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BOEING FLIGHT OPERATIONS REVIEW
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BOEING

Flight Operations **REVIEW**

A MESSAGE TO FLIGHT CREWS FROM THE BOEING COMMERCIAL AIRPLANE GROUP

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GUIDELINES FOR SITUATIONS WHICH ARE BEYOND THE SCOPE OF THE NON-NORMAL PROCEDURES

It is rare to encounter inflight events which are beyond the scope of established non-normal procedures. These events can arise as a result of unusual occurrences such as a mid-air collision, bomb explosion or other major malfunction. In these situations the flight crew may be required to accomplish multiple non-normal checklists, selected elements of several different checklists (applied as necessary to fit the situation) or find little or no specific guidance and need to rely on their own judgment and experience. Because of the highly infrequent nature of these occurrences, it is not practical or possible to create definitive flight crew procedures to cover all events.

The following guidelines may aid the flight crew in determining the proper course of action should an inflight event of this type be encountered. Although these guidelines represent what might be called "conventional wisdom", circumstances will determine the course of action which the crew perceives will conclude the flight in the safest manner.

BASIC AERODYNAMICS AND SYSTEMS KNOWLEDGE

Knowledge of basic aerodynamic principles and airplane handling characteristics and a comprehensive understanding of airplane systems can be key factors in situations of this type.

Basic aerodynamic principles are known and understood by all pilots. Although not a complete and comprehensive list, following are a brief review of some basic aerodynamic principles and airplane systems information relevant to such situations:

1. If aileron control is affected, rudder inputs can assist in countering unwanted roll tendencies. The reverse is also true if rudder control is affected.

2. If both aileron and rudder control are affected, the use of asymmetrical engine thrust may aid roll and directional control.

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3. If elevator control is affected, stabilizer trim and thrust can be used to control pitch and airplane attitude. In order to do this effectively, engine thrust and airspeed must be coordinated with stabilizer trim inputs. Increasing thrust without a corresponding stab trim change will result in an increase in airplane pitch attitude to seek a speed consistent with the stab trim setting. Flight crews should be aware of the airplane's natural tendency to oscillate in the pitch axis if the stable pitch attitude is upset (known as Phugoid Oscillation). These oscillations are normally self damping in Boeing airplanes, but to ensure proper control, it may be desirable to use thrust and/or elevator trim to hasten damping and return to a stable condition. All current production Boeing airplanes have wing mounted engines and exhibit a pitch up when thrust is increased and a pitch down when thrust is decreased. Use caution when attempting to damp pitch oscillations by use of engine thrust so that applications of thrust are timed correctly and diverging pitch oscillations do not develop.

4. If a jammed flight controls condition exists, both pilots can apply force to either clear the jam or activate the break-out feature designed into all Boeing airplanes. There should be no concern about damaging the mechanism by applying too much force. In certain cases, clearing the jam may permit one of the control columns to operate the flight controls with portions of a control axis jammed. It may be necessary to apply break-out forces for the remainder of the flight on the affected control axis.

5. Stall speed increases with angle of bank and increasing load factors. Therefore, it is prudent to limit bank to 15° in the event maneuvering capability is in question. In general, increasing the normal flap/speed maneuvering schedule (but staying within flap placard limits), will provide extra stall margin where greater bank angles are necessary as an alternative.

6. All Boeing airplanes have the capability to land using any flap position, including flaps up. Use proper maneuvering and final approach speeds and ensure adequate runway is available to stop the airplane after landing.

7. If airspeed indications are unreliable or suspect, charts located in the Boeing Operations Manual can provide thrust settings and pitch attitudes for desired airspeeds in climb, level flight, descent, and approach and landing. For airplanes equipped with Flight Management Computers, airspeed and ground speed information is available from the FMC and can be used as a cross check. Many air traffic control radars can also measure ground speed.

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FLIGHT PATH CONTROL

When encountering an event of the type described above, the flight crew's first consideration should be to maintain or regain full control of the airplane and establish an acceptable flight path. This may require use of unusual techniques such as the application of full aileron or rudder or in an asymmetrical thrust situation, reduction of power on the operating engine(s) to regain lateral control. This may also require trading altitude for airspeed or vice versa. The objective is to take whatever action is necessary to control the airplane and maintain a safe flight path. Even in a worst case condition where it is not possible to keep the airplane flying and ground contact is imminent, a "controlled crash" is a far better alternative than uncontrolled flight into terrain.

