird Strikes

Experience shows that bird strikes are common in aviation. Most bird strikes occur at very low altitudes, below 500 feet AGL. This section deals with bird strikes that affect the engines.

Recent studies of engine bird strikes reveal that approximately 50% of engine bird strikes damage the engine(s). The risk of engine damage increases proportionally with the size of the bird and with increased engine thrust settings. When an engine bird strike damages the engine, the most common indications are significant vibrations due to fan blade damage and an EGT increase.

Note: After any bird strike, the engines should be inspected by maintenance.

Preventative Strategies

Airports are responsible for bird control and should provide adequate wildlife control measures. If large birds or flocks of birds are reported or observed near the runway, the crew should consider:

- delaying the takeoff or landing when fuel permits. Advise the tower and wait for airport action before continuing
- takeoff or land on another runway that is free of bird activity, if available.

To prevent or reduce the consequences of a bird strike, the crew should:

- discuss bird strikes during takeoff and approach briefings when operating at airports with known or suspected bird activity.
- be extremely vigilant if birds are reported on final approach
- if birds are expected on final approach, plan additional landing distance to account for the possibility of no thrust reverser use if a bird strike occurs.

Note: The use of weather radar to scare the birds has not been proven effective.

Crew Actions for a Bird Strike During Takeoff

If a bird strike occurs during takeoff, the decision to continue or reject the takeoff is made using the criteria found in the Rejected Takeoff maneuver of the QRH.

If a bird strike occurs above 80 knots and prior to V1, and there is no immediate evidence of engine failure (e.g. failure, fire, power loss, or surge/stall), the preferred option is to continue with the takeoff followed by an immediate return, if required.

Crew Actions for a Bird Strike During Approach or Landing

If the landing is assured, continuing the approach to landing is the preferred option. If more birds are encountered, fly through the bird flock and land. Maintain as low a thrust setting as possible.

If engine ingestion is suspected, limit reverse thrust on landing to the amount needed to stop on the runway. Reverse thrust may increase engine damage, especially when engine vibration or high EGT is indicated.

Evacuation

If an evacuation is planned and time permits, a thorough briefing and preparation of the crew improves the chances of a successful evacuation. Flight deck preparations should include a review of pertinent checklists and any other actions to be accomplished. Appropriate use of auto brakes should be discussed. If evacuating due to fire in windy conditions, consider positioning the airplane so the fire is on the downwind side. Be aware of possible adverse conditions at the affected exits. The availability of various exits may differ for each situation. Crewmembers must make the decision as to which exits are usable for the circumstances.

For unplanned evacuations, the captain needs to analyze the situation carefully before initiating an evacuation order. Quick actions in a calm and methodical manner improve the chances of a successful evacuation.

Method of Evacuation

When there is a need to evacuate crew, the captain has to choose between commanding an emergency evacuation using the emergency escape slide or less urgent means such as deplaning using stairs or other means. All available sources of information should be used to determine the safest course of action including reports from additional crew members, other aircraft, and air traffic control. The captain must then determine the best means of evacuation by carefully considering all factors. These include, but are not limited to:

- the urgency of the situation, including the possibility of significant injury or loss of life if a significant delay occurs
- the type of threat to the airplane, including structural damage, fire, reported bomb on board, etc.
- the possibility of fire spreading rapidly from spilled fuel or other flammable materials
- the extent of damage to the airplane

If in doubt, the crew should consider an emergency evacuation using the escape slide.

If there is a need to deplane, but circumstances are not urgent and the captain determines that the Evacuation NNC is not needed, the normal shutdown procedure should be completed before deplaning.

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If the operation of flaps is in doubt, leading and trailing edge flap position should not be changed unless it appears that airplane performance immediately requires such action. Consideration should be given to the possible effects of an asymmetrical flap condition on airplane control, if flap position is changed. If no flap damage exists, wing flaps should be operated as directed in the associated NNC. Anytime an increasing rolling moment is experienced during flap transition (indicating a failure to automatically shut-down an asymmetric flap situation), return the flap handle to the previous position.

Unusual events adversely affecting airplane handling characteristics while airborne may continue to adversely affect airplane handling characteristics during landing ground roll. Aggressive differential braking and/or use of asymmetrical reverse thrust, in addition to other control inputs, may be required to maintain directional control.

Checklists with Memory Steps

After flight path control has been established, do the memory steps of appropriate NNCs. The emphasis at this point should be on containment of the problem. Reference steps are initiated after the airplane flight path and configuration are properly established.

Complete all applicable NNCs prior to beginning final approach. Exercise common sense and caution when accomplishing multiple NNCs with conflicting direction. The intended course of action should be consistent with the damage assessment and handling evaluation.

Communications

Establish flight deck communications as soon as possible. This may require use of the flight deck interphone system or, in extreme cases of high noise levels, hand signals and gestures in order to communicate effectively.

Declare an emergency with Air Traffic Control (ATC) to assure priority handling and emergency services upon landing. Formulate an initial plan of action and inform ATC. If possible, request a discrete radio frequency to minimize distractions and frequency changes. If unable to establish radio communication with ATC, squawk 7700 and proceed as circumstances dictate.

Communications with the cabin crew and with company ground stations are important, but should be accomplished as time permits. If an immediate landing is required, inform any additional crew as soon as possible.

Damage Assessment and Airplane Handling Evaluation

Unless circumstances such as imminent airplane breakup or loss of control dictate otherwise, the crew should take time to assess the effects of the damage and/or conditions before attempting to land. Make configuration and airspeed changes slowly until a damage assessment and airplane handling evaluation have been done and it is certain that lower airspeeds can be safely used. In addition, limit bank angle to 15° and avoid large or rapid changes in engine thrust and airspeed that might adversely affect controllability. If possible, conduct the damage assessment and handling evaluation at an altitude that provides a safe margin for recovery should flight path control be inadvertently compromised. It is necessary for the flight crew to use good judgment in consideration of the existing conditions and circumstances to determine an appropriate altitude for this evaluation.

The evaluation should start with an examination of flight deck indications to assess damage. Consideration should be given to the potential cumulative effect of the damage. A thorough understanding of airplane systems operation can greatly facilitate this task.

If structural damage is suspected, attempt to assess the magnitude of the damage by direct visual observation from the flight deck and/or cabin. While only a small portion of the airplane is visible to the flight crew from the flight deck, any visual observation data could be used to gain maximum knowledge of airplane configuration and status and could be valuable in determining subsequent actions.

If controllability is in question, consider performing a check of the airplane handling characteristics. The purpose of this check is to determine minimum safe speeds and appropriate configuration for landing. If flap damage has occurred, prior to accomplishing this check, consider the possible effects on airplane control should an asymmetrical condition occur if flap position is changed. Accomplish this check by slowly and methodically reducing speed and lowering the flaps. Lower the gear only if available thrust permits.

As a starting point, use the flap/speed schedule as directed in the appropriate NNC. If stick shaker or initial stall buffet are encountered at or before reaching the associated flap speed, or if a rapid increase in wheel deflection and full rudder deflection are necessary to maintain wings level, increase speed to a safe level and consider this speed to be the minimum approach speed for the established configuration.

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After the damage assessment and handling characteristics are evaluated, the crew should formulate a sequential plan for the completion of the flight.

If airplane performance is a concern, use of the alternate flap or gear extension systems may dictate that the check of airplane handling characteristics is done during the actual approach. Configuration changes made by the alternate systems may not be reversible. The crew must exercise extreme caution on final approach with special emphasis on minimum safe speeds and proper airplane configuration. If asymmetrical thrust is being used for roll control or pitch authority is limited, plan to leave thrust on until touchdown.

Landing Airport

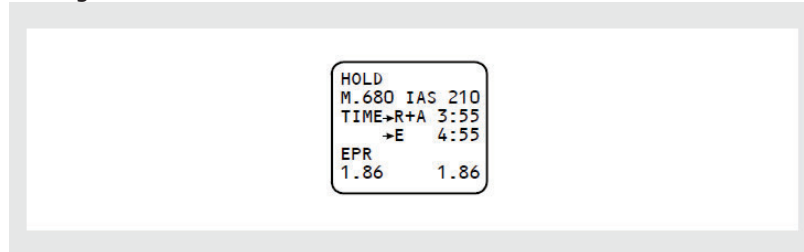
The following items should be considered when selecting an airport for landing:

- weather conditions (VMC preferred)
- en-route time
- length of runway available (longest possible runway preferred, wind permitting)
- emergency services available
- flight crew familiarity
- other factors dictated by the specific situation.

Holding

The information displayed on the HOLD page is based on minimum fuel usage at present holding altitude, at the present gross weight, with flaps up in a standard race track holding pattern:

Flight mode selector.....HOLD



Line 2 indicates MACH and/or airspeed for holding.

Line 3 displays endurance time in hours and minutes to reserve fuel levels (R+A.)

Line 4 shows endurance time in hours and minutes to empty fuel tanks.

ENGAGE keyPush

Observe the ENGAGE light extinguishes, HOLD is annunciated and the airspeed and EPR bugs drive to displayed values.

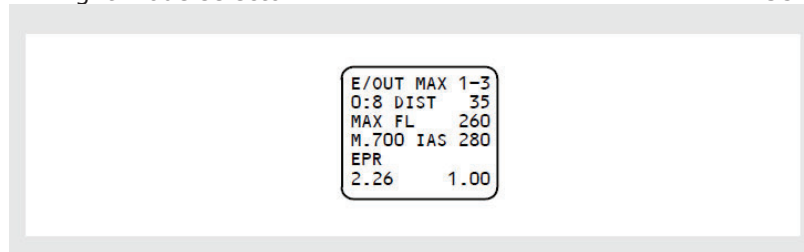
Continuous Thrust

Pages 1 and 2 provide data for one engine inoperative operation. They display maximum continuous thrust EPR limits, time and distance and MACH/airspeed for driftdown to, or climb to, a maximum flight level which can be maintained with one engine inoperative.

Page 3 displays maximum continuous thrust EPR limits only.

Example: Engine failure at an altitude above maximum flight level for one engine inoperative.

Flight mode selector.....CON



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Line 2 is in the time and distance to level-off at the maximum flight level (line 3.)

Line 4 is the target MACH/airspeed for the best possible driftdown flight path.

EPR values are for MCT

Page 2 displays data similar to page 1 except the flight level displayed is the maximum flight level at which LRC speed can be maintained using MCT with one engine inoperative.

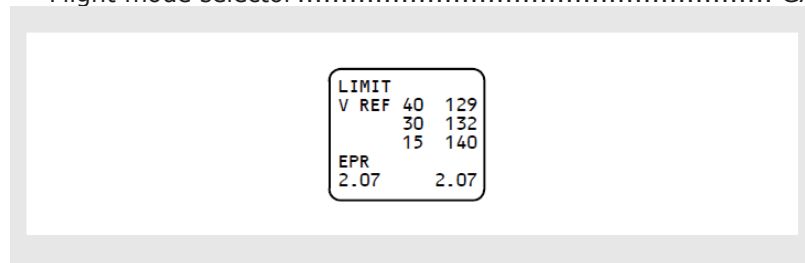
ENGAGE key Push

Observe the ENGAGE light extinguishes, CON is annunciated and the airspeed and EPR bugs drive to displayed values.

Go-Around

Prior to commencing approach:

Flight mode selector GA



VREF speeds are based on present gross weight. Go-around EPR limits are based on present total air temperature and pressure altitude.

Airspeed selector Pulled out

Set airspeed bugs for manual operation.

Engage the GA flight mode when it is desired to have the EPR bugs drive to the displayed EPR values.

ENGAGE key Push

Observe the ENGAGE light extinguishes, GA is annunciated and the EPR bugs drive to the displayed values.

Note: If the airspeed selector remains in PDCS control, the airspeed bugs drive to the stowed position, 440 KTS.

Ditching

Send Distress Signals

Transmit Mayday, current position, course, speed, altitude, situation, intention, time and position of intended touchdown, and type of aircraft using existing air-to-ground frequency. Set transponder code 7700 and, if practical, determine the course to the nearest ship or landfall.

Advise Crew

Alert the crew to prepare for ditching and put on life vests, shoulder harnesses, and seat belts. Do not inflate life vests until after exiting the airplane.

Fuel Burn-Off

Consider burning off fuel prior to ditching, if the situation permits. This provides greater buoyancy and a lower approach speed. However, do not reduce fuel to a critical amount, as ditching with engine power available improves ability to properly control touchdown.

Ditching Final

Transmit final position. Select flaps 40 or landing flaps appropriate for the existing conditions.

Advise cabin occupants of imminent touchdown. On final approach announce ditching is imminent and advise them to brace for impact. Maintain airspeed at VREF. Maintain 200 to 300 fpm rate of descent. Plan to touchdown on the windward side and parallel to the waves or swells, if possible. To accomplish the flare and touchdown, rotate smoothly to touchdown attitude of 10° to 12°. Maintain airspeed and rate of descent with thrust.

Initiate Evacuation

After the airplane has come to rest, proceed to assigned ditching stations. Evacuate as soon as possible, ensuring all occupants are out of the airplane.

