MANUAL FLIGHT TECHNIQUES

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TAKEOFF PROCEDURES

Takeoff Speeds: The speeds appropriate for the takeoff weight of the aircraft should have been selected and confirmed in the TAKEOFF PERF page of the FMC during the initial cockpit setup. If the FMC has not registered confirmed takeoff speeds, an amber NO V-SPD warning will be displayed on the PFD, near the top of the airspeed scale.

Takeoff speeds are computed using crew input, and the appropriate V speed indicators and flaps setting markers will be displayed in their appropriate place on the airspeed scale. Not all settings will be visible at any given time.

Takeoff Position: Weight and engine thrust not-withstanding, the 737 is capable of conducting a rolling takeoff on most runways. Before advancing the thrust levers, be certain that the aircraft is properly aligned with the runway. The takeoff roll should begin deliberately after the aircraft has been properly aligned with the runway centerline.

If a short delay is anticipated once in the takeoff position, the parking brake should be set in order to protect against inadvertent movement of the aircraft due to thrust, wind or runway slope conditions. Slight movement of the aircraft may not be immediately noticeable to the crew when concentrating on other takeoff related tasks.

Upon receipt of the takeoff clearance, the aircraft lights should be configured according to the appropriate checklist, and the parking brake released.

Throttle Advance: Advance the throttles smoothly for takeoff. If the autothrottle is not used to set takeoff thrust, the Pilot Flying (PF) should advance the throttles until reaching approximately 60% N1. Once engine readings have stabilized, the throttles should be advanced to takeoff power, with final throttle adjustments being made before the aircraft has accelerated to 80 knots.

After reaching 80 knots in the takeoff roll, the throttles should only be adjusted to keep the engines within operating parameters.

If the autothrottle is being used to set takeoff thrust, the PF should bring the throttles smoothly forward until approximately 70% N1 is displayed on the EICAS. Once engine indications have stabilized, the TO/GA switch should be pressed. (To make the TOGA switch accessible, we have placed a click spot on the top left screw of the autopilot Mode Control Panel….click there to simulate pressing the TO/GA button.)

As the throttles advance to their FMC determined position, it is important that the PF back the throttles up with a hand, and the hand should only be removed upon reaching V1.

In all cases, the crew should be mindful that the engine power settings do not exceed the green maximum power settings displayed above the engine power strips on the EICAS display.

Takeoff Roll: At the beginning of the takeoff role, the PF should maintain slight forward pressure on the controls in order to ensure proper directional control through firm contact between the nose wheels and the runway surface. This is not to imply than use of the tiller above more than 20 knots is acceptable, but firm tire adhesion to the runway surface will greatly improve directional control in the event of an engine failure at high thrust and low speeds.

Directional control should be maintained through the use of coordinated rudder and aileron input to ensure a straight takeoff with minimum roll tendency on rotation.

The PNF will call out "80 knots" at the appropriate time, as an indication to the PF that the aircraft has entered into the high speed regime of the takeoff.

At 80 knots, the PF should begin to release the forward pressure held on the flight controls.

The automatic aural warning system will call out “V1” when the indicated aircraft speed is still 5 knots lower than the actual V1 speed setting. This buffer is included in recognition of the fact that a no-go decision immediately before V1 can be more effectively made if the PF is aware of the rate of acceleration to V1.

Note: In order to obtain airspeed callouts during the takeoff role, you must have initialized the FMC before commencing the takeoff. This is a simulator specific requirement.

Upon reaching V1, the PF should remove the hand used to back up the throttles. This is done to enforce the ‘go’ decision, and to prevent a reactive decision to reject a takeoff after reaching V1.

At Vr, the PNF will call “Rotate,” as a signal for the PF to begin applying back pressure on the controls to raise the nose of the aircraft from the runway.

A proper rate of rotation for the 737 is 2.5º to 3º per second until a target takeoff pitch attitude of approximately 8º nose up is attained. Target pitch attitudes for each airframe are listed as follows:

Type	T/O Pitch	Tail Strike Pitch
-600	9.0º	16.2º
-700	9.0º	14.8º
-800	8.0º	11.0º
-900	8.0º	9.2º

Due to fuselage length, the pitch attitude for takeoff becomes increasingly critical in the –800 and –900 airframes.

