Factual Report – Attachment 12

Ameristar Windshear Avoidance (AOM excerpts)

OPERATIONAL FACTORS

DCA17FA076

Windshear

Avoiding Microbursts

Avoidance Actions

When positive indications of severe windshear exist, avoid the areas by:

- Delaying take-off until conditions improve.
- Inflight, divert around the areas.
- On approach, initiate a go-around or hold until conditions improve.

Other Precautions

While avoidance is the best precaution, there are some situations when windshear clues do not clearly dictate delaying, but can be interpreted to mean that conditions are right for windshear activity.

WARNING

Use of precautions along with even the best recovery piloting skills cannot guarantee a successful escape from many microburst windshears. It is important to realize that the recommended precautions each have a relatively small effect on the outcome of an inadvertent windshear encounter. Therefore, use of precautions should not replace sound pilot judgment in deciding whether or not it is safe to proceed. Use of precautions should not bias a go/no-go decision in the go direction.

Takeoff Precautions

1. *Thrust Setting*
   Maximum rated takeoff thrust should be used for takeoff. This shortens the takeoff roll and reduces overrun exposure. Full thrust also provides the best rate of climb, thus increasing altitude available for recovery if required. Lastly, full thrust takeoffs may eliminate resetting thrust in a recovery, thereby maximizing acceleration capability and reducing crew workload.

2. *Runway Selection*
   Use the longest suitable runway that avoids suspected areas of windshear. Consideration should be given to exposure to obstacles after liftoff and crosswind and tailwind limitations. This assures maximum runway available to accelerate to rotation speed and may result in more ground clearance at the end of the runway and during the climb profile. Should the decision be made to reject the takeoff, more runway is available on which to stop the airplane.

3. *Takeoff Flap Selection*
   Use minimum flap setting to comply with obstacle clearance and/or climb gradient.

4. *Increased Airspeed*
   Increased airspeed at rotation improves the ability of the airplane to negotiate a windshear encountered after liftoff. Increased airspeed improves the flight path, reduces potential exposure to flight near stick shaker speeds, and reduces pilot workload.

   Delaying rotation to a higher airspeed may appear to increase the risk of overrunning available runway. However, because of the manner in which increased rotation speed is calculated, it is simply using the runway as if the aircraft was loaded to the field length limit weight for that runway.

   If the takeoff is at field length limit conditions, the risk of overrunning the available runway is increased because there is no extra runway available. The overrun exposure is also increased if the windshear reduces the airspeed below the minimum airspeed required for liftoff at the maximum available (body contact) attitude. However, initiating rotation no later than 2000 feet from the end of the useable runway surface reduces the probability of overrun and maximizes the available energy after liftoff.

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Windshear

If increased V_R is to be used, the technique for scheduling and using increased rotation airspeed is:

a. Determine V_1, V_R, and V_2 speeds for actual airplane gross weight and flap setting. Set airspeed bugs to these values in the normal manner.

b. Determine field length limit maximum weight and corresponding V_R for selected runway.

c. If field length limit V_R is greater than actual gross weight V_R, use the higher V_R (up to 20 knots in excess of actual gross weight V_R) for takeoff. Do not set the higher weight V1 or VR.

d. Rotate to normal initial climb attitude at the increased V_R and maintain this attitude. This technique produces a higher initial climb speed that may slowly adjust back to the initial climb speed based on the actual gross weight.

WARNING

If windshear is encountered at or beyond the actual gross weight V_r, do not attempt to accelerate to the increased VR, but rotate without hesitation. In no case should rotation be delayed beyond 2,000 feet runway surface remaining.

If increased airspeed was not used prior to liftoff, accelerating to higher than normal airspeed after liftoff is not recommended. Reducing pitch attitude at low altitude to accelerate might produce a hazard if windshear is encountered.

Approach Precautions

1. *Stabilized Approach*
   During some normal operations, stabilized approaches are not achieved prior to 500 feet AGL. However, in a potential windshear environment, a stabilized approach should be established no later than 1,000 feet AGL to improve windshear recognition capability.
2. *Thrust Management*
   Minimize thrust reductions rather than immediately compensating for an airspeed increase by reducing thrust, a brief pause to evaluate speed trends is prudent. If a tailwind shear occurs and recovery is initiated, the additional airspeed and earlier availability of thrust (due to engines accelerating from a higher RPM) will be advantageous. In the absence of a tailwind shear, this procedure may result in a higher than normal approach speed which may have to be accounted for on landing.
3. *Runway Selection*
   Use the most suitable runway that avoids the area of suspected windshear and is compatible with crosswind and tailwind limitations. A longer runway provides the greatest margin for increased ground roll due to unanticipated winds and possible resulting high ground speed at touchdown. A precision (instrument) approach and other aids to glide path monitoring (VASI, etc.) are also desirable as they can enhance windshear recognition by providing timely, accurate flight path deviation information.
4. *Increased Airspeed*
   Increased airspeed on approach improves climb performance capability and reduces the potential for flight at stick shaker during recovery from an inadvertent windshear encounter.

If available landing field length permits, airspeed may be increased up to a maximum of 20 knots. This increased speed should be maintained to flare. Touchdown must occur within the normal touchdown zone - do not allow the airplane to float down the runway.

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Windshear Continued

As many variables are involved, it is not practical to provide exact guidance on the effect of 20 knots extra speed on actual stopping distance. Wind can be a major factor since stopping distance is affected by ground speed rather than airspeed. If increased airspeed is used and an increasing performance shear is encountered, a go-around may be necessary due to insufficient landing field length for the higher approach speed. Furthermore, if a pilot can be reasonably certain that wind changes (due to topography or unique local conditions) will not result in decreasing performance, it may be inappropriate to use increased approach speed.