Note: Be careful not to rip or puncture the life vests. Avoid drifting into or under parts of the airplane. Remain clear of fuel-saturated water.

Engines and APU

Engine Limit Display Markings

Maximum and minimum limits are red. Caution limits are amber.
Normal operating ranges are green.

JT8D-17A

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
Maximum Acceleration EGT (2 minutes)	660° C
Maximum Takeoff EGT (5 minutes)	650° C
Maximum Continuous EGT	610° C
Maximum Start EGT -Ground Momentary -Flight	575° C 650° C

JT8D-15

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
Maximum Acceleration EGT (2 minutes)	630° C
Maximum Takeoff EGT (5 minutes)	620° C
Maximum Continuous EGT	580° C
Maximum Start EGT -Ground Momentary -Flight	550° C 620° C

JT8D-9

Maximum N1 RPM	100.1%
Maximum N2 RPM	100%
Maximum Acceleration EGT (2 minutes)	580° C
Maximum Takeoff EGT (5 minutes)	580° C
Maximum Continuous EGT	540° C
Maximum Start EGT -Ground Momentary -Flight	420° C 350° C

Engine Oil

Minimum Oil Pressure	40 psi
Maximum Oil Pressure	55 psi
JT8D-17A & -15 Maximum Oil Temperature (continuous) (15 minutes)	130° C 131° C - 165° C
JT8D-9 Maximum Oil Temperature (continuous) (15 minutes)	120° C 121° C - 157° C

Engine Ignition

Engine ignition must be on for:

• Operation in heavy rain • Anti-ice operation	• Takeoff • Landing
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Engine Thrust

Operation at reduced takeoff thrust based on an assumed temperature higher than the actual ambient temperature is permissible if the airplane meets all applicable performance requirements at the planned takeoff weight and reduced thrust setting. The amount of thrust reduction must not exceed 25 percent of the full rated takeoff thrust of the respective engine; for takeoff thrust equal to approximately 75 percent of normal takeoff thrust:

JT8D-7/ -7A/ -7B/ -9/ -9A-0.30 EPR

JT8D-15/ -15A-0.36 EPR

JT8D-17/ -17A/ -17R/ -17AR-0.37 EPR

When operating with an engine intermix:

The lowest rated engine installed shall be used for referencing the appropriate Runway Analysis Manual section for determining performance. Reduced takeoff thrust based on the assumed temperature method may still be used, however; when operating the higher rated engine at the lower rated engine's thrust level use the maximum EPR reduction associated with the lower rated engine.

● **NON-AFM ENGINE OPERATIONAL INFORMATION** ●

T/A Minimum Oil Quantity for Takeoff	1.5 gallons
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Pneumatic pressure (prior to starter engagement): minimum 30 psig at sea level, decreasing .5 psig per 1,000 ft. above sea level.

Ignition Duty Cycle –

- LOW IGN
- continuous
- FLT
- 2 minutes on, 3 minutes off
- 2 minutes on, 23 minutes off

Reverse Thrust

Reverse thrust is for ground operation only. Intentional selection of reverse thrust in flight is prohibited.

Auxiliary Power Unit (APU)

Do not use APU for both bleed and electrical load above 10,000 feet
Do not use APU bleed above 17,000 feet
With APU electrical load, maximum altitude is 35,000 feet
APU can operate up to 37,000 feet
Maximum start EGT is • 760°C - Ground • 650°C - Flight
Maximum continuous EGT is 710°C
APU bleed valve must be closed when: • Ground air connected and isolation valve open • Engine no. 1 bleed valve open • Isolation and engine no. 2 bleed valves open.
APU bleed valve may be open during engine start, but avoid engine power above idle.

● **NON-AFM OPERATIONAL INFORMATION** ●

If there are multiple aborted start attempts, five minutes cooling is required between the second and third attempt. A wait of one hour is required after the third start attempt.

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Maneuvers

Note: If positive visual verification is made that no obstacle or terrain hazard exists when flying under daylight VMC conditions prior to a terrain or obstacle warning, the alert may be regarded as cautionary and the approach may be continued.

Engine Overboost

A significant thrust overboost capability exists which could be used in emergency situations. This overboost capability should only be considered when ground contact is imminent. Overboosting the engines when the situation is not sufficiently serious unnecessarily shortens engine life and increases the potential for engine failure. In an emergency situation "firewalling the thrust levers" should be considered. This condition could result in an EGT or N1 exceedance. Land at the nearest suitable airport.

Traffic Alert and Collision Avoidance System

The Traffic Alert and Collision Avoidance System (TCAS) is designed to enhance crew awareness of nearby traffic and issue advisories for timely visual acquisition or appropriate vertical flight path maneuvers to avoid potential collisions. It is intended as a backup to visual collision avoidance, application of right-of-way rules and ATC separation.

Use of TA/RA, TA Only, and Transponder Only Modes

TCAS operation should be initiated just before takeoff and continued until just after landing. The system is to be operated in the TA/RA mode at all times during flight.

The responsibility for avoiding collisions still remains with the flight crew and ATC. Pilots should not become preoccupied with TCAS advisories and displays at the expense of basic airplane control, normal visual lookout and other crew duties.

Traffic Advisory

A Traffic Advisory (TA) occurs when nearby traffic meets system minimum separation criteria, and is indicated aurally and visually on the TCAS traffic display. A goal of the TA is to alert the pilot of the possibility of an RA.

Initial Climb – All Engines

After liftoff, use the attitude indicator as the primary pitch reference. Pitch, airspeed, and airspeed trends must be cross-checked. Adjust pitch to maintain a target airspeed of $V_2 + 20$ knots.

$V_2 + 20$ is the optimum climb speed with takeoff flaps. It results in the maximum altitude gain in the shortest distance from takeoff. Acceleration to higher speeds reduces the altitude gain. If airspeed exceeds $V_2 + 20$ during the initial climb, stop the acceleration but do not attempt to reduce airspeed to $V_2 + 20$. Any speed between $V_2 + 15$ and $V_2 + 25$ knots results in approximately the same takeoff profile. Crosscheck indicated airspeed for proper initial climb speed.

Retract the landing gear after a positive rate of climb is indicated on the altimeter. Do not apply brakes after becoming airborne. Braking is automatically applied when the landing gear lever is placed in the up position. After gear and flaps are retracted, the PM should verify the gear and flaps indications are normal.

Minimum Fuel Operation - Takeoff

The minimum fuel recommended for takeoff is trip fuel plus reserves. On very short flights this fuel quantity may not be enough to prevent forward fuel pump low pressure lights from illuminating after takeoff.

If any main tank fuel pump indicates low pressure do not turn off fuel pump switches. Avoid rapid acceleration of the airplane, reduce nose-up body attitude and maintain minimum nose-up body angle required for a safe climb gradient.

Immediate Turn after Takeoff - All Engines

Obstruction clearance, noise abatement, or departure procedures may require an immediate turn after takeoff. Initiate the turn at the appropriate altitude (normally at least 400 feet AGL) and maintain $V_2 + 15$ to $V_2 + 25$ with takeoff flaps.

Note: A maximum bank angle of 30° is permitted at $V_2 + 15$ knots with takeoff flaps. After completing the turn, and at or above acceleration height, accelerate and retract flaps while climbing.

Note: The possibility of an engine failure along the departure track must be considered. Special engine out procedures, if available, are preferable to a takeoff weight reduction to ensure all obstacles are cleared.

Autopilot Engagement

The autopilot is FAA certified to allow engagement at or above 1,000 feet AGL after takeoff. The airplane should be in trim, and the flight director commands should be satisfied prior to autopilot engagement. This prevents unwanted changes from the desired flight path during autopilot engagement.

Flap Retraction Schedule

The minimum altitude for flap retraction is 400 feet, unless the RAM states otherwise.

For noise abatement considerations during line operations, thrust reduction typically occurs at approximately 1,500 feet AFE and acceleration typically occurs between 1,500 and 3,000 feet AFE, or as specified by individual airport noise abatement procedures.

At thrust reduction altitude, select or verify that climb thrust is set. At acceleration height retract flaps on the Flap Retraction Schedule.

Begin flap retraction at $V_2 + 15$ knots, except for a flaps 1 takeoff. For a flaps 1 takeoff, begin flap retraction when reaching the flaps 1 Retraction Schedule.

With airspeed increasing, subsequent flap retractions should be initiated when airspeed reaches the fixed maneuver speed for the existing flap position.

For flaps up maneuvering, maintain at least flaps up maneuver speed. With flaps up and above 3,000 feet AGL, adjust pitch to climb attitude.

Takeoff Flap Retraction Speed Schedule

T/O Flaps	Select Flaps	At & Below 117,000 Lb (53,070 Kg)	Above 117,000 Lb (53,070 Kg)
25	15	$V_2 + 15$	$V_2 + 15$
	5	150	160
	1	170	180
	UP	190	200
15	5	$V_2 + 15$	$V_2 + 15$
	1	170	180
	UP	190	200
5	1	$V_2 + 15$	$V_2 + 15$
	UP	190	200
1	UP	190	200

Note: Limit bank angle to 15 degrees until reaching $V_2 + 15$.

Takeoff – Engine Failure

General

Differences between normal and engine out profiles are few. One engine out controllability is excellent during takeoff roll and after liftoff. Minimum control speeds in the air (VMCAs) are below VR and VREF.

Engine Failure Recognition

An engine failure at or after V1 initially affects yaw much like a crosswind effect. Vibration and noise from the affected engine may be apparent and the onset of the yaw may be rapid. The airplane heading is the best indicator of the correct rudder pedal input. To counter the thrust asymmetry due to an engine failure, stop the yaw with rudder. Flying with lateral control wheel displacement or with excessive aileron trim causes spoilers to be raised.

Rotation and Liftoff - One Engine Inoperative

If an engine fails between V1 and liftoff, maintain directional control by smoothly applying rudder proportionate with thrust decay.

During a normal all engine takeoff, a smooth continuous rotation toward 15° of pitch is initiated at VR. With an engine inoperative, a smooth continuous rotation is also initiated at VR; however, the target pitch attitude is approximately 2° to 3° below the normal all engine pitch attitude. The rate of rotation with an engine inoperative is also slightly slower (1/2° per second less) than that for a normal takeoff. After liftoff adjust pitch attitude to maintain the desired speed.

If the engine failure occurs at or after liftoff apply rudder and aileron to control heading and keep the wings level. In flight, correct rudder input approximately centers the control wheel. To center the control wheel, rudder is required in the direction that the control wheel is displaced. This approximates a minimum drag configuration.

Typical Rotation - One Engine Inoperative

Liftoff attitude depicted in the following tables should be achieved in approximately 5 seconds. Adjust pitch attitude, as required, to maintain the desired airspeed between V2 and V2+15 (SP-77).

4.6 Non-Normal Operations

This chapter describes pilot techniques associated with accomplishing selected Non-Normal Checklists (NNCs) and provides guidance for situations beyond the scope of NNCs. Aircrews are expected to accomplish NNCs listed in the QRH. These checklists ensure maximum safety until appropriate actions are completed and a safe landing is accomplished. Techniques discussed in this chapter minimize workload, improve crew coordination, enhance safety, and provide a basis for standardization. A thorough review of the QRH Introduction section and Non-Normal Checklists is an important prerequisite to understanding this chapter.

Non-Normal Situation Guidelines

When a non-normal situation occurs, the following guidelines apply:

- **NON-NORMAL RECOGNITION:** The crewmember recognizing the malfunction calls it out clearly and precisely
- **MAINTAIN AIRPLANE CONTROL:** It is mandatory that the Pilot Flying (PF) fly the airplane while the Pilot Monitoring (PM) accomplishes the NNC. Maximum use of the autoflight system is recommended to reduce crew workload.
- **ANALYZE THE SITUATION:** NNCs should be accomplished only after the malfunctioning system has been positively identified. Review all caution and warning lights to positively identify the malfunctioning system(s).

Note: Pilots should don oxygen masks and establish communications anytime oxygen deprivation or air contamination is suspected, even though an associated warning has not occurred.

- **TAKE THE PROPER ACTION:** Although some in-flight non-normal situations require immediate corrective action, difficulties can be compounded by the rate the PF issues commands and the speed of execution by the PM. Commands must be clear and concise, allowing time for acknowledgment of each command prior to issuing further commands. The PF must exercise positive control by allowing time for acknowledgment and execution. The other crewmembers must be certain their reports to the PF are clear and concise, neither exaggerating nor understating the nature of the non-normal situation. This eliminates

confusion and ensures efficient, effective, and expeditious handling of the non-normal situation

- **EVALUATE THE NEED TO LAND:** If the NNC directs the crew to land at the nearest suitable airport, or if the situation is so identified in the QRH, diversion to the nearest airport where a safe landing can be accomplished is required. If the NNC or the Introduction section does not direct landing at the nearest suitable airport, the pilot must determine if continued flight to destination may compromise safety.