In Microsoft Flight Simulator, striking the tail of the aircraft on the ground is treated as an aircraft crash, and Microsoft Flight Simulator may fail engines, wings or otherwise disable the aircraft.

This is not precisely realistic behavior, but this warning serves to remind crews that conducting the aircraft in an unsafe manner carries dire consequences in the real world.

The proper technique for takeoff involves careful rotation until the target takeoff pitch attitude is reached.

The target pitch attitude should be maintained until the aircraft flies itself off the runway. Resist the temptation to continue raising the nose above the target pitch attitude or a tail strike may result.

In gusty conditions, the rotation may be delayed slightly in order to prevent inadvertent over-rotation induced by wind gusts.

Once the aircraft becomes airborne, confirm via the radar altimeter that at least 20 feet has been attained, the continue rotating at 2.5º - 3º per second until airspeed stops increasing.

A proper rate of rotation will lead to the aircraft attaining V2 at 35 feet above the runway surface. Early, rapid or excessive rotation can extend the takeoff run, cause a tail strike condition, and/or activate the stick shaker and stall warning.

Crosswind Takeoff: As with other aircraft types, the most effective method to maintain directional control during the takeoff is to use rudder for directional control as necessary, and aileron input to control roll tendency.

As the aircraft accelerates, the control inputs should be gradually reduced so as to achieve a smooth liftoff without banking the wings. An uneven bank angle on rotation produces a risk of engine nacelle damage from striking the runway surface.

Rejected Takeoff: It is extremely important that crews understand that **a decision to reject a takeoff is not made because the airplane can stop.** A decision to reject a takeoff is made because **the airplane will not fly.**

Once entering the high-speed regime of the takeoff role, a decision to reject the takeoff should only be made if, from the captain’s perspective, a failure occurring prior to V1 sufficiently calls into question the ability of the aircraft to fly safely. Crews should keep in mind that rejecting the takeoff at high speed may place the aircraft at greater risk than the initial failure.

A decision to reject the takeoff should be made with authority, and in time that braking can be applied before V1 is reached. The pilot flying should quickly reduce the throttles to idle, disengage the autothrottle and apply reverse thrust.

If set to RTO, the autobrakes will activate when the throttles are returned to idle.

Note: Most users of Microsoft Flight Simulator know that pressing the F2 key will apply reverse thrust, but it is important to know that you will not get proper breaking unless you also bring your joystick throttle to idle in order to activate the spoilers during the Rejected Takeoff!

If the autobrakes do not activate, the crew should apply maximum manual braking commensurate with safety.

Reverse thrust should be applied normally, with careful consideration given to asymmetric thrust in the event the takeoff is being rejected due to an engine failure.

Engine Failure During Takeoff: In the event that an engine fails on takeoff but a decision to continue the takeoff is made, directional control must be maintained by applying rudder to the side opposite that of the failed engine. The amount of rudder required to maintain directional control will depend on aircraft weight, crosswind influence, airspeed at the time of the failure and which engine failed. It is important that only enough rudder be applied to maintain directional stability as additional rudder will produce excess drag or cause the aircraft to yaw away from the failed engine. This condition is undesirable because it may result in yaw oscillations during the takeoff that will reduce the overall controllability of the aircraft.

After an engine failure, avoid rotating the aircraft early or excessively. Rotate smoothly at Vr and hold the target takeoff pitch until the aircraft flies itself off the runway. Continue the takeoff normally, accelerating to V2. The pitch attitude during the early climb will be slightly lower than that normally required for a two engine takeoff. (Usually 2º lower than the normal climb out angle.)

Maintain V2 until reaching the Engine Out Acceleration Height. (E/O Accel Ht.) as set in the FMC takeoff page. On passing the E/O Acceleration Height, lower the nose by one half of the pitch attitude required for the climb. . (e.g. from 20° to 10° pitch.) Reducing the pitch in this fashion will allow the aircraft to begin accelerating so that the flaps may be retracted.

Do not descend during the acceleration sequence. After completion of the flap retraction sequence, ensure the operating engine is not exceeding the selected thrust parameter and continue the climb profile.

