Attachment # 4

Tail Strike Awareness Training
Instructors Guide

TAIL STRIKE AWARENESS TRAINING

CONTENTS

TAIL STRIKE AWARENESS TRAINING
INSTRUCTOR NOTES

BRIEFING 30 MINUTES
TRAINING DEVICE 1 HOUR
DEBRIEF 30 MINUTES

OBJECTIVE

The primary objective of tail strike awareness training is to improve awareness of the pilot controlled factors that affect pitching tendency after touchdown and to reinforce proper sink rate and bounce recovery technique.

This training may be accomplished as part of recurrent, initial, or transition training.

REQUIRED SIGN OFF

Note completion by a remark "Tail Strike Awareness Training Accomplished" in the remarks section of the 007 or 007A.

TAIL STRIKE AWARENESS BRIEFING

INTRODUCTION

- **MD-11 tail strike incidents/accidents have occurred at a fairly constant rate (tail strikes/total landings).**

- **25% of MD-11 tail strikes to date have occurred on takeoff and 75% on landing.**

TAKEOFF

The recommended rotation technique is a 3 degree per second rotation to an initial pitch attitude of approximately 15 degrees. The PF should then transition to the flight director pitch bar for guidance. The flight director pitch bar is not usable until approximately five seconds after nose gear strut extension. A two step rotation is not appropriate. Two step or segmented rotations will significantly impact takeoff performance i.e. required runway, second segment climb gradients, and obstacle clearance. It is, however, the PF's responsibility to ensure that the aircraft is accelerating properly and has become airborne passing 10 degrees of pitch attitude. If the aircraft has not become airborne, possibly due to an inaccurate flap setting, stab setting, gross weight entry, or contaminated wing, the rotation should be stopped.

Some tail strikes on takeoff have occurred as a result of early or quick rotations. One tail strike occurred as a result of the pilot initiating a rotation at V1 vs. VR. Another tail strike occurred as a result of an inaccurate gross weight entry into the FMS which resulted in inaccurate V speeds.

LANDING

- **Some of the factors that affect pitching tendency after touchdown are:**

Flap setting	**Strut servicing**	**Sink rate**
Center of gravity	**Ground spoilers**	**Attitude**
Gross weight	**Autobrakes**	**Attitude rate**

- **Tail strikes have occurred with the following:**

  Flaps 35 and flaps 50
  Forward and aft center of gravity
  Light and heavy gross weight
  Over serviced and correctly serviced struts

One consistent factor in every landing tail strike to date has been an excessive descent rate with an increasing attitude rate prior to the initial touchdown. Sink rates, aircraft attitude, and attitude rate are pilot controlled factors that affect pitching tendency after touchdown and will be the focus of this training program.

- **The following pilot actions may result in high sink rates prior to touchdown:**

  Unstable approach
  Late or abrupt forward slip maneuver
  Early flare

- **Unstable approach**

  The aircraft should be fully configured, on speed (including appropriate wind and gust corrections applied to Vref) and on flight path by 1000 feet AGL. If the aircraft is not stabilized by 500 feet or if a sink rate of more than 1000 FPM develops, a missed approach should be executed.

  Several tail strikes have occurred on visual approaches without the use of an electronic glideslope. Increased crew awareness and crew coordination during these types of approaches is critical.

- **Late or abrupt forward slip maneuver**

  The recommended method for a crosswind landing is to fly the final approach in a wing's level attitude with a crab into the wind. At approximately 200 feet AGL, align the fuselage with the runway by smoothly applying rudder pressure and lower the upwind wing to prevent drifting off runway centerline. In high crosswinds, consideration should be given to commencing the forward slip maneuver prior to 200 feet, and in all cases, the forward slip should be fully established by 100 feet AGL.

  Some tail strikes have occurred as a result of the pilot initiating a late or abrupt align maneuver. The align maneuver, commonly referred to as a forward slip, will reduce lift and if unchecked, will result in an increased sink rate. This will be demonstrated in the simulator.

- **Early flare**

  The recommended flare technique is to maintain a stabilized flight path through the 50 and 40 foot CAWS callout (unless sink rate is high). At 30 feet a smooth 2.5 degree flare should be initiated so as to arrive below 10 feet in the landing attitude. Back pressure should then be relaxed until touchdown.

  Some tail strikes have occurred as a result of the pilot initiating an early flare and *"feeling for the runway." It is critical that pilots understand the dynamics* involved in this situation. The autothrottles switch to the retard mode at 50 feet radio altitude. In the retard mode, the throttles are retarded to idle at a pre-programmed rate without airspeed, vertical speed, or radio altitude bias. The pilot flying or the autopilot, if selected, must maintain the appropriate glide path to touchdown. If the aircraft is flared early, the airspeed will decay, elevator effectiveness will be reduced, and a higher pitch attitude will be required making the pitch up tendency after touchdown more pronounced and more difficult to counteract. This will be demonstrated in the simulator.

HIGH SINK RATE AND BOUNCE RECOVERY TECHNIQUE

The recommended high sink rate and bounce recovery technique is to establish a 7 1/2 degree pitch attitude and arrest the sink rate with thrust. If a high bounce occurs, a go-around should be initiated. Low level go-arounds, i.e. less than 20 feet RA, are dramatically different than higher altitude go-arounds. High altitude go-arounds are initiated with pitch, while low level go-arounds must be initiated with thrust. During low level go-arounds main wheel touchdown may be unavoidable. The PF must not exceed 10 degrees of pitch or retract the landing gear until passing 20 feet RA with a positive rate of climb.