Troubleshooting

Troubleshooting can be defined as:

- taking steps beyond a published NNC in an effort to improve or correct a non-normal condition
- initiating an annunciated checklist without a light, alert, or other indication to improve or correct a perceived non-normal condition
- initiating diagnostic actions.

Examples of troubleshooting are:

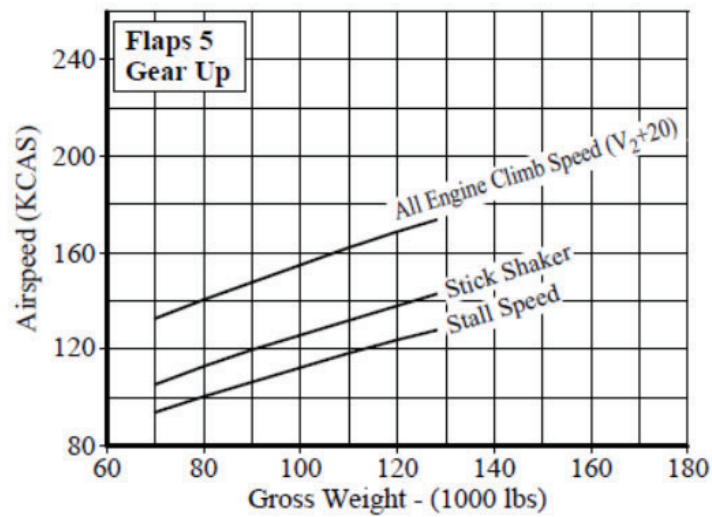
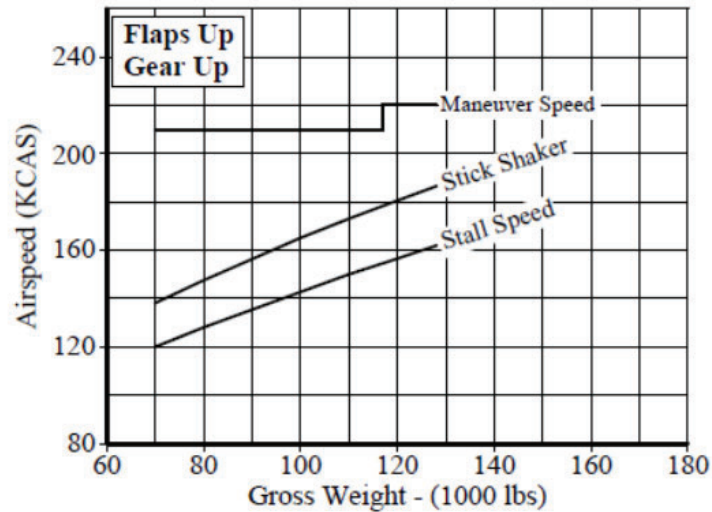
- attempting to reset a system by cycling a system control or circuit breaker when not directed by the NNC
- using maintenance-level information to diagnose or take action
- using switches or controls intended only for maintenance.

Troubleshooting beyond checklist directed actions is rarely helpful and has caused further loss of system function or failure. In some cases, accidents and incidents have resulted. The crew should consider additional actions beyond the checklist only when completion of the published checklist steps clearly results in an unacceptable situation. In the case of airplane controllability problems when a safe landing is considered unlikely, airplane handling evaluations with gear, flaps or speedbrakes extended may be appropriate. In the case of jammed flight controls, do not attempt troubleshooting beyond the actions directed in the NNC unless the airplane cannot be safely landed with the existing condition. Always comply with NNC actions to the extent possible.

Crew distraction, caused by preoccupation with troubleshooting, has been a key factor in several fuel starvation and CFIT accidents. Boeing recommends completion of the NNC as published whenever possible, in particular for flight control malfunctions that are addressed by a NNC. Guidance for situations beyond the scope of the non-normal checklist is provided later in this chapter.

Stick Shaker and Stall Speeds

737-200A



4.2 Taxi, Takeoff and Initial Climb

Preface

This chapter provides a quick reference summary of operating procedures. The discussion portion of each illustration highlights important information. The flight profile illustrations represent the recommended basic configuration during the accomplishment of the flight maneuvers, and provides a basis for standardization and crew coordination.

Preflight

Fluctuating and inaccurate airspeed and altimeter indications after takeoff have been attributed to static ports obstructed by ice formed while the airplane was on the ground. Precipitation or water rundown after snow removal may freeze on or near the static ports. This may cause an ice buildup which disturbs airflow over the static ports resulting in erroneous airspeed and altimeter readings, even when static ports appear to be clear. Since static ports and the surrounding surfaces are not heated when probe heat is activated, a thorough preflight inspection and clearing of all contaminants around the static ports are critical.

The crew should pay particular attention to the static ports during the exterior inspection when the airplane has been subjected to freezing precipitation. Clear ice on the static ports can be difficult to detect. If in doubt, contact maintenance for assistance.

Takeoff Briefing

The takeoff briefing is conducted by the pilot flying and is a description of the departure flight path with emphasis on anticipated track and altitude restrictions. It assumes normal operating procedures will be used. Additional briefing items may be required when any elements of the takeoff and/or departure are different from those routinely used. These may include inclement weather, adverse runway conditions, unique noise abatement requirements, dispatch using the minimum equipment list or any other situation where it is necessary to review or define crew responsibilities. The takeoff briefing must be accomplished as soon as practical so as not to interfere with the final takeoff preparations.

The following will be briefed before all takeoffs:

- If an RTO is necessary, the Captain will execute the procedure and the First Officer will notify the tower.
- If an engine fail/fire occurs at (or near V1) and the takeoff is continued, the Pilot Flying (PF) will continue flying and,

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when the aircraft is under positive control, call for the appropriate checklist. The Pilot Monitoring (PM) will assist in identifying the engine, execute the memory items in a timely but deliberate manner and then complete the checklist.

- If an emergency landing is necessary, it will be at the nearest suitable runway - not necessarily the Takeoff Alternate, if one was required for dispatch. In addition to the phrase "Standard Rhoades Briefing," the following will be added:
 - Engine failure acceleration altitude
 - Initial heading
 - Initial assigned altitude
 - Takeoff thrust, Max or Reduced. If Reduced thrust is used, brief and verify the appropriate EPR and bugs are set correctly.
 - Special conditions (if any) such as; inclement weather, runway conditions, unusual engine-out procedures, etc. A typical Takeoff Briefing could be; "Standard Rhoades Briefing", engine failure acceleration altitude 800 feet, heading 120°, 5000 feet initial altitude, Reduced thrust, thunderstorm 5 miles off end of runway."
-

Backing with Reverse Thrust

Backing with reverse thrust is prohibited.

Takeoff – Engine Failure

General

Differences between normal and engine out profiles are few. One engine out controllability is excellent during takeoff roll and after liftoff. Minimum control speeds in the air (VMCAs) are below VR and VREF.

Engine Failure Recognition

An engine failure at or after V1 initially affects yaw much like a crosswind effect. Vibration and noise from the affected engine may be apparent and the onset of the yaw may be rapid. The airplane heading is the best indicator of the correct rudder pedal input. To counter the thrust asymmetry due to an engine failure, stop the yaw with rudder. Flying with lateral control wheel displacement or with excessive aileron trim causes spoilers to be raised.

Rotation and Liftoff - One Engine Inoperative

If an engine fails between V1 and liftoff, maintain directional control by smoothly applying rudder proportionate with thrust decay.

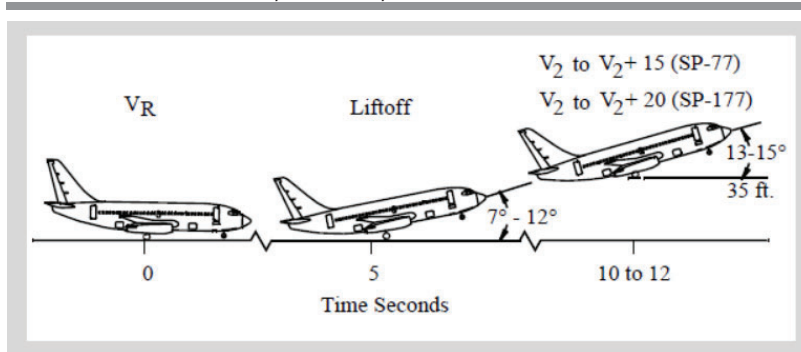
During a normal all engine takeoff, a smooth continuous rotation toward 15° of pitch is initiated at VR. With an engine inoperative, a smooth continuous rotation is also initiated at VR; however, the target pitch attitude is approximately 2° to 3° below the normal all engine pitch attitude. The rate of rotation with an engine inoperative is also slightly slower (1/2° per second less) than that for a normal takeoff. After liftoff adjust pitch attitude to maintain the desired speed.

If the engine failure occurs at or after liftoff apply rudder and aileron to control heading and keep the wings level. In flight, correct rudder input approximately centers the control wheel. To center the control wheel, rudder is required in the direction that the control wheel is displaced. This approximates a minimum drag configuration.

Typical Rotation - One Engine Inoperative

Liftoff attitude depicted in the following tables should be achieved in approximately 5 seconds. Adjust pitch attitude, as required, to maintain the desired airspeed between V2 and V2+15 (SP-77).

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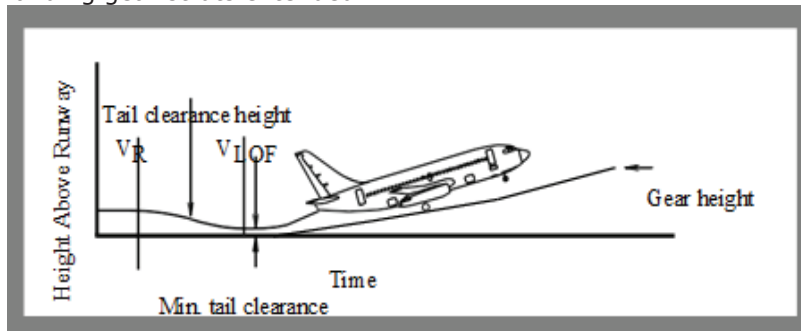


Retract the landing gear after a positive rate of climb is indicated on the altimeter.

Retract flaps in accordance with the technique described in this chapter.

Typical Takeoff Tail Clearance - One Engine Inoperative

The following diagram and table show the effect of flap position on liftoff pitch attitude and minimum tail clearance during takeoff with one engine inoperative. Additionally, the last column shows the pitch attitude for tail contact with wheels on runway and landing gear struts extended.



Model	Flap	Liftoff Attitude (degrees)	Minimum Tail Clearance inches (cm)	Tail Strike Pitch Attitude (degrees)
200A	1	12.2	20 (51)	15.0
	2	11.5	24 (61)	
	5	11.2	26 (65)	
	15	10.7	28 (70)	
	25	10.8	28 (70)	

Initial Climb - One Engine Inoperative

The initial climb attitude should be adjusted to maintain a minimum of V_2 and a positive climb. After liftoff attitude and indicated airspeed are the primary pitch references. Cross check indicated airspeed, vertical speed and other flight instruments as needed.

Retract the landing gear after a positive rate of climb is indicated on the altimeter. The initial climb attitude should be adjusted to maintain a minimum of V_2 . If an engine fails at an airspeed between V_2 and $V_2 + 20$ knots, climb at the airspeed at which the failure occurred. If engine failure occurs above $V_2 + 20$ knots, increase pitch to reduce the airspeed to $V_2 + 20$ knots and maintain $V_2 + 20$ knots until reaching acceleration height.

Indications of an engine fire, impending engine breakup or approaching or exceeding engine limits, should be dealt with as soon as possible. Accomplish the appropriate memory checklist items as soon as the airplane is under control, the gear has been retracted and a safe altitude has been attained. Accomplish the reference checklist items after the flaps have been retracted and conditions permit.

If an engine failure has occurred during initial climb, accomplish the appropriate checklist after the flaps have been retracted and conditions permit.

Immediate Turn after Takeoff - One Engine Inoperative

Obstacle clearance or departure procedures may require a special engine out departure procedure. If an immediate turn is required, initiate the turn at no lower than 500 AFE

Note: Maintain V_2 to $V_2 + 15$ knots with takeoff flaps while maneuvering.

Note: Limit bank angle to 15° until $V_2 + 15$ knots. Bank angles up to 30° are permitted at $V_2 + 15$ knots with takeoff flaps.

After completing the turn, and at or above acceleration height, accelerate and retract flaps.

Autopilot Engagement - One Engine Inoperative

When at a safe altitude above 1,000 feet AGL with correct rudder pedal or trim input, the autopilot may be engaged.

Flap Retraction - One Engine Inoperative

The minimum altitude for flap retraction with an engine inoperative is 400 feet AGL.

Acceleration height for a takeoff with an engine failure after V1 is based on accelerating to the recommended flaps up speed while retracting flaps and selecting maximum continuous thrust limits within 5 minutes after initiating takeoff. Some combinations of high gross weight, takeoff flap selection and airport elevation may require initiating flap retraction as low as 400 feet after takeoff with an engine failure.