In the event the engine failure occurs after reaching V2, but before reaching V2 + 10, maintain the speed at which the aircraft was travelling at the time of the engine failure. Use pitch to maintain airspeed, and accept whatever rate of climb results unless obstacle clearance is an issue. Climb to the E/O Acceleration Height and commence the acceleration and flap retraction as described above.

If the engine failure occurs at V2 + 10, then use pitch to maintain this speed until reaching the E/O Acceleration Height and commencing the acceleration and flap retraction sequence as described above.

If the engine failure occurs at a speed greater than V2 + 10, use pitch to reduce speed to V2 + 10 and climb to the flap retraction/acceleration altitude. This technique will give the best rate of climb for the given available thrust. The above described procedure for acceleration and flap retraction applies.

Failure of an engine on one side of the aircraft will cause a yaw tendency toward the failed engine. Opposite rudder input should be applied using trim with enough rudder deflection to eliminate the aircraft's tendency to change heading. The aircraft should be considered properly trimmed if yaw tendency is eliminated and the yoke can be held without aileron input. Although a slight banking may be noticed, using ailerons to level the wings will cause an increase in aerodynamic drag, resulting in a less efficient wingform, reduced lift effectiveness and reduced climb performance.

CLIMBOUT PROCEDURES

Initial Climb: In a normal takeoff condition, the pitch attitude required to maintain V2+10 knots in the climb is 15-17º nose up. In light airplane configurations, this pitch attitude may be exceeded in order to maximize the rate of climb. (Provided the airspeed is not allowed to drop below V2+10.)

Some consideration to passenger comfort should be given to if the climb angle required to maintain V2+10 exceeds 25º nose up pitch. If this is a concern, a slight reduction in N1 is the best way to reduce climb angle.

If a turn is required during the initial climbout phase of the flight, do not begin banking until the aircraft has climbed at least 200 feet AGL. Between 200 AGL and 400AGL do not exceed bank angles of 15º.

If the flight director is being used to provide guidance during takeoff, bank attitude according to the flight director is satisfactory, as the flight director takes aircraft speed, weight and stall factors into account.

Acceleration in the Climb: If the flight directors are not being used in the climb, the pitch angle should be reduced when climbing through the Flap Acceleration Height as set on the FMC Takeoff page. Pitch angle should be reduced by not more than ½ of the pitch required to maintain V2+10. For example, if 20º nose up was required, then the pitch angle can be reduced to 10º nose up, but not lower. This will allow the aircraft to begin accelerating in the climb.

Flaps should be retracted according the flap retraction schedule on the airspeed indicator. During the flap retraction sequence, do not select the next flap setting until the aircraft has accelerated beyond the amber warning band (on the airspeed indicator) for the next flap setting.

Acceleration should be continued until the flaps are fully retracted

If necessary, modify the pitch, power and flap settings as required in order to comply with ATC clearances or SID requirements.

When reaching Flaps Up, the crew should select the Climb Thrust setting by pressing the LVL CHG switch, the N1 switch, or via the FMC Climb page. Verify the appropriate CLB setting is displayed on the EICAS engine display. Once in this mode, engine thrust settings will be automatically adjusted for maximum cost/climb performance given current environmental conditions and climb requirements.

Engine failure in/during climb: Once above the E/O Acceleration Height, select the ENG OUT mode on the FMC Climb Page. Selecting the engine out page will not change the behavior of the autopilot, but It will provide reference information to assist the crew with the single engine climb.

CRUISE PROCEDURES

Optimum Altitude: The FMC VNAV Cruise page will display both the Optimum cruise altitude and Maximum Cruise Altitude for the current flight configuration. The Optimum altitude will give the best ratio of ground mileage for fuel consumed.

Normally, a cruise altitude close to the Optimum altitude should be selected. Flight above the optimum altitude will reduce the margin between cruise speed and stall speed. Flight above optimum altitude should be avoided if autothrottles are inoperative.

Fuel Economy: The FMC will continually monitor and report on fuel usage during the course of a flight. If a change in flight conditions reduces the range of the aircraft and causes a fuel reserves reduction, the FMC message INSUFFICIENT FUEL will be displayed.