Other factors affecting stopping distance such as availability and effectiveness of thrust reversers, tire and brake condition, runway surface conditions, etc., must also be taken into consideration. On a dry runway with no adverse factors present, landing field length may accommodate 20 knots extra speed at touchdown. In other cases greater field length may be required. If in doubt, use the longest suitable runway which does not expose the airplane to greater hazard from possible shear.

WARNING

Increased touchdown speeds increase stopping distance. An additional 20 knots at touchdown can increase stopping distance by as much as 25 percent and in some cases may exceed brake energy limits.

5. *Flight Director and Autopilot*
   During approach it is desirable to utilize the flight director and autopilot to the maximum extent practical. These systems may relieve pilot workload, allowing the crew more time to monitor instruments and weather conditions. The autopilot should be disconnected when continued use appears counter-productive.

Windshear Recovery Technique

If a windshear is encountered, the primary recovery technique objective is to keep the airplane flying as long as possible. The best results, without the benefits of computed flight guidance, have been achieved by pitching toward an initial target attitude while using necessary thrust.

The guidelines for unacceptable flight path degradation are:

Takeoff/Approach

- ±15 knots indicated airspeed
- ±500 FPM vertical speed
- ±5° pitch attitude

Approach

- ±1 dot glideslope displacement
- Unusual throttle position for a significant period of time.

These should be considered as guidelines since exact criteria cannot be established. In every case, it is the responsibility of the pilot flying to assess the situation and use sound judgment in determining the safest course of action. In certain instances where significant rates of change occur, it may be necessary to initiate recovery before any of the above are exceeded.

If windshear is inadvertently encountered after liftoff or on approach, immediately initiate the recommended recovery technique. If on approach, do not attempt to land.

The technique for recovery from a windshear encounter after liftoff or during approach is the same for both cases. The following pages describe these techniques.

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Windshear

Technique - Pilot Flying

- *Autopilot*
  Disconnect the Autopilot if engaged.
- *Thrust*
  Aggressively apply necessary thrust to ensure adequate airplane performance. Do not be reluctant to overboost the engines to avoid ground contact. When airplane safety has been ensured, adjust thrust to maintain engine parameters within specified limits. (80)Disconnect autothrottles and aggressively apply necessary thrust to ensure adequate airplane performance. Do not be reluctant to overboost the engines to avoid ground contact. When airplane safety has been ensured, adjust thrust to maintain engine parameters within specified limits.
- *Pitch*
  The pitch control technique for recovery from a windshear encounter after liftoff or on approach is as follows:

  a. At a normal pitch rate, increase or decrease pitch attitude as necessary toward an initial target attitude of 15°. The autopilot/flight director should be turned off by the PM.

  b. Always respect the stick shaker. Use intermittent stick shaker as the upper pitch limit. In a severe shear, stick shaker may occur below 15° pitch attitude.

  c. If attitude has been limited to less than 15° to stop stick shaker, increase attitude toward 15° as soon as stick shaker stops.

  d. If vertical flight path or altitude loss is still unacceptable after reaching 15°, further increase pitch attitude smoothly in small increments.

  e. Control pitch in a smooth, steady manner (in approximately 2 degree increments) to avoid excessive overshoot/undershoot of desired attitude.

  f. Once the airplane is climbing and ground contact is no longer an immediate concern, airspeed should be increased by cautious reductions in pitch attitude.

(80) The pitch control technique for recovery from a windshear encounter after liftoff or on approach is essentially the same as on the 15 series aircraft. On the 80 series more information is presented on the PFD to assist the pilot in recovering from a windshear encounter. Even though the DFGC will be providing information to the FD and autopilot any windshear is a very dynamic situation and the FD and autopilot commands may lag the actual recovery requirements. Therefore, in any windshear encounter follow the procedure below.

a. Press the TOGA switch on the throttles and observe that the pitch mode on the FMA changes to WIND SHR. Once the PM observes WIND SHR in the pitch mode of the FMA he will call "YOU HAVE GUIDANCE" indicating that the FD will be providing windshear guidance.

b. At a normal pitch rate, increase or decrease pitch attitude as necessary toward an initial target attitude of 15° on the PFD.

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Summary

Takeoff Precautions

- Use Maximum Rated Takeoff Thrust
- Use Longest Suitable Runway
- Consider Using Recommended Flap Setting
- Consider Using Increased Rotation Airspeed

Approach Precautions

- Stabilize Approach No Later Than 1000 Feet AGL.
- Minimize Thrust Reductions
- Use Most Suitable Runway
- Consider Using Recommended Flap Setting
- Consider Using Increased Approach Speed
- Use Autoflight Systems During Approach.

Takeoff (On Runway) Recovery Technique

- *Thrust*
  Apply Necessary Thrust
  (80) Disconnect autothrottles and
  Press TOGA
- *Pitch*
  Rotate Toward 15° (No Later Than 2000 Feet Remaining)
  Increase Beyond 15° If Required To Lift Off.

Note: After liftoff follow After Liftoff Recovery Technique

After Liftoff/On Or Approach Recovery Technique

- *Autopilot*
  Disconnect the Autopilot, if engaged.
- *Thrust*
  Apply Necessary Thrust
  (80) Disconnect autothrottles and
  Press TOGA
- *Pitch*
  Adjust Toward 15°
  Increase Beyond 15° If Required To Ensure Acceptable Flight Path
  Always Respect Stick Shaker
  (80) Monitor and respect the PLI
  FOLLOW FD COMMANDS ONLY IF FD COMMANDS ARE PROVIDING ACCEPTABLE PERFORMANCE.

  Configuration
  Maintain existing configuration

THE BEST DEFENSE AGAINST MICROBURSTS IS AVOIDANCE