Engine-out acceleration and climb capability for flap retraction are functions of airplane thrust to weight ratio. Decrease pitch attitude to maintain approximately level flight while accelerating.

Accelerate and retract flaps on the flap-speed schedule.

Note: When the autopilot is engaged, the flight crew needs to monitor the autopilot performance to ensure a near level or slight climb is maintained.

If the flight director is not being used at acceleration height, decrease pitch attitude to maintain approximately level flight while accelerating. Retract flaps on the takeoff flap retraction Speed schedule.

As the airplane accelerates and flaps are retracted, adjust the rudder pedal position to maintain the control wheel centered and trim to relieve rudder pedal pressure.

Flaps Up - One Engine Inoperative

After flap retraction and at flaps up maneuver speed, set maximum continuous thrust and continue to climb to the obstacle clearance altitude.

Initiate the appropriate engine failure non-normal checklist followed by the After Takeoff checklist when the flaps are up and thrust is set. Remain at flaps up maneuver speed until all obstructions are cleared, then select the engine-out schedule from the PDCS. After level-off, set thrust as required.

Noise Abatement - One Engine Inoperative

When an engine failure or abnormal situation affecting safety occurs after takeoff, noise abatement is no longer a requirement.

Engine Failure During a Reduced Thrust (ATM) Takeoff

Since the reduced thrust (ATM) takeoff must still comply with all regulatory takeoff performance requirements, it is not necessary to increase thrust beyond the reduced level on the operating engine in the event of an engine failure. However, if more thrust is needed during an ATM takeoff, thrust on the operating engine may be increased to full rated takeoff thrust by manually advancing the thrust lever. This is because the takeoff speeds consider VMCG and VMCA at the full rated takeoff thrust.

Increasing thrust on the operating engine to full rated takeoff thrust provides additional performance margin. This additional performance margin is not a requirement for the reduced thrust takeoff and its use is at the discretion of the flight crew.

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Takeoff: Engine Failure After V1

PILOT FLYING	PILOT MONITORING
Do not advance the thrust levers for takeoff until the BEFORE TAKEOFF checklist is complete. If the First Officer is the Pilot Flying, the Captain states, " YOU HAVE CONTROL. " when transferring control. The First Officer acknowledges, " I HAVE CONTROL. "	
As the aircraft is aligned with the runway, advance the thrust levers to 1.4 EPR and allow the engines to stabilize. (for no more than 2 seconds)	Call " ENGINES STABLE. " when engine instruments have stabilized.
Advance thrust levers to takeoff EPR and call: " SET REDUCED THRUST. " or " SET MAX THRUST. " as applicable. Verify EPR.	Set thrust as commanded. After desired EPR Thrust is set, verify target N1 is achieved and call out " THRUST SET. "
Note: After takeoff thrust is set, the Captain's hand must be on the thrust levers until V1.	
Hold light forward pressure on the control column, maintain directional control.	Monitor engine instruments.
Confirm the airspeed and respond " CHECK. "	At 80 KIAS call " 80 KNOTS ". (if the 80 kt call is called late, call the actual speed indicated.)
	5 KIAS PRIOR to V ₁ , Call " V₁ ".
Captain removes hand from thrust levers.	
ENGINE FAILURE at V1	
Announce " ENGINE FAILURE " (recognized primarily from yawing moment and rudder input required to counteract it)	Announce " ENGINE FAILURE " (recognized primarily from yawing moment and engines gauges)
Rotate at 2 - 2½° per second toward a climb attitude of approximately 12 - 13°.	At VR, call " ROTATE. " At V2, call " V2 ".

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PILOT FLYING	PILOT MONITORING
Stay on runway heading with wings and yoke level	When positive climb noted on the barometric altimeter, call "POSITIVE RATE" .
(Call "POSITIVE RATE" if the PM omits.) Call "GEAR UP." after "POSITIVE RATE" is announced. Adjust pitch attitude, as required, to maintain the desired climb speed V2 to V2 + 20 until flap retraction altitude (V2 to V2 + 15 if maneuvering). Limit bank angle to 15° until V2+15 knots	Position LANDING GEAR lever UP when directed.

Initial Climb: Engine Failure After V1

PILOT FLYING	PILOT MONITORING
At or above 500 feet AGL (unless an earlier turn is required by a departure procedure):	
If using the Flight Director, call for appropriate lateral mode: "HEADING SELECT" or "VOR/LOC." "DECLARE EMERGENCY"	Select the requested lateral mode on the Flight Director. Acknowledges "DECLARE EMERGENCY" request and notifies ATC when able
After the aircraft has reached Acceleration Altitude (800 ft AFE minimum or higher as required by Transair runway analysis):	
Adjust pitch to allow aircraft to accelerate to flaps up maneuvering speed Call for flap retraction on schedule Example - flaps 5 t/o: At V2+15: "FLAPS 1" At 190 KIAS: "FLAPS UP"	Position FLAP lever as directed and monitor flaps and slats retraction.

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At 210 KIAS, call "SET MAX CONTINUOUS THRUST" and resume climbing at flaps up maneuvering speed	Set Max Continuous Thrust.
Engage autopilot if desired and announce, "AUTOPILOT ENGAGED."	
Determine the malfunction and call for the appropriate non-normal checklist.	Read and accomplish the appropriate QRH checklist.
When complete, call for the "AFTER TAKEOFF CHECKLIST."	Silently accomplish the After Takeoff Checklist and announce "AFTER TAKEOFF CHECKLIST COMPLETE."

Enroute

PILOT FLYING	PILOT MONITORING
Captain: When established in a level flight attitude, if the center tank contains usable fuel and a center tank fuel pump switch(es) is OFF, set the center tank fuel pump switch(es) to ON again. Set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates. Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.	
Advise any changes from ATC or "NO CHANGES." Set the standby altimeter to destination altimeter setting.	Retrieve current information when arrival ATIS can be received. On short segments, PM may retrieve ATIS during climb when above 5,000 feet. If leaving the main frequency, confirm with PF that he will monitor that frequency. Advise PF when you are on the main frequency again. Brief PF on new weather, notams, etc.
After reviewing the destination weather and determining the approach to be flown, direct the PM to set up for approach when appropriate. Example: SET UP THE ILS 31 CENTER, FLAPS 40 LANDING.	Accomplish the following: - Check the allowable landing weight. - Tune navigation radios for the appropriate approach. - Select VOR/ADF Bearing Pointer Switch on the RMI

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	to either VOR or ADF as required. • Set the final approach course in both COURSE windows. • Set MDA(H)/DA(H) with the appropriate MINS selector and inform PF of this value.
PILOT FLYING	PILOT MONITORING
	• Select required setting with the AUTO BRAKE switch. • Select VREF for requested flap setting and inform PF of any wind correction.
Transfer aircraft control to the PM by saying (similar to) "Ready for briefing?" "YOU HAVE CONTROL." and advise new PF of current automation, navigation, and configuration (example - "Autopilot on, altitude hold 15,000, heading 285, speedbrakes extended.")	"Ready." "I HAVE CONTROL" (includes control of navigation, ATC communication, and setting altitude alerter)."
Complete the Arrival Briefing prior to top of descent (TOD). Include all information on the ARRIVAL BRIEFING checklist.	Monitor the approach briefing.
When briefing complete, assume aircraft control back by announcing (similar to) "Ready for controls."	"YOU HAVE CONTROL." plus current automation, navigation, and configuration.

Taxi - Adverse Weather

Taxi under adverse weather conditions requires more awareness of surface conditions.

When taxiing on a slippery or contaminated surface, particularly with strong crosswinds, use reduced speeds. Use of differential engine thrust assists in maintaining airplane momentum through the turn. When nearing turn completion, placing both engines to idle thrust reduces the potential for nose gear skidding. Avoid using large nose wheel steering inputs to correct for skidding. Differential braking may be more effective than nose wheel steering on slippery or contaminated surfaces. If speed is excessive, reduce speed prior to initiating a turn.

Note: A slippery surface is any surface where the braking capability is less than that on a dry surface. Therefore, a surface is considered "slippery" when it is wet or contaminated with ice, standing water, slush, snow or any other deposit that results in reduced braking capability.

During cold weather operations, nose gear steering should be exercised in both directions during taxi. This circulates warm hydraulic fluid through the steering cylinders and minimizes the steering lag caused by low temperatures.

Low Visibility

Pilots need a working knowledge of airport surface lighting, markings, and signs for low visibility taxi operations. Understanding the functions and procedures to be used with stop bar lights, ILS critical area markings, holding points, and low visibility taxi routes is essential to conducting safe operations. Many airports have special procedures for low visibility operations. For example, airports operating under FAA criteria with takeoff and landing minimums below 1200 feet (350m) RVR are required to have a low visibility taxi plan.

Takeoff - General

This profile may not satisfy noise abatement guidelines established by the FAA. Some airports may have special procedures that require modification of the takeoff profile. As part of the before start procedure, review the takeoff page on the PDCS to ensure the entries are correct. Ensure V2 is set on the airspeed indicators.

Although flaps up speed to 3000' is generally recommended for noise abatement reasons, it may not be required except at heavy weights. At lighter weights the performance of the airplane is such

that 3,000 feet is usually reached before flap retraction is complete.

Takeoff Flap Setting

For takeoffs, when conditions permit, consider using larger flap settings to provide shorter takeoff distance. Larger flap settings also provide greater tail clearance. Refer to the Typical Takeoff Tail Clearance table in this chapter to determine minimum tail clearance for different takeoff flap settings.

Thrust Management

High thrust settings from jet engine blast over unpaved surfaces or thin asphalt pavement intended only to support occasional aircraft movements can cause structural blast damage from loose rocks, dislodged asphalt pieces, and other foreign objects. Ensure run ups and takeoff operations are only conducted over well maintained paved surfaces and runways.

Initiating Takeoff Roll

The flight director is normally off for takeoff. Flight director commands may be used after flaps are retracted and climb thrust is set.

Note: If a possibility exists of a windshear being encountered on takeoff, flight directors should be turned off for airplanes not equipped with a windshear warning system.

A rolling takeoff procedure is recommended for setting takeoff thrust. It expedites takeoff and reduces the risk of foreign object damage or engine surge/stall due to a tailwind or crosswind. Flight test and analysis prove that the change in takeoff roll distance due to the rolling takeoff procedure is negligible when compared to a standing takeoff.

Rolling takeoffs are accomplished in two ways:

- If cleared for takeoff prior to or while entering the runway, maintain normal taxi speed. When the airplane is aligned with the runway centerline ensure the nose wheel steering wheel is released and apply takeoff thrust by advancing the thrust levers to approximately 1.4 EPR (levers in vertical position.). Allow the engines to stabilize momentarily then promptly advance the thrust levers to takeoff thrust. There is no need to stop the airplane before increasing thrust.
- If holding in position on the runway, ensure the nose wheel steering wheel is released, release brakes, then apply takeoff thrust as described above.

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Note: Brakes are not normally held with thrust above idle unless a static run-up in icing conditions is required.

A standing takeoff procedure may be accomplished by holding the brakes until the engines are stabilized, ensure the nose wheel steering wheel is released, then release the brakes and promptly advance the thrust levers to takeoff thrust.

Allowing the engines to stabilize provides uniform engine acceleration to takeoff thrust and minimizes directional control problems. This is particularly important if crosswinds exist or the runway surface is slippery. The exact initial setting is not as important as setting symmetrical thrust. If thrust is to be set manually, smoothly advance thrust levers toward takeoff thrust.

Note: Allowing the engines to stabilize for more than approximately 2 seconds prior to advancing thrust levers to takeoff thrust may adversely affect takeoff distance.

Ensure the target EPR is set by 60 knots. Minor increases in thrust may be made immediately after 60 knots to reach the target EPR. After takeoff thrust is set, a small deviation in EPR between the engines should not warrant a decision to reject the takeoff unless this deviation is accompanied by a more serious event. (Refer to the QRH, Maneuvers Chapter, Rejected Takeoff, for criteria.) Due to variation in thrust settings, runway conditions, etc., it is not practical to specify a precise tolerance for EPR difference between the engines.

Limited circumstances such as inoperative rudder pedal steering may require the use of the nose wheel steering wheel at low speeds during takeoff when the rudder is not effective. Reference the airplane MEL for more information concerning operation with rudder pedal steering inoperative.

If an engine exceedance occurs after thrust is set and the decision is made to continue the takeoff, do not retard the thrust lever in an attempt to control the exceedance. Retarding the thrust levers after thrust is set invalidates takeoff performance. When the PF judges that altitude (minimum 400 feet AGL) and airspeed are acceptable, the thrust lever should be retarded until the exceedance is within limits and the appropriate NNC accomplished.

Light forward pressure is held on the control column. Keep the airplane on centerline with rudder pedal steering and rudder. The rudder becomes effective between 40 and 60 knots. Maximum nose wheel steering effectiveness is available when above taxi speeds by using rudder pedal steering.

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Regardless of which pilot is making the takeoff, the captain should keep one hand on the thrust levers until V1 in order to respond quickly to a rejected takeoff condition. After V1, the captain's hand should be removed from the thrust levers.