FMC monitoring of the required fuel level does not remove crew responsibility for monitoring and managing the useful fuel load.

Factors which can cause a change in the required fuel load include, but are not limited to:

- Improper Trim Settings
- Unbalanced Fuel Load
- Excessive Throttle Adjustments
- Flight Higher Than Optimum Altitude
- Lower Than Planned Cruise Altitude
- Temperatures Higher Than Forecast
- Faster Airspeed Than Planned
- Slower Airspeed Than Planned
- Higher than forecast wind conditions.
- Infarcts enroute holding.
- Unforecast altitude changes.

Known Fuel Consumption Increases:

M.01 over planned speed:	2% Increase
2,000 above Optimum Alt:	2% Increase
4,000 above Optimum Alt:	3.4% Increase
4,000 below Optimum Alt:	4% Increase
8,000 below Optimum Alt:	9% Increase

DESCENT PROCEDURES

Leaving Cruise: The descent process can be conducted manually by taking control of the flight, or by selecting a lower assigned altitude in the MCP and pressing LVL CHG or VNAV. A descent may also be initiated by entering a lower FL___ in the FMC VNAV Cruise Page.

Higher profile descents may require the use of speed brakes in order to reach altitude or speed targets during the descent. In descents requiring the use of speed brakes, it is important that level off at the lower assigned altitude be anticipated so that speed brakes can be retracted and thrust increased to obtain a smooth level out procedure. Late reduction of speed brakes and cause uncomfortable G loading and passenger discomfort.

The use of flaps to increase aerodynamic drag in order to facilitate a higher descent rate is not recommended as this places significant wear and tear on the flaps, flap track and flap actuator mechanisms. If additional drag is required, speedbrakes or a reduced descent angle are recommended.

Speedbrake Usage: In all cases where speed brakes are used, the speed brakes should be closed before thrust is added. Speed brakes should not be used below 1500' AGL. Crews should keep in mind that speedbrake usage with greater than Flaps 10 selected causes additional stress loading to be placed on the trailing edge flaps. Although this will not adversely affect controllability of the aircraft, it does place additional wear and tear on the flap track mechanisms.

APPROACH PROCEDURES

Initial Approach: Crew workload during the approach portion of the flight increases steadily right up to the point of touchdown. As such, the earlier a crew is prepared with all weather, runway and approach information the more distributed the workload will become.

A strong approach briefing allows the crew to plan ahead for various contingencies such as vectoring through congested airspace, unusual approach procedures, emergency procedures, weather related contingencies, etc.

The crew should have all information regarding ATIS, NOTAMS and aircraft performance data collected prior to descending below 10,000 feet.

Approach Speeds: The speed bugs displayed on the ND airspeed indicator are selected based upon the crew's selection in the Approach page of the FMC. Speeds are based on the aircraft weight and fuel remaining. When speed is maintained at these airspeed/flap limits, a full safety margin for aerodynamic stall is maintained.

The maneuvering speed for a specific flap setting is displayed using a green index marker with the associated flap number beside it.

Prior to entering the approach, the landing flap setting should be selected in the FMC APPROACH REF page. This page will show the 25 REF, 30 REF and 40 REF speeds given the current aircraft weight. The selected flap setting and REF speed should be selected and entered using the appropriate LSK. Once selected, the FMC will not continue to adjust the REF speed to reflect continued fuel burn. If significant weight change is experienced due to prolonged holding, reselecting a REF speed is necessary to update approach and flap maneuvering speeds.

When selecting speeds independently of ATC instructions, selecting an MCP speed which is 10 knots higher than the flap maneuvering speed bug will provide a stable, efficient flight envelope with a comfortable margin for banking turns which may be required by ATC.

Flaps Usage: To ensure a normal, stabilized approach, it is good technique to have Flaps 5 selected by the time the initial approach is commenced.

Proper deployment technique is to set the next flap setting as the airspeed passes through the next highest flap setting maneuver speed. For example, selecting flaps 10 will be done as airspeed slows through the flaps 5 maneuver speed.