Fuel jettison (if available) should be a primary consideration if airplane performance appears to be critical. In certain cases, this may also be used to maintain or establish lateral controllability.

As a general rule, 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 on airplane control if an asymmetrical flap condition should occur if flap position is changed. If no flap damage exists, wing flaps may be retracted or extended, as required. If leading edge damage is observed or suspected, consider leaving the leading edge devices in their present position for the remainder of the flight. Trailing edge flaps should be operated as directed in the associated non-normal procedure. On some airplane models, independent operation of leading and trailing edge flaps may not be possible through normal flight deck controls.

RECALL CHECKLISTS / PROCEDURES

After flight path control has been established, accomplish the recall steps of appropriate non-normal procedures. The emphasis at this point should be on containment of the problem and not on configuring the airplane for an immediate landing. Examples of this type of checklist include "Engine Fire, Severe Damage or Separation", "Multiple Engine Flameout or Stall", or "Rapid Depressurization".

Accomplish all applicable non-normal procedures prior to commencing final approach. Exercise common sense and caution when accomplishing multiple procedures with differing 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 the cabin crew as soon as possible.

DAMAGE ASSESSMENT AND AIRPLANE HANDLING EVALUATION

Unless circumstances such as imminent airplane break-up 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. Use caution when slowing to lower flaps. Make configuration and airspeed changes slowly until a damage and controllability assessment has been accomplished and it is certain that lower airspeeds can be safely utilized. In addition, limit bank angle to 15° and avoid large or rapid changes in engine thrust and/or airspeed. If possible, conduct this assessment and handling evaluation at an altitude that will provide 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 assessment should start with an examination of flight deck indications to assess damage. Consideration should be given to the potential cumulative effects of the damage. As previously mentioned, 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 passenger compartment. 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.

The flight crew should consider contacting the company to both inform them of the situation and as a potential source of useful information. In addition to current and forecast weather, airfield conditions and similar routine but essential information, it may be possible to obtain technical information and recommendations from expert sources. These expert sources are available from within the company as well as from the airplane manufacturer.

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. Limit bank to 15° and avoid rapid thrust and airspeed changes which might adversely affect controllability. 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. As previously stated, if leading edge flap damage is suspected, consider leaving the leading edge flaps in their present position for the remainder of the flight and operating the trailing edge flaps with the alternate system. 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 non-normal procedure. 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.

If airplane performance is a concern, use of the alternate flap or gear extension systems may dictate that the configuration portion of this check be accomplished coincident with 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.

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

APPROACH AND LANDING

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

1. Weather conditions (VMC preferred)
2. Enroute time

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3. Length of runway available (longest possible runway preferred, wind permitting)
4. Emergency services available
5. Flight crew familiarity
6. Other factors dictated by the specific situation.

As previously stated, fuel jettison may improve airplane performance and permit lower approach and landing speeds. Plan an extended straight-in approach with time allotted for the completion of any lengthy non-normal procedures such as the use of alternate flap or landing gear extension systems. Arm autobrakes and speedbrakes unless advised otherwise by the checklist(s).

If possible, fly a normal approach profile and attempt to land in the normal touchdown zone. After landing, use available deceleration devices to bring the airplane to a complete stop on the runway. Circumstances will dictate the requirement for an airplane evacuation or if the airplane can be taxied off the runway.

This information will be incorporated in appropriate detail in future revisions of the model Flight Crew Training Manuals.

BOEING PUBLISHES THE "FLIGHT OPERATIONS REVIEW" FOR OPERATORS AND THEIR FLIGHT CREWS IN ORDER TO PROVIDE ADVISORY INFORMATION RELATED TO FLIGHT OPERATIONS. ALL INFORMATION IN THE "FLIGHT OPERATIONS REVIEW" IS CONSIDERED ACCURATE. HOWEVER, IT IS NOT INTENDED TO REPLACE OR SUPERSEDE INFORMATION CONTAINED IN APPROVED OPERATING DOCUMENTATION.

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