The PM should monitor engine instruments and airspeed indications during the takeoff roll and announce any abnormalities. The PM should announce passing 80 knots and the PF should verify that his airspeed indicator is in agreement.

A pitot system blocked by protective covers or foreign objects can result in no airspeed indication, or airspeed indications that vary between instruments. It is important that aircrews ensure airspeed indicators are functioning and reasonable at the 80 knot callout. If the accuracy of either primary airspeed indication is in question, reference the standby airspeed indicator. Early recognition of a malfunction is important in making a sound go/stop decision. Refer to the Airspeed Unreliable in the QRH for the non-normal procedure.

Rotation and Liftoff - All Engines

Takeoff speeds are established based on minimum control speed, stall speed, and tail clearance margins. Shorter bodied airplanes are normally governed by stall speed margin while longer bodied airplanes are normally limited by tail clearance margin. When a smooth continuous rotation is initiated at VR, tail clearance margin is assured because computed takeoff speeds depicted in the PI chapter of the QRH are developed to provide adequate tail clearance.

Above 80 knots, relax the forward control column pressure to the neutral position. For optimum takeoff and initial climb performance, initiate a smooth continuous rotation at VR toward 15° of pitch attitude. The use of stabilizer trim during rotation is not recommended.

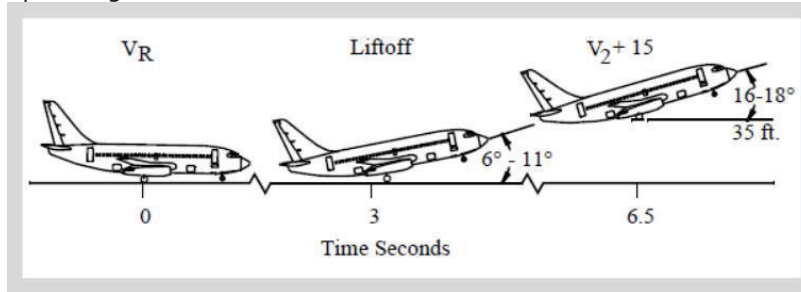
After liftoff use the attitude indicator as the primary pitch reference, cross checking indicated airspeed and other flight instruments to maintain the proper vertical flight path.

Using the technique above, liftoff attitude is achieved in approximately 3 to 6 seconds. Rotate smoothly at an average pitch rate of 3 degrees/second.

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Typical Rotation, All Engines

The following figure shows typical rotation with all engines operating.

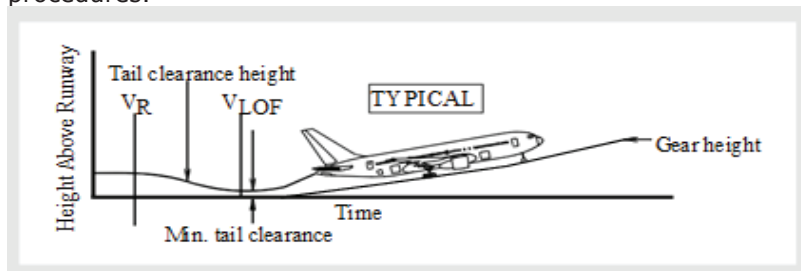


Retract the landing gear after a positive rate of climb is indicated on the altimeter.

Retract flaps in accordance with the technique described in this chapter.

Typical Takeoff Tail Clearance

The following diagram and table show the effect of flap position on liftoff pitch attitude and minimum tail clearance during takeoff. Additionally, the last column shows the pitch attitude for tail contact with wheels on the runway and landing gear struts extended. See AOMv1 Non-Normal procedures for tail strike procedures.



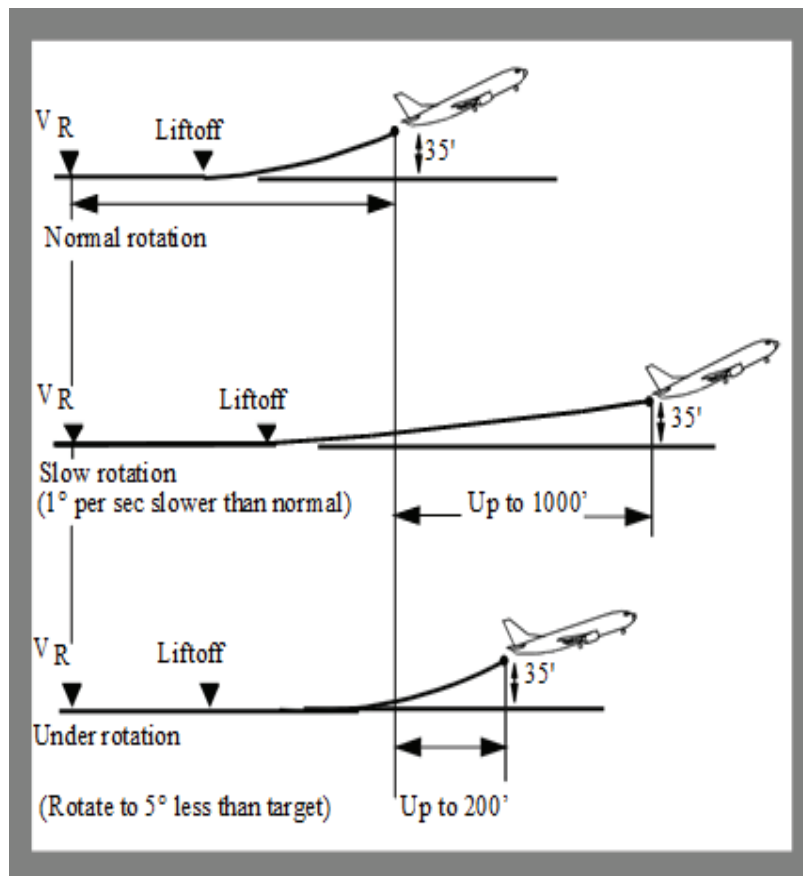
Model	Flap	Liftoff Attitude (degrees)	Minimum Tail Clearance inches (cm)	Tail Strike Pitch Attitude (degrees)
200A	1	10.9	27 (69)	15.5
	2	10.0	31 (79)	
	5	9.6	33 (84)	
	15	8.9	36 (92)	
	25	8.8	36 (92)	

Effect of Rotation Speed and Pitch Rate on Liftoff

Takeoff and initial climb performance depend on rotating at the correct airspeed and proper rate to the rotation target attitude. Early or rapid rotation may cause a tail strike. Late, slow, or under-rotation increases takeoff ground roll. Any improper rotation decreases initial climb flight path.

The following diagram shows how a slow or under rotation during takeoff increases the distance to a height of 35 feet compared to a normal rotation.

Slow or Under Rotation (Typical)



Center-Of-Gravity (C.G.) Effects

When taking off at light weight and with an aft C.G., the combination of full thrust, rapid thrust application, and sudden brake release may tend to pitch the nose up, reducing nosewheel steering effectiveness. With C.G. at or near the aft limit, maintain forward pressure on the control column until 80 knots to increase nosewheel steering effectiveness. Above 80 knots, relax the forward control column pressure to the neutral position. At light weight and aft C.G., use of reduced thrust and rolling takeoff technique is recommended whenever possible. The rudder becomes effective between 40 and 60 knots.

Directional Control

Initial runway alignment and smooth symmetrical thrust application result in good crosswind control capability during takeoff. Light forward pressure on the control column during the initial phase of takeoff roll (below approximately 80 knots) increases nose wheel steering effectiveness. Any deviation from the centerline during thrust application should be countered with immediate smooth and positive control inputs. Smooth rudder and control wheel inputs result in a normal takeoff with no over-controlling. Large control wheel inputs can have an adverse effect on directional control near V₁(MCG) due to the additional drag of the extended spoilers.

Note: With wet or slippery runway conditions, the PM should give special attention to ensuring the engines have symmetrically balanced thrust indications.

Rotation and Takeoff

Begin the takeoff roll with the control wheel approximately centered. Throughout the takeoff roll, gradually increase control wheel displacement into the wind only enough to maintain approximately wings level.

Note: Excessive control wheel displacement during rotation and liftoff increases spoiler deployment. As spoiler deployment increases, drag increases and lift is reduced which results in reduced tail clearance, a longer takeoff roll, and slower airplane acceleration.

At liftoff, the airplane is in a sideslip with crossed controls. A slow, smooth recovery from this sideslip is accomplished by slowly neutralizing the control wheel and rudder pedals after liftoff.

Gusty Wind and Strong Crosswind Conditions

For takeoff in gusty or strong crosswind conditions, use of a higher thrust setting than the minimum required is recommended. When the prevailing wind is at or near 90° to the runway, the possibility of wind shifts resulting in gusty tailwind components during rotation or liftoff increases. During this condition, consider the use of thrust settings close to or at maximum takeoff thrust. The use of a higher takeoff thrust setting reduces the required runway length and minimizes the airplane exposure to gusty conditions during rotation, liftoff, and initial climb.

To increase tail clearance during strong crosswind conditions, consider using a higher VR if takeoff performance permits. This can be done by:

- using improved climb takeoff performance methods
- increasing VR speed to the performance limited gross weight rotation speed, not to exceed actual gross weight VR + 20 knots. Set V speeds for the actual gross weight. Rotate at the adjusted (higher) rotation speed. This increased rotation speed results in an increased stall margin, and meets takeoff performance requirements.

Avoid rotation during a gust. If a gust is experienced near VR, as indicated by stagnant airspeed or rapid airspeed acceleration, momentarily delay rotation. This slight delay allows the airplane additional time to accelerate through the gust and the resulting additional airspeed improves the tail clearance margin. Do not rotate early or use a higher than normal rotation rate in an attempt to clear the ground and reduce the gust effect because this reduces tail clearance margins. Limit control wheel input to that required to keep the wings level. Use of excessive control wheel may cause spoilers to rise which has the effect of reducing tail clearance. All of these factors provide maximum energy to accelerate through gusts while maintaining tail clearance margins at liftoff. The airplane is in a sideslip with crossed controls at this point. A slow, smooth recovery from this sideslip is accomplished after liftoff by slowly neutralizing the control wheel and rudder pedals.

Reduced Thrust Takeoff

The reduced thrust takeoff lowers EGT and extends engine life. Operation with reduced takeoff thrust requires that the engine inoperative climb gradient is not less than the regulatory minimum, or that required to meet obstacle clearance criteria. Therefore, there is no need for additional thrust beyond the reduced takeoff thrust in the event of an engine failure.

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The reduced thrust takeoff may be done using the Assumed Temperature Method (ATM). Use the takeoff speeds provided by the Runway Analysis Manual.

Note: Reduced thrust takeoffs are not authorized if potential windshear conditions exist.

Assumed Temperature Method (ATM)

The ATM achieves a takeoff thrust less than the maximum takeoff thrust by assuming a temperature that is higher than the actual temperature. The thrust reduction is limited to 25% below any certified takeoff thrust rating.

The primary thrust setting parameter (EPR) is not considered a limitation. Takeoff speeds consider ground and in-air minimum control speeds (VMCG and VMCA) with full takeoff thrust for the actual temperature. If conditions are encountered during the takeoff where additional thrust is desired, such as windshear, the crew should not hesitate to manually advance thrust levers to maximum rated thrust.

The assumed temperature method of computing reduced thrust takeoff performance is always conservative. Actual performance is equal to or better than the performance obtained if actually operating at the assumed temperature.

This is because the true airspeed at the actual temperature is lower than at the assumed temperature.

Note: Do not use the ATM if conditions that affect braking such as a runway contaminated by slush, snow, standing water, or ice exist. ATM takeoffs are allowed on a wet runway if suitable performance accountability is made for the increased stopping distance on a wet surface.

Note: An increase in elevator column force during rotation and initial climb may be required for ATM takeoffs.

Improved Climb Performance Takeoff

When not field length limited, an increased climb limit weight is achieved by using the excess field length to accelerate to higher takeoff and climb speeds. This improves the climb gradient, thereby raising the climb and obstacle limited weights. V1, VR and V2 are increased and must be obtained from Flight Following or by airport analysis.

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Preface

Abbreviations

Maximum Takeoff and Landing Tailwind Component	10 knots
Authorized Outboard Landing Light Usage (T/A)	Only as needed or required (e.g., landing at night in heavy rain, inboard landing light inoperative)
Outboard Landing Light Maximum Extension & Retraction Speed (T/A)	250 KIAS

Maximum demonstrated takeoff and landing crosswind: 33 knots.
The forward attendant seat may not be occupied during flight.

Altitude Display Limits for RVSM Operations

Standby altimeters do not meet altimeter accuracy requirements of RVSM airspace.

The maximum allowable in-flight difference between Captain and First Officer altitude displays for RVSM operations is 200 feet.