Stabilized Approach: A stabilized approach is important to a consistent and safe landing technique. This is particularly true in transport category aircraft.

A stabilized approach is defined by accomplishment of the following before reaching 1000 feet AGL on an instrument approach or 500 feet AGL on a visual approach:

- Landing configuration (gear and flaps)
- On descent profile (ILS Localizer and glide slope, published non precision profile, or when conditions have been met to allow a visual approach below DH or MDA on a non precision approach.)
- Speed within 5 knots of target REF speed.
- Rate of descent not in excess of 1000 fpm on precision approach or 1200 fpm on non precision approach.
- Engines spooled up normally to maintain speed and rate of descent.

In order to facilitate a stabilized approach, crews should plan to have the landing gear down and the final approach checklist completed prior to crossing the outer marker.

If the approach is unstable, or becomes unstable below 1000 feet on an instrument approach or 500 feet on a visual approach, initiate a go around.

Precision Approach and Landing (ILS): The initial approach can be flown using a number of different modes in the autoflight mode, regardless of whether a manual or automatic landing is anticipated. The HDG SEL and LNAV modes can be used for lateral tracking of the flight path and VNAV, LVL CHG or V/S can be used for altitude changes. Generally VNAV is considered to be the preferred method, as the VNAV program provides speed management not found in the V/S mode, and as such can make for a smoother approach with less significant throttle movement and thrust changes. When VNAV mode is not usable, or at the crews discretion, LVL CHG will provide for speed management during a descent, but will result in increased throttle movement and cabin noise during small altitude changes. For small altitude changes, use of the V/S mode will minimize autothrottle thrust changes until the new, lower altitude is reached.

Passenger comfort is maximized and engine wear and tear are minimized when changes in required thrust settings are anticipated and accounted for by the crew. For example, when the landing gear are lowered, timely selection of the next slower speed required for the approach will eliminate the need for the autothrottle to increase thrust in order to compensate for increased drag from the landing gear immediately prior to a thrust change for a decrease in approach speed.

Whenever possible, it is helpful to enter the landing runway into the FMC DEP/ARR page, as this will display an extended runway centerline in the ND MAP mode, which can help with spatial awareness.

When turning onto the localizer intercept heading and commencing the approach, select APP mode on the ND. The expanded compass rose or full compass rose (HSI) provide for the best approach information display.

If LNAV is being used to manage lateral track navigation, use caution to ensure that the aircraft actually captures the ILS localizer. In some cases, the aircraft will continue to fly the LNAV approach heading without actually capturing the localizer, which can lead to dangerous descent conditions if a glideslope capture occurs.

After localizer capture, the heading bug should be set to reflect to inbound approach course. If a large intercept angle was being flown, the autopilot will perform one intercept maneuver before stabilizing on the localizer. At intercept angles less than 30 degrees, the autopilot will not require an intercept maneuver.

The aircraft should be configured for final approach prior to reaching the final approach fix. This will ensure an accurate glide slope intercept at the appropriate speed for the approach. Landing flaps setting should be selected immediately after capturing the glideslope, with the MCP speed set to final approach speed for the landing flaps setting. Normally, landings will be performed at flaps 25, or flaps 30 unless runway or weather conditions dictate the use of flaps 40.

Single Engine ILS Approach: A normal approach should be flown in accordance with the Abnormal Procedure for single engine landing.

When flying the approach with an engine out, it is important the crew stabilize the aircraft on the final approach speed prior to reaching the outer marker. This will provide an opportunity to re-trim the aircraft as required to eliminate yaw tendencies at the slower approach speeds. Once the aircraft is trimmed, a normal approach and landing can be flown.

It is generally not considered good practice to land with flaps 30 or flaps 40 unless runway length limitations require it. Selecting a higher flap setting is preferable in the event that a single engine go-around is necessary.

In some cases, the crew may desire to zero out any trim influence prior to flying the approach. This will require that the crew manually input the control deflections necessary to eliminate the yaw tendencies of the aircraft. While this is a higher workload solution, it is available to the crew and should be completed prior to reaching the final approach fix.

Crews should resist the temptation to adjust rudder trim after crossing the final approach fix as this may distract crew members from flying the approach effectively.

Non-Precision Approaches: When flying non precision approaches, the aircraft must be in the landing configuration prior to reaching the final approach fix. Final Descent checklist should be completed prior to crossing the final approach fix as well. Landing flaps should be set and landing speed selected on the MCP speed selector prior to commencing the descent to the MDA.

A rate of descent should be used which will allow visual acquisition of the runway environment (commensurate with MDA) in time to align the aircraft with the landing runway.

During NDB approaches, the MAP CTR mode provides a good picture of needle tracking throughout the approach.

During VOR approaches, the VOR or MAP modes provides a good situational awareness picture of the approach.

Circling to Land: When circle to land minimums are met and wind conditions require such a maneuver, the pilot flying must maintain visual contact with the field once descent below the clouds in completed. When circling, bank angles in excess of 30 degrees should be avoided. Flaps 20 and the associated flaps 20 maneuvering speed is recommended for the approach portion of the procedure as well as the circling maneuver. Once the turn to final is commenced, extend landing flaps and commence a normal visual approach profile.

VNAV Approaches: It is possible to use a combination of VNAV and LNAV to fly non precision approaches down to 50' above the runway environment.

If the aircraft is within 15nm of the arrival runway and flaps15 or greater has been selected, it is possible to use VNAV to fly the non precision approach profile.

For example: The crew should enter the required crossing altitudes and speeds in the FMC flightplan for stepdown fixes along the approach. Then, when within 15nm of the airport and operating at flaps 15 or greater, the MCP altitude will not serve to inhibit the VNAV/FMC descent according to the descent profile.

Generally the MCP altitude should be set to the cleared altitude prior to crossing the final approach fix. The MCP altitude can then be set to the Missed Approach Altitude when crossing the final approach fix, and a VNAV managed descent according to the altitude/speed restrictions in the FMC will be commenced.

Note: We have included this level of accuracy in the FMC capability because it represents operational procedures used by aircrews around the world on a regular basis.

This level of accuracy brings forward some unfortunate factors regarding the MSFS navigation and landmass database employed by FS9.

During our pre-release testing we found that it was not uncommon for the VNAV approach mechanism was able to fly the airplane down to 50' above the threshold altitude with precision accuracy. However, in a number of test cases, the runway location within the MSFS scenery based upon outmoded position data and the runway was not always exactly under the airplane even though the FMC navigation position was reported to be identical to the runway touchdown zone position on current Jeppesen Approach Plates.

So, as in the real world, we strongly encourage crewmembers to remember that the pilot flies the airplane, not the automation, and it may occasionally be necessary to demonstrate sound judgment and pilotage when working within the MSFS world.

LANDING PROCEDURES

Landing Geometry: To make consistently accurate and safe landings, it is important that the pilot have a firm understanding of the geometry in the landing configuration.

The standard ICAO glideslope installation requires the glideslope to intersect the runway surface 1,000 feet from the threshold. In this configuration, a 2.5º glideslope will have a runway threshold crossing height (TCH) of 66 feet.

If the aircraft is flown to the runway in this configuration without a normal flare, the main gear will touch down approximately 900 feet from the runway threshold.

If a moderate flare is accomplished, rather than simply flying the aircraft onto the runway, the flight path of the main landing gear can be expected to lengthen by between 300 and 700 feet.

It is recommended that the aircraft be flared to touch down on the runway surface between 1,000 and 1,500 feet from the threshold. As such, the pilot should use the 1,000 foot markings on the runway as the visual aim point for the approach.

Coincidentally, this aim point will provide a good visual reference for flying both a 2.5º and 3º glide slope, and result in an appropriately placed touchdown using normal flare technique.

Touchdown should occur in the first 3,000 feet of the runway, or 1/3 of the runway length, whichever is shorter.

Flare: At 50 feet radio altitude above the runway surface, the throttles should be moved to idle. At 30 feet radio altitude, nose up pitch should be increased from the approach angle to approximately 5º nose up. If accomplished correctly, the aircraft should settle onto the runway without extended floating.