The maximum allowable on-the-ground altitude display differences for RVSM operations are:

Field Elevation	Max Difference Between Captain & F/O	Max Difference Between Captain or F/O & Field Elevation
Sea Level to 5,000 feet	50 feet	75 feet
5,001 to 10,000 feet	60 feet	75 feet

Weight Limitations

Limit	Pounds
Maximum Taxi	125,000 – 306AL, 737CS 120,000 – 326TR, 809TA, 810TA
Maximum Takeoff	124,500 – 306AL, 737CS 119,500 – 326TR, 809TA, 810TA
Maximum Landing	107,000 – 306AL, 326TR, 737CS 105,000 – 809TA, 810TA
Maximum Zero Fuel Weight	95,000 (306AL only – 99,000 if more than 4,000lbs loaded in compartments 3 and 4)

Note: The Maximum Weight Limits may be less as limited by center of gravity or may be further restricted by takeoff,

Flap Operation

Acceleration Altitude - All Engines

The altitude selected for acceleration and flap retraction is specified for each airport. Safety, obstruction clearance, airplane performance or noise abatement requirements are usually the determining factors.

The minimum altitude for All Engines flap retraction is 1000 feet AFE, or the published Acceleration Altitude - whichever is higher.

Acceleration Altitude - Engine Out

The minimum altitude for flap retraction with an engine inoperative is the published acceleration altitude. This altitude varies by runway and is listed in the runway analysis. The standard minimum Engine Out Acceleration Altitude set by Transair through runway analysis is 800 feet AFE. This published altitude may be greater than 800 feet AFE if required to meet performance requirements. Flight crews must obtain and brief this altitude before every takeoff.

At engine out acceleration altitude, following the flight director commands will provide a decreased pitch attitude to level flight or a slight climb (0-200 FPM). Accelerate and retract flaps on schedule. After flap retraction, at flaps up maneuvering speed, set maximum continuous thrust and continue climb to obstacle clearance altitude. Accomplish the Engine Failure/Shutdown checklist or the Engine Fire, Severe Damage or Separation checklist reference items.

Landing

The recommended method for approach speed correction is to add one half of the reported steady headwind component plus the full gust increment above the steady wind to the reference speed. One half of the reported steady headwind component can be estimated by using 50% for a direct headwind, 35% for a 45° crosswind, zero for a direct crosswind and interpolation in between.

When making adjustments for wind additives, the maximum command speed should not exceed VREF + 20 knots or landing flap placard speed minus 5 knots, whichever is lower. This technique provides sufficient low speed maneuver capability and reduces the possibility of flap load relief activation. Margin to load relief activation may also be increased by using a reduced landing flap setting. The following table shows examples of wind additives with a runway heading of 360°.

Window Heat INOP Max Speed

250 KIAS below 10,000 ft.

Wing (Ground Operation)

Do not use wing anti-ice as a substitute for ground De-icing/ Anti-icing, and inspection procedures, which are necessary to comply with operating rules.
--

Do not operate wing anti-ice on the ground when the OAT is above 10°C (50°F).

Autopilot/Flight Director System

Use of autopilot is not authorized for takeoff or landing.

Do not use autopilot roll channel above 30,000 ft. with yaw damper inoperative.

Do not use ALT HOLD mode when captain's alternate static source is selected.

- All changes in altitude should be monitored to ensure that the autopilot captures and levels off at the desired altitude.

Do not engage an autopilot on takeoff below 1000 feet AFE.
--

• NON-AFM OPERATIONAL INFORMATION •

Do not use autopilot pitch channel above .81M with hydraulic system A or B depressurized.

Communications

Traffic Alert and Collision Avoidance System (TCAS)

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with a TCAS resolution advisory.

Electrical Power

Max engine driven generator load: 111 amps.

• NON-AFM OPERATIONAL INFORMATION •

Maximum generator drive oil temperature: 157°C

Performance Data Computer Systems (PDCS)

Do not use the PDCS information unless the engine configuration displayed on the PDCS is the same as the engine configuration of the airplane.

Verify that the representative takeoff EPR limits displayed on the CDU and EPR indicators agree with the predetermined limits obtained from the Runway Analysis Manual.

2.0 Normal Procedures

2.1 General

This chapter contains Normal Procedures and incorporates routine normal procedures.

Controls and Indications – Nomenclature

Controls and indications appear in all UPPERCASE type to correspond to the words on the control panel or display. For example, the following item has UPPERCASE words to match what is found on the panel:

EQUIPMENT COOLING switchesNORMAL

The word EQUIPMENT is spelled out, even though it is abbreviated on the panel.

The following appears in all lower case because there are no words identifying the panel name.

Engine display control panelSet

Normal Procedures

This section contains procedures (flows) for conducting routine operations. The procedures are accomplished by recall. The procedures do not contain “read and do” checklist items and are not necessarily in the same order as the Normal Checklists.

During accomplishment of procedures, it is the crewmember’s responsibility to ensure proper system response. If an improper indication is noted, first verify that the system controls are properly positioned. Then, if necessary, check the appropriate circuit breaker(s), and test related system light(s).

Before engine start, individual system lights are used to verify system status. If an individual system light is indicating an improper condition prior to engine start, determine if the condition may affect dispatch and require maintenance action or compliance with the Minimum Equipment List (MEL).

After engine start, the MASTER CAUTION system, annunciator lights and alerts are used as the primary means to alert the crew to a non-normal system condition. Illumination of the MASTER CAUTION and system annunciator lights requires accomplishment of the appropriate non-normal procedure. Upon completion of the procedure and prior to takeoff, the Minimum Equipment List (MEL) should be consulted to determine if relief is available.

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Flight crew duties are organized in accordance with an area of responsibility concept. Each crewmember is assigned a flight deck area where the crewmember initiates actions for required procedures. The panel illustrations in this section describe each crewmember's area of responsibility for pre/post flight and phase of flight.

Duties may be apportioned between the Captain and First Officer, or between the Pilot Flying (PF) and Pilot Monitoring (PM). A normal scan flow is encouraged; however, certain items may be handled in the most logical sequence for existing conditions. Actions outside the crewmember's area of responsibility are initiated at the direction of the Captain. General phase of flight responsibilities are as follows:

Pilot Flying (PF):

- taxiing
- flight path and airspeed control
- airplane configuration
- navigation

Pilot Monitoring (PM):

- checklist reading
- communications
- tasks requested by (PF)
- monitoring taxiing, flight path, airspeed, airplane configuration and navigation.

The First Officer, when flying the airplane, performs the duties listed under PF, and the Captain performs those duties listed under PM.

Note: The area of responsibility concept is meant as a guide only, and is not a "hard and fast" rule. Logic and professionalism always take precedence.

The Captain retains final authority for all actions directed and performed.

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Normal Checklists

Cockpit Checklists on the Normal Checklist laminated card. Checklists are used as a verification to ensure that certain critical or essential steps of the preceding procedure have been accomplished. Checklist items are not necessarily in the same order as the corresponding procedure (flow). The First Officer will read all checklists on the ground. The Pilot Monitoring will read all checklists in flight. The crewmember who is responding to the checklist challenge should visually confirm that the challenged action, i.e., switch position, instrument configuration, etc., has been properly accomplished. That crewmember should then respond appropriately to the challenge, confirming the action or describing the configuration. Any action which has not been performed or completed when challenged MUST be completed before the next checklist item is read. If performance of the challenge action cannot be accomplished immediately, the crewmember designated to perform the action should respond with "Stand by" or other suitable response to indicate that the action is not yet complete. The crewmember should suspend any further reading of the checklist until the item is complete and the proper response given. Because of the workload during some phases of flight, it may be necessary for the Pilot Monitoring to remind the Pilot Flying that the checklist is incomplete in order to complete it in a timely manner. The Pilot Monitoring is responsible for verification of his checklist items. In addition, he should crosscheck all responses to ensure that the appropriate action has been completed. Each checklist line item should be treated separately, read in a command tone, and answered only when the checklist challenge action has been completed and is in agreement with the response. The After Takeoff and Before Landing checklists are divided by a "line." When these checklists are called for, the person reading the checklist will stop at the line and announce "_____checklist to the line." When that checklist is to be continued, the crewmember calling for the checklist will call "Below the line." When the respective checklist has been completed, the crewmember reading the checklist will announce: "_____checklist complete."

Normal Procedures and Checklist Usage

Flow

"Flow" is the term used to describe the physical pattern (order) used to execute a particular procedure. There is a "flow pattern" for each phase of flight. The "flow" typically follows a logical sequence and is described in the Normal Procedures. Checklist items will not necessarily be listed in the exact same order as in the "flow."

Preflight Inspections (Flows)

The Preliminary Flight Deck Preparation are normally accomplished by the Pilot Flying (PF) for the subsequent leg, while the Exterior Inspection is normally accomplished by the Pilot Monitoring (PM).

Before Start

The Flight Deck Preparation procedure will be performed by the Captain and First Officer. The Captain will then call for the Before Start checklist. The First Officer will read the checklist and the Captain and/or the First Officer will respond.

Engine Start

Performed by the Captain and First Officer. The Captain will call for the Engine Start checklist. The First Officer will read the checklist and the Captain and/or First Officer will respond, as applicable.

After Start

Performed by the Captain and First Officer. The Captain will call for the After Start checklist. The First Officer will read the checklist and the Captain and/or First Officer will respond, as applicable.

Taxi

As the airplane begins taxiing, and when clear of congested areas, the Captain calls set "Flaps __°, Taxi Checklists". The flows are then accomplished by the Captain and First Officer. When the flows are complete, if the takeoff briefing has not been previously accomplished, or if there are any changes, the PF conducts/amends the briefing. The First Officer will then read the checklist down to the line and the Captain and/or the First Officer will respond.

Before Takeoff

When the airplane is cleared for takeoff, the Captain calls "Before Takeoff Checklist." The procedures are accomplished by the Captain and First Officer. The First Officer will then read the remainder of the Before Takeoff checklist and the Captain and/or First Officer will respond.

After Takeoff

When the flaps are retracted, the Pilot Flying will call for the After Takeoff checklist. The Pilot Monitoring will complete the checklist silently.

Descent

The approach briefing will be accomplished by the Pilot Flying prior to descent, or as early in the descent as practical. The Pilot Flying will call for the Descent checklist and the Pilot Monitoring will read the checklist.

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Before Landing

The Before Landing checklist is accomplished at the Pilot Flying's command during the final approach phase. The Pilot Monitoring will read the checklist aloud and complete the items.

After Landing

When the airplane is clear of the active runway, the Captain ensures the SPEED BRAKE lever is in the DOWN detent, then calls "Flaps Up, After Landing checklist." The First Officer raises the flaps, performs the After Landing flow and reads the After Landing checklist.

Shutdown

The Shutdown checklist will be performed by the Captain and First Officer. The Captain will call for the checklist. The First Officer will read the checklist and the Captain or First Officer will respond.

Securing

The Captain will complete the Securing checklist as the First Officer is attending the unloading process. The Securing checklist must be completed anytime the aircraft is to be left unattended (i.e., terminating stations/overnights) and RAI maintenance is not available and or has not accepted the aircraft from the crew.

Callouts

Both crewmembers should be aware of altitude, airplane position and situation.

Avoid casual and nonessential conversation during critical phases of flight, particularly during taxi, takeoff, approach, and landing. Unnecessary conversation reduces crew efficiency and alertness and is prohibited by FARs when below 10,000 feet.

Pilots should accomplish callouts based on instrument indications or observations for the appropriate condition. If a required callout is not made by the appropriate crewmember, the other pilot should make it.

One of the basic fundamentals of the "Crew Coordination Concept" is that each crewmember must be able to supplement or act as a back-up for the other crewmember. Proper adherence to standard callouts is an essential element of a well-managed flight deck. These callouts provide both crewmembers required information about airplane systems and about the participation of the other crewmember. The absence of a standard callout at the appropriate time may indicate a malfunction of an airplane system or indication, or indicate the possibility of incapacitation of the other crewmember.

Whenever a change is made to the selected altitude in the altitude window, the crewmember making the change should keep his finger pointed at the altitude window until the new setting has been confirmed by the other pilot.

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The Pilot Flying should acknowledge all EGPWS voice callouts during approach except altitude callouts. If the normally expected electronic voice callout is not heard by the flight crew, the Pilot Monitoring should make the callout.

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Normal Expanded Checklist

2.8 Checklist and Expanded Checklist

Normal Checklist

transair

(Rhodes Aviation, Inc.)