Keeping power added during the flare may cause extended floating in ground effect just above the runway surface, which will significantly increase landing distance. Crews are likewise cautioned not to continue to increase nose up pitch during the flare in an effort to “grease it on” as this may cause a rapid decay in airspeed, reducing aircraft controllability and reducing the effectiveness of immediate go around thrust should it be needed. In addition, a pitch attitude of only 9.2º nose up will cause fuselage contact with the runway surface upon main gear touchdown in the –900..

The recommended approach and landing technique is to fly a visual aim point 1,500 feet down the runway. Reduce thrust to idle beginning at 50 feet, with the flare commencing at 30 feet. Fly the aircraft onto the runway surface and commence the rollout procedure.

Effective use of this procedure will consistently result in a runway touchdown between 1,000 and 1,500 feet from the threshold.

VASI/ PAPI: If landing on a runway equipped with a standard two bar VASI system or a PAPI, use caution to manage the threshold crossing effectively.

During testing, it has been discovered that Microsoft Developers misplaced the location of many ILS glideslopes, making them not congruent with the VASI/PAPI and in some cases making the touchdown point of the runway incorrect.

It is not uncommon to find airports in the real world where the visual approach aids do not align with the instrument approach aids, so again the practical use of sound piloting will reward with good, safe landings.

Crosswinds: When the flying a coupled approach, the autopilot will fly most of the approach with the airplane’s nose crabbed into the wind.

As the airplane touches down on the runway surface, the upwind wing may be lower than the downwind wing, and enough rudder input will be applied to keep the aircraft aligned with the runway centerline.

This is the best technique for landing the aircraft in a crosswind condition, as it provides the best directional control of the aircraft upon touchdown and minimizes wear and tear on the airframe and landing gear.

After the nose has been lowered to the runway, rudder and steering tiller input may be required to keep the aircraft aligned with the runway during deceleration due to the reduced effectiveness of spoilers and ailerons after touchdown.

If conducting an Autoland, do not anticipate having the airplane track the centerline while rolling out. The 737, unlike some larger Boeing airplanes, does not have a ROLLOUT mode in the Autoland capability so the crew is continually responsible for tracking the runway centerline after touchdown.

Due to the tandem wheel arrangement on the 737 main landing gear, the airplane has a strong tendency to travel in the direction the nose of the airplane is pointed at the moment of touchdown. Thus, a slight nose into the wind deflection can result in the aircraft travelling toward the upwind side of the runway during the rollout. This should be immediately and precisely corrected with rudder input while lowering the nose wheel to the runway surface.

Autobrakes provide the best braking response during crosswind landings because of the difficulty in applying even brake pressure to rudder pedals that are displaced in order to provide rudder deflection for the final phase of the approach. As such, crews are advised to use autobrakes whenever possible on crosswind landings.

Runway Braking: To understand the importance of steady brake pressure application, it is important to understand that the antiskid system which is used to prevent wheel locking and skidding monitors friction between the tires and the runway surface through a deliberate modulation and testing of braking power to the main gear. If the autobrakes are overridden by flight crew application of braking pressure, this process of runway sampling starts again from the beginning. Repeated pumping of the brake pedals by the flight crew can increase the landing roll by as much as 75% in some cases. Crews are advised to apply a steady rate of pressure on the brake pedals when autobrakes are not used.

The autobrake system allows for settings 1 – 4 and MAX. Autobrakes are recommended for any landing being accomplished on a runway shorter than 8,000 feet, or at high gross landing weights on longer runways. During the approach segment of the flight, select the autobrakes power setting required for the landing.

After touchdown, brake application is indicated by a positive rate of deceleration beginning one or two seconds after touchdown. The braking is applied gradually, with the full selected braking power being applied as the nose wheel touches the runway surface.

A combination of Autobrakes and Spoiler deployment is normally sufficient to decelerate the airplane within it’s landing distance requirements. Remember that the aircraft runway length certification involves only normal braking, spoilers and no reverse thrust, so the application of reverse thrust will shorten the expected landing distance.

In order to ensure proper Autobrake and Spoiler deploy on landing, it is EXTREMELY important that the throttle be pulled to idle immediately upon main wheel touchdown if some power was used during the landing. (The throttles should have been at idle 30’ AGL, but sometimes it is necessary to carry some power until touchdown.)

If you do not get autobrake/spoiler activation, be sure to pull the throttles to idle!

If the autobrakes system fails (accompanied by a AUTOBRAKE DISARM warning), apply manual brake pressure.

Use of reverse thrust will augment the braking system and reduce wear on the brake systems. Regardless of whether or not reverse thrust is applied, the autobrake system seeks a target rate of deceleration (see Landing chapter), rather than a certain brake power. This will result in a consistent and smooth rate of deceleration after touchdown.

The autobrake system is designed to bring the aircraft to a complete stop upon touchdown, so crew intervention is required if a full stop is not desired. Simply disarm the autobrakes system by selecting OFF after passing through 60 knots and reducing reverse thrust to idle.

Autobrakes may also be disarmed by advancing the throttles or manually applying brake pressure momentarily.

Reverse Thrust: Application and amount of reverse thrust is subject to the discretion of the flight crew. When touching down on wet or slippery runways, every effort should be made to ensure that only symmetrical reverse thrust is applied. On dry runways, asymmetrical thrust should only be applied with extreme caution, as this may pose a significant directional control problem to the flight crew.

When passing through 80 knots begin moving the throttles so as to reach reverse idle by 60 knots. Use of reverse thrust levels higher than idle when forward speed is below 60 knots increases the potential for FOD ingestion and engine surging due to ingestion of engine exhaust.

The engines should be brought to forward idle by the time taxi speed is reached.

If directional control problems are encountered during the landing rollout, it is important that they be identified and solved quickly in order to keep the aircraft on the runway centerline and under control.

If a skid is detected during the landing roll:

- Reduce reverse thrust to idle if at high levels of reverse thrust.
- Verify correct control inputs for current crosswind conditions. (aileron into the wind and opposite rudder)
- Use forward differential thrust, if necessary to restore directional control.

MISCELLANEOUS FLIGHT TECHNIQUES

Emergency Descent: At the first indication of a cabin altitude /cabin pressure problem, the crew should immediately don oxygen masks. A quick trouble shooting process is to verify that all packs are normal and to close all isolation valves. If this does not remedy the problem, or if it is obvious that cabin altitude is uncontrollable, an emergency descent should be commenced at once.

An emergency descent is best performed under control of the autopilot, as this reduced the crew workload and allows them to focus on issues related to localizing and identifying the aircraft problem.

Immediately select 14,000 feet or Minimum Enroute Altitude, whichever is higher in the MCP Altitude window. Press LVL CHG, extend the speedbrakes and verify the MCP commanded airspeed is in the usable range.

Passing through 16,000 feet begin preparing for a controlled level out by selecting 290 knots in the MCP speed window. Retract speedbrakes and apply thrust as necessary during the level out and consult the required checklists.

Stalls: An aerodynamic stall in any aircraft configuration, flight mode, or at any altitude is an unacceptable flight condition for the 737. At the first warning of an impending stall, (stick shaker or stall buffet):

- **Throttles**: Full Forward
- **Pitch**: Adjust to minimize loss of altitude. Intermittent stick shaker is acceptable in order to prevent ground or obstacle contact.
- **Wings:** Level
- **Configuration:** Do not change flap or gear settings until recovery from the stall is complete.

Steep Turns: Turns in excess of 30º are not normally accomplished during normal operations. For pilot familiarity with the aircraft in all regimes of flight, is important the flight crews be able to manage steeper bank angles should they be necessary or desired.

Entry into a 45º bank should be accomplished with the MCP speed set to 240 KIAS. Level flight can be maintained with only a slight nose pitch up in the turn. Use of stabilizer trim is recommended to eliminate approximately half of the required flight column control input required to maintain level flight in the turn.

Force-Feedback Issues: For users who have force-feedback joysticks enabled, we STRONGLY recommend that you disable “Control Surface Forces” within Microsoft Flight Simulator before attempting to fly this airplane.

Force feedback provides tactile cues to you via the joystick. The control forces are not generated based upon algorithms that realistically simulate control feedback, and can actually cause significant Pilot Induced Oscillations as you attempt to correct for unrealistic forces exerted against your control inputs during flight.