Boeing 737-200C Normal Checklist

Revision: 4, Date: 03/07/2018

Before Start

(F/O) * Through Items (CAPT)	
Cockpit Preparation ... Complete (both)	Checked
Logbook	Checked
Lights Test	Checked
O ₂ Masks & Intercom ... Checked (both)	On Board (F/O)
Gear Pins	Armed
Emergency Exit Lights	Tested
CVR	On
* Yaw Damper	Lbs (both)
* Fuel Quantity	On
* Fuel Pumps	Off
* Anti-Ice	Closed
* Ground Interconnect	Set / Ground
* Hydraulic Pumps	As Req (both)
* Pressurization	Set & X-Checked
* HSI select	As Req
* Inst's & Bugs	Checked
* Auto Brake	Standby
* Oil Quantity	Down Detent
* Transponder & Radar	Normal
* Nav/Coms	Free & Zero
* Speedbrake	Onboard
* Stabilizer Trim Switches	Complete
* Rudder & Aileron Trim	Set
* Papers	
* Departure Briefing	
* Parking Brake	

Engine Start

(F/O) (CAPT)	
Tail Stand	Removed
Cargo	Secured
Doors & Windows	Closed & Locked
Seat Belts	On (all)
Anti-Collision Lights	On
Pushback	Off
Packs	PSI
Start Pressure	

After Start

(F/O) (CAPT)	
Generators	On
Window Heat	On
Pitot Static Heat	On
Anti-Ice	As Req
Pressurization	Set / Flight
Transponder	Checked
Recall	Checked

Taxi

(F/O) (CAPT)	
Shoulder Harnesses	On (all)
APU	As Req
Trim	Units Set (both)
Flaps	/ Green Light (both)
Flight Controls	Checked (both)
Takeoff Brief	Complete (both)

Before Takeoff

(F/O) (F/O)	
Exterior Lights	On
Start Switches	Low
Recall	Checked
Transponder	TA/RA
Runway	Runway Confirmed (both)

After Takeoff

(PM) Silent (PM)	
Start Switches	As Req
Landing Gear	Off / Lights Out
Flaps	Up / Lights Out
Pressurization	Set
Transition	29.92 & X-Checked (both)

Descent

(PM) (PM)	
Pressurization	Set
Anti-Ice	As Req
Auto Brake	Set
Altimeters	& X-Checked (both)
Landing Data & Brief	Complete (PF)
Speed & EPR Bugs	Set & X-Checked (both)

Before Landing

(PM) (PM)	
Shoulder Harnesses	On (all)
Exterior Lights	On
Start Switches	Low
Recall	Checked
Landing Gear	Down / 3 Green (both)
Speedbrake-Armed / Green Light (both)	
Flaps	/ Green Light (both)

After Landing

(F/O) Silent (F/O)	
Speedbrake	Down Detent
Radar	Sby
Transponder	As Req
Exterior Lights	As Req
Start Switches	Off
Pressurization	Ground
Anti-Ice	Off
Pitot Static Heat	Off
Window Heat	Off
Flaps	Up
APU	As Req

Shutdown

(F/O) (CAPT)	
Parking Brake	Set / Pressure Normal
Start Levers	Cutoff
Anti-Collision Lights	Off
Packs	As Req
Bleeds	On
Fuel Pumps	As Req

Securing

(CAPT) (CAPT)	
Packs	Engine On / APU Off
Bleeds	Off
Transponder, Radar	Off
Hydraulic Pumps	A On / B Off
Emergency Exit Lights	Off
O ₂ Valve	Closed
Regulators	Off/100%/Off
APU	Off
Parking Brake	Released
Tail Stand	Verify Installed
Paperwork	Complete
DC Selector	Not on BAT
Battery	Off

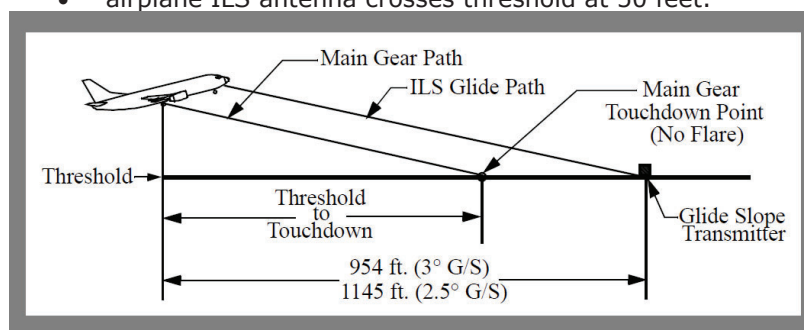
This checklist may be temporarily removed and used in flight operations.

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Holding, Approach, and Landing

ILS Approach - Landing Geometry

The following diagrams use these conditions:

- data is based on typical landing weight
- airplane body attitudes are based on flaps 30, VREF 30 + 5 knots and should be reduced by 1° for each 5 knots above this speed
- pilot eye height measured at point when main gear crosses threshold
- airplane ILS antenna crosses threshold at 50 feet.



737 Model	Flaps 30		Main Gear over Threshold		Threshold to Main Gear Touchdown Point - No Flare (feet)
	Glide Path (degrees)	Airplane Body Attitude (degrees)	Pilot Eye Height (feet)	Main Gear Height (feet)	
- 200	2.5	5.4	49	31	709
	3.0	4.9	49	31	590
- 200 Adv	2.5	4.4	49	32	728
	3.0	3.9	49	32	606

Non-Normal Operations

This section describes pilot techniques associated with engine inoperative ILS approaches. Techniques discussed minimize workload, improve crew coordination, and enhance flight safety. However, a thorough review of applicable Non-Normal Checklists associated with engine inoperative flight is a prerequisite to understanding this section.

One Engine Inoperative

AFDS management and associated procedures are similar to those used during the normal ILS approach. Flight director (manual) or single autopilot may be used. Weather minima for an ILS approach with one engine inoperative are specified in the Operations Specifications.

During a single autopilot or flight director (manual) approach, the pilot must use rudder pedal pressure to control yaw, followed by rudder trim to maintain an in-trim condition during the entire approach. A centered control wheel indicates proper trim.

Minimize thrust lever movements to reduce both asymmetry and speed changes. Airplane configuration changes require little thrust change until capturing the glide slope.

Intercept the localizer with flaps 5 at flaps 5 speed. When the glide slope is alive, lower the landing gear, extend flaps to 15, set final approach speed, and decelerate.

Be prepared to take over manually in the event system performance is not satisfactory.

Engine Inoperative, Rudder Trim - All Instrument Approaches

The pilot must use rudder pedal pressure to control yaw, followed by rudder trim to maintain an in-trim condition during all approaches. Manually centering the rudder trim prior to thrust reduction for landing is normally unnecessary.

Rudder trim may be set to zero to facilitate directional control during thrust reduction. This should be accomplished by 500 feet AFE to allow the PM ample time to perform other duties and make appropriate altitude callouts.

Centering the rudder trim prior to landing allows most of the rudder pedal pressure to be removed when the thrust of the operating engine is retarded to idle at touchdown. Full rudder authority and rudder pedal steering capability are not affected by rudder trim.

It may not be advisable to center the rudder trim due to crew workload and the possibility of a missed approach. However, if touchdown occurs with the rudder still trimmed for the approach, be prepared for the higher rudder pedal forces required to track the centerline on rollout.

Engine Failure On Final Approach

If an engine failure should occur on final approach with the flaps in the landing position, the decision to continue the approach or execute a go-around should be made immediately. If the approach is continued, retract the flaps to 15 and adjust thrust on the operating engine. Speed should be increased to 15 knots over the previously set flaps 30 or 40 VREF. This sets a command speed that is equal to at least VREF for flaps 15. Wind additives should be added as needed, if time and conditions permit.

If a go-around is required, follow the Go-Around and Missed Approach procedures except use flaps 15 initially if trailing edge flaps are at 30 or 40. Subsequent flap retraction should be made at a safe altitude and in level flight or a shallow climb.

Final Approach

Roll out of the turn to final on the extended runway centerline and maintain the appropriate approach speed. An altitude of approximately 300 feet AFE for each NM from the runway provides a normal approach profile. Attempt to keep thrust changes small to avoid large trim changes. With the airplane in trim and at target airspeed, pitch attitude should be approximately the normal approach body attitude. At speeds above approach speed, pitch attitude is less. At speeds below approach speed, pitch attitude is higher. Slower speed reduces aft body clearance at touchdown. Stabilize the airplane on the selected approach airspeed with an approximate rate of descent between 700 and 900 feet per minute on the desired glide path, in trim. Stabilize on the profile by 500 feet above touchdown.

Note: Descent rates greater than 1,000 fpm should be avoided.

With one engine inoperative, the rudder trim may be centered before landing. This allows most of the rudder pedal pressure to be removed when the thrust of the operating engine is retarded to idle at touchdown.

Full rudder authority and rudder pedal steering capability are not affected by rudder trim. If touchdown occurs with the rudder still trimmed for the approach, be prepared for the higher rudder pedal forces required to track the centerline on rollout.

Engine Failure On Final Approach

In case of engine failure on visual final approach, use the procedure described in the ILS approach section, this chapter.

Approach

Accomplish the pattern and approach procedures as illustrated. The landing gear may remain extended throughout the maneuver for brake cooling, but be prepared to retract the landing gear if an actual engine failure occurs during go-around. Do not arm the speedbrakes. Select the auto brakes OFF.

Landing

The trainee should do a normal final approach and landing. After touchdown, the instructor selects flaps 15, sets stabilizer trim, ensures speedbrakes are down, and at the appropriate time instructs the trainee to move the thrust levers to approximately the vertical position (so engines stabilize before applying go-around thrust). When the engines are stabilized, the instructor instructs the trainee to set thrust.

Maneuver Capability and Flap Usage

Flap Usage

For takeoffs, when conditions permit, consider using larger flap settings to provide shorter takeoff distance. Refer to the Typical Takeoff Tail Clearance table, page 256, to determine Minimum Tail clearance for different takeoff flap settings.

During maneuvering for an approach, when the situation dictates an earlier than normal speed reduction, the use of flaps 10 with the gear up is acceptable.

For normal landings, use flaps 30. When required, use flaps 40 to minimize landing speed and landing distance.

Flap-Speed Schedule/Maneuvering Speeds

The flap maneuvering speed schedule provides the recommended maneuvering speed for various flap settings. When recommended maneuvering speeds are followed, the schedule provides full maneuvering margin to stick shaker for inadvertent 15 overshoot beyond the normal 30 angle of bank.

The schedule provides speeds which are close to minimum drag and in climb are close to maximum angle of climb speed. In level flight it provides relatively constant pitch attitudes and requires little change in thrust at different flap settings.

Flap Maneuvering Speed Schedule

The flap maneuvering speed schedule is based on a fixed speed for each flap setting for a range of gross weights and will provide adequate maneuver margin to stick shaker at all weights. The schedule shows maneuvering speeds for airplanes with a Rudder Pressure Reducer (RPR) operating. If the RPR is not operating, refer to the MEL for Maneuver speeds.

Flap Position	At & Below 117,000 LB (53,070 KG)	Above 117,000 LB (53,070 KG)
Flaps UP	210knots	220 knots
Flaps 1	190 knots	200 knots
Flaps 5	170 knots	180 knots
Flaps 10	160 knots	170 knots
Flaps 15	150 knots	160 knots
Flaps 25	140 knots	150 knots
Flaps 30	VREF 30	
Flaps 40	VREF 40	

Engine Tailpipe Fire

Engine tailpipe fires are typically caused by engine control malfunctions that result in the ignition of pooled fuel. These fires can be damaging to the engine and have caused unplanned evacuations.

If a tailpipe fire is reported, the crew should accomplish the NNC without delay. Flight crews should consider the following when dealing with this situation:

- motoring the engine is the primary means of extinguishing the fire
- communications with ramp personnel and the tower are important to determine the status of the tailpipe fire and to request fire extinguishing assistance
- the engine fire checklist is inappropriate because the engine fire extinguishing agent is not effective against a fire inside the tailpipe.

Loss of Engine Thrust Control

Engine response to a loss of control varies from engine to engine. Malfunctions have occurred in-flight and on the ground. The major challenge the flight crew faces when responding to this malfunction is recognizing the condition and determining which engine has malfunctioned. The Engine Limit/Surge/Stall NNC is written to include this malfunction. This condition can occur during any phase of flight.

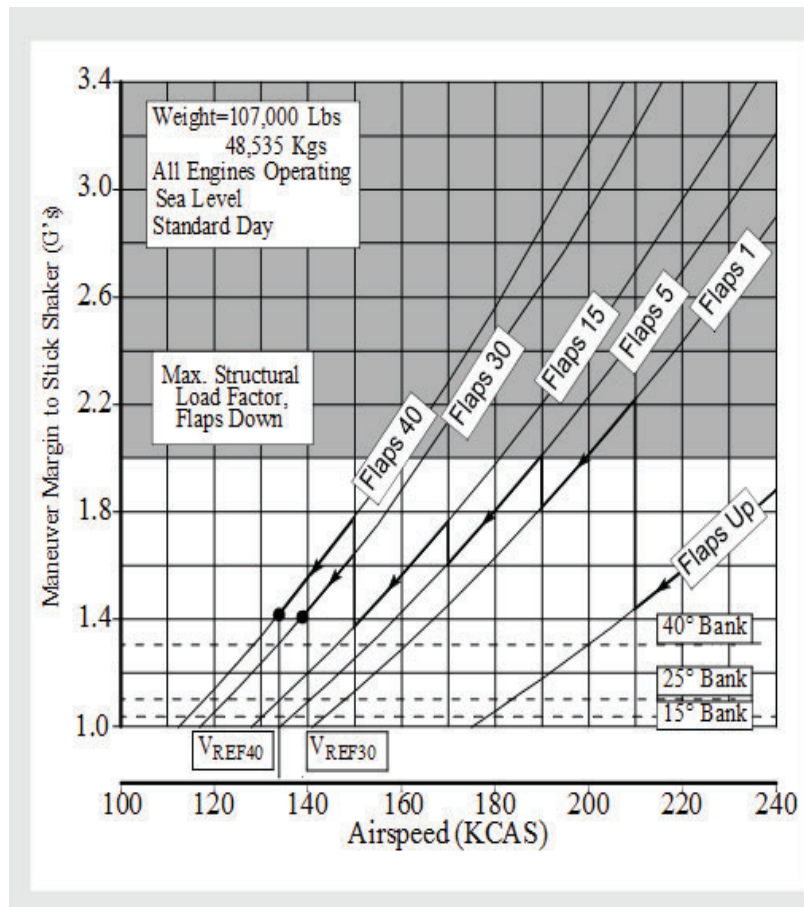
Failure of engine or fuel control system components or loss of thrust lever position feedback has caused loss of engine thrust control. Engine thrust control loss may not be immediately evident since many engines fail to some fixed RPM or thrust lever condition. This fixed RPM or thrust lever condition may be very near the commanded thrust level and therefore difficult to recognize until the flight crew attempts to change thrust with the thrust lever. Other engine responses include: shutdown, operation at low RPM, or thrust at the last valid thrust lever setting (in the case of a thrust lever feedback fault) depending on altitude or air/ground logic. In all cases, the affected engine does not respond to thrust lever movement or the response is abnormal.

Since recognition may be difficult, if a loss of engine thrust control is suspected, the flight crew should continue the takeoff or remain airborne until the NNC can be accomplished. This helps with directional control and may preclude an inadvertent shutdown of the wrong engine. In some conditions, such as during low speed ground operations, immediate engine shutdown may be necessary to maintain directional control.

Flap Extension Schedule

During flap extension, selection of the flaps to the next position should be made when approaching, and before decelerating below the maneuver speed for the existing flap position. The flap extension speed schedule is based on a fixed speed for each flap setting for a range of gross weights and provides full maneuver margin to stick shaker at all weights. The schedule shows maneuver speeds for airplanes with a Rudder Pressure Reducer (RPR) operating and for airplanes with and without the Rudder System Enhancement Program (RSEP) installed. If the RPR is not operating, refer to the MEL.

Maneuver Margins to Stick Shaker - Flap Extension



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Before Takeoff

CAPTAIN	FIRST OFFICER
Pilots shall acknowledge ATC instructions or clearance to enter, "line up and wait", or "hold short" of a runway specific runway by reading back their callsign and the entire instruction or clearance, including the runway designator.	
If weather will be a factor on departure, WX Radar will be - On	
Before entering the runway: Verify proper runway for departure using all available information, to include runway marking/signs, heading indicators, and airport diagrams.	
Before entering the runway for takeoff: Call "BEFORE TAKEOFF CHECKLIST." (early enough to allow its completion before entering the runway)	
If takeoff clearance is received before entering the runway OR if tower is not in operation: Accomplish the following flow: • OUTBOARD LANDING lights – As required • INBOARD LANDING lights - On • RUNWAY TURNOFF lights - On • TAXI light – Off	Accomplish the following flow: • ENGINE START switches - LOW IGN • LOGO LIGHTS – On • (night only) • STROBE lights – On • WING lights - On • Recall – Check • Transponder – TA/RA
If cleared to line up and wait: Accomplish the following flow: • RUNWAY TURNOFF lights – On When cleared for takeoff: • OUTBOARD LANDING lights – As required • INBOARD LANDING lights - On • TAXI light – Off (Taxi light should be off after line-up and stopped)	Read the BEFORE TAKEOFF CHECKLIST. Announce "BEFORE TAKEOFF CHECKLIST COMPLETE."

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Takeoff

PILOT FLYING	PILOT MONITORING
Do not advance the thrust levers for takeoff until the BEFORE TAKEOFF checklist is complete. The standard takeoff procedure is a <u>rolling</u> takeoff while setting takeoff thrust to expedite the takeoff and reduce the risk of foreign object damage or engine surge/stall due to a tailwind or crosswind. If the First Officer is the Pilot Flying, the Captain states, "YOU HAVE CONTROL." when transferring control. The First Officer acknowledges, "I HAVE CONTROL."	
As the aircraft is aligned with the runway, advance the thrust levers to 1.4 EPR and allow the engines to stabilize momentarily (for no more than 2 seconds)	Call " ENGINES STABLE. " when engine instruments have stabilized.
Advance thrust levers to takeoff EPR and call " SET REDUCED THRUST. " or " SET MAX THRUST. " as applicable.	Set thrust as directed.
Verify EPR.	After desired EPR Thrust is set, verify target N1 is achieved and call out " THRUST SET "
Note: After takeoff thrust is set, the Captain's hand must be on the thrust levers until V₁.	
Hold light forward pressure on the control column, maintain directional control.	Monitor engine instruments.
Verify the airspeed and respond " CHECK ".	At 80 KIAS call " 80 KNOTS ". (If the 80 kt call is called late, call the actual speed indicated.)
Verify V ₁ .	5 KIAS PRIOR to V ₁ , Call " V₁ ".
Captain removes hand from thrust levers.	
Confirm the airspeed and rotate 2½ - 3° per second toward a climb attitude of approximately 15°.	At VR, call " ROTATE. " At V ₂ , call " V₂ ".
	When positive climb noted on the barometric altimeter, call " POSITIVE RATE ".

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Takeoff (Cont.)

PILOT FLYING	PILOT MONITORING
(Call "POSITIVE RATE" if the PM omits.) Call " GEAR UP. " after "POSITIVE RATE" is announced. Climb at V2 + 15-25 to flap retraction altitude.	Position LANDING GEAR lever UP when directed.

Initial Climb

PILOT FLYING	PILOT MONITORING
At or above 400 feet AGL:	
If using the Flight Director, call for appropriate lateral mode: " HEADING SELECT " or " VOR/LOC. "	Select the requested lateral mode on the Flight Director.
After the aircraft has reached the greater of 1,000 feet AGL or Acceleration Altitude:	
Call for flap retraction on schedule: " FLAPS __ (5, 1)."	Check for proper airspeed, position FLAP lever as directed and monitor flaps and slats retraction.
At thrust reduction height, call " SET CLIMB THRUST. "	Set climb EPR; approximately 90% N1.
On schedule call " FLAPS UP, AFTER TAKEOFF CHECK. "	Accomplish the following flow: • FLAPS – UP, Lights out • LANDING GEAR lever – OFF, Lights out • AUTO BRAKES - OFF
Engage autopilot if desired and announce " AUTOPILOT ENGAGED. "	Verify ENGINE BLEEDS ON, air conditioning and pressurization operating normally, then • APU switch – OFF (if required) • ENGINE START switches – OFF or as required
	Read the After Takeoff Checklist, and announce " AFTER TAKEOFF CHECKLIST COMPLETE " or " AFTER TAKEOFF CHECKLIST TO THE LINE " if the final altitude is to be at or above FL180.

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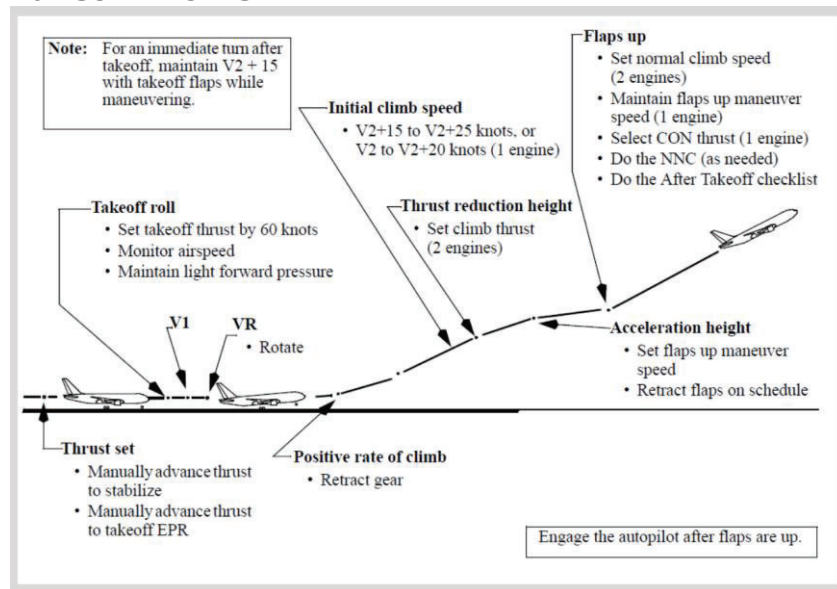
Climb

PILOT FLYING	PILOT MONITORING
Note: Both pilots shall call 1,000 feet prior to all level-off altitudes by stating the current altitude and then the altitude cleared to (e.g., "FOUR FOR FIVE THOUSAND" or "THIRTY TWO FOR THIRTY THREE.")	
After the aircraft has leveled at or climbed above 10,000 feet MSL:	
Captain call "10,000" Accomplish the following flow: • RUNWAY TURNOFF lights – Off • INBOARD LANDING lights – Off • OUTBOARD LANDING lghts – Retract (if extended) (Retract before accelerating above 250 kts.)	First Officer call "10,000" Accomplish the following flow: • LOGO LIGHTS – Off • WING lights - Off
If lights are needed for recognition above 250 kts, use INBOARD LANDING lights, RUNWAY TURNOFF lights, LOGO lights, or WING lights as necessary.	
	Notify ACM's verbally of the conclusion of sterile cockpit
Climbing to or through the Transition Altitude (usually 18,000 feet MSL in the U.S.): Set barometric altimeters to QNE 29.92. DO NOT SET EARLY in anticipation of reaching the Transition Altitude.	
	Read below the transition line on the After Takeoff Checklist and call "AFTER TAKEOFF CHECKLIST COMPLETE".
Captain: During climb, set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates. Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.	

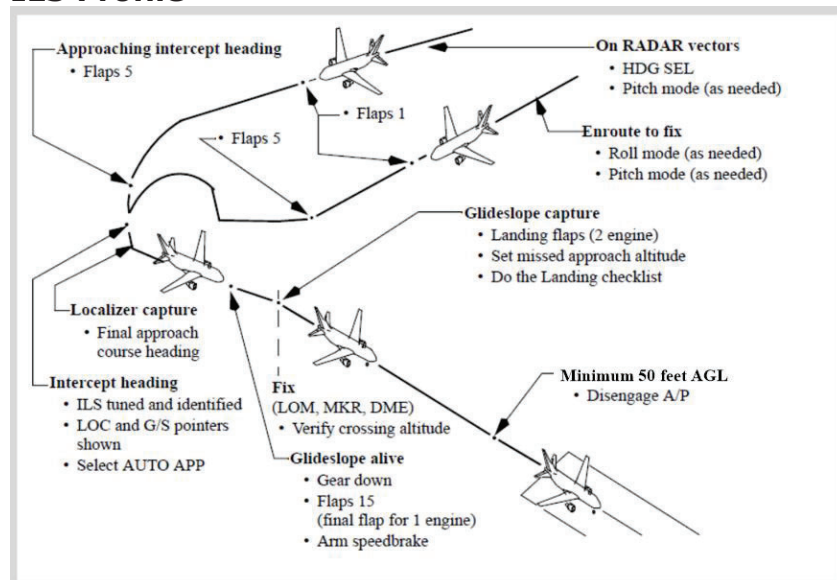
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Flight Profiles

2.9 Flight Profiles

Takeoff Profile



ILS Profile



Recommended Technique for an In-Flight Engine Shutdown

Any time an engine shutdown is required in flight, good crew coordination is essential. Airplane incidents have turned into airplane accidents as a result of the flight crew shutting down the incorrect engine.

When the flight path is under complete control, the crew should proceed with a deliberate, systematic process that identifies the correct engine and ensures that the operating engine is not shut down. Do not rush through the shutdown checklist, even for a fire indication. The following technique is an example that could be used:

The PF then verbally coordinates confirmation of the affected engine with the PM and then slowly retards the thrust lever of the engine that will be shutdown.

Coordinate activation of the start lever as follows:

- PM places a hand on and verbally identifies the start lever for the engine that will be shutdown
- PF verbally confirms that the PM has identified the correct start lever
- PM moves the start lever to cutoff.

If the NNC requires activation of the engine fire switch, coordinate as follows:

- PM places a hand on and verbally identifies the engine fire switch for the engine that is shutdown
- PF verbally confirms that the PM has identified the correct engine fire switch
- PM pulls the engine fire switch.

Bird Strikes

Experience shows that bird strikes are common in aviation. Most bird strikes occur at very low altitudes, below 500 feet AGL. This section deals with bird strikes that affect the engines.

Recent studies of engine bird strikes reveal that approximately 50% of engine bird strikes damage the engine(s). The risk of engine damage increases proportionally with the size of the bird and with increased engine thrust settings. When an engine bird strike damages the engine, the most common indications are significant vibrations due to fan blade damage and an EGT increase.