Some tail strikes have occurred as a result of the pilot attempting to arrest a high sink rate or bounce by quickly adding up elevator. This technique immediately increases both the effective weight of the aircraft and the aircraft's vertical velocity. The resulting increased attitude rate will aggravate the pitching tendency after touchdown and drive the main wheels into the ground, thus compressing the main wheel struts. The aft fuselage will contact the runway at approximately 10 degrees pitch attitude with the struts compressed. This will be demonstrated in the simulator.

TAIL STRIKE AWARENESS TRAINING
QUICK SETUP VALUES

Location	**KMEM Runway 27**
Gross Weight	**450,000**
Fuel	**150,000**
ZFW	**300,000**
ZFWCG	**28.6**
Altimeter	**29.80**
Visual	**Day**
Ceiling	**Clear**
Visibility	**48NM**
Temperature	**58 F**
Wind	**270/30**

SIMULATOR SETUP

APU power on the aircraft
All quantities normal
All system controllers auto

ATIS

This is Memphis international airport information MIKE, the ____zulu observation, sky clear, visibility 48, temperature 58, dewpoint 40, wind 270 degrees at 30 knots, altimeter 29.80, departing runway 27, advise the controller on initial contact that you have received information Mike.

TAIL STRIKE AWARENESS TRAINING TRAINING DEVICE

- **Instructor note.**

  In order to make maximum utilization of simulator time, tail strike awareness simulator periods have no preflight/cockpit setup. The instructor will have the simulator fully configured for takeoff prior to the students arrival, i.e. on the active runway, all engines started, fms loaded (KMEM to KDFW) and the before takeoff checklist complete to the line.

  Tail strike awareness simulator training is comprised of three individual scenarios. Each scenario is designed to demonstrate a specific pilot controlled factor that affects pitching tendency after touchdown.

BEFORE TAKEOFF

- **Review *before* takeoff checklist below the line.**
- **Save flight plan if able.**

TAKEOFF

- **Review normal takeoff procedures.**
- **Reinforce proper rotation technique.**

  The recommended rotation technique is a 3 degree per second rotation to an initial pitch attitude of approximately 15 degrees. The PF should then transition to the flight director pitch bar for guidance. The flight director pitch bar is not usable until approximately five seconds after nose gear strut extension. A two step rotation is not appropriate. Two step or segmented rotations will significantly impact takeoff performance i.e. required runway, second segment climb gradients, and obstacle clearance. It is, however, the PF's responsibility to ensure that the aircraft is accelerating properly and has become airborne passing 10 degrees of pitch attitude. If the aircraft has not become airborne, possibly due to an inaccurate flap setting, stab setting, gross weight entry, or contaminated wing, the rotation should be stopped.

AFTER TAKEOFF

- **Review normal after takeoff procedures.**

APPROACH AND LANDING

- **Vector the aircraft for an ILS to 36L.**

  Multiple resets to the 6 NM final to runway 36L will be used as a time management tool. To eliminate the need for time consuming FMS programming, the runway 36L ILS (IOHN/358) should be hard tuned, and both NDs should display raw data.

FORWARD SLIP SCENARIO

- **Instructor note.**

  The primary objective of this scenario is to demonstrate that a forward slip will reduce lift, and if unchecked, will result in an increased sink rate. Ideally, this demonstration will impress upon your students the need to commence the forward slip prior to 200 feet in a high crosswind and, in all cases, to have the forward slip fully established by 100 feet AGL.

  The setup for this demonstration is as follows:

Position	6 NM final
Init runway	36L
Visual	Day
Ceiling	Clear
Visibility	48NM
Wind	270/30
AP and ATS	Engaged
Instructor station	APPR PROG displayed

  It is imperative that this scenario commence from a fully stabilized condition. The AP and ATS must be engaged and the FGS programed to fly the ILS. At 1000 feet AGL the AP and ATS should be disconnected. The PF should take their hands off the throttles and accomplish an aggressive forward slip. At 500 feet AGL, the demonstration is complete, and the simulator should be repositioned to the 6 NM point. The instructor should now direct the pilots attention to the APPR PROG display on the instructor station and point out the inevitable dip below glideslope that occurred when the forward slip maneuver was initiated. This is a classic example of how a high sink rate can develop prior to touchdown.

  Repeat this demonstration with the other pilot flying.

EARLY FLARE SCENARIO

- **Instructor note.**

  The primary objective of this scenario is to demonstrate the dynamics of an early flare. The autothrottles switch to the retard mode at 50 feet radio altitude. In the retard mode, the throttles are retarded to idle at a pre-programmed rate without airspeed, vertical speed, or radio altitude bias. The pilot flying or the autopilot, if selected, must maintain the appropriate glide path to touchdown. If the aircraft is flared early, the airspeed will decay, elevator effectiveness will be reduced, and a higher pitch attitude will be required making the pitch up tendency after touchdown more pronounced and more difficult to counteract. Ideally this demonstration will increase the pilots understanding of the correlation between a high pitch attitude at touchdown and an increased pitch up tendency after touchdown. Additionally, ATS retard logic will be stressed to encourage overriding the autothrottles when needed.

  The setup for this demonstration is as follows:

Position	6 NM final
Init runway	36L
Visual	Day
Ceiling	Clear
Visibility	48NM
Wind	Calm
AP and ATS	Engaged

  The AP and ATS should be engaged and the FGS programed to fly the ILS. At 1000 feet AGL the AP should be disconnected. The PF should take their hands off the throttles for the remainder of this demonstration. The PF should be directed to make a normal descent until 40 feet RA, where an early flare should be commenced. The PNF should be directed to call out RA and pitch attitude. The PF should make every effort to remain at or above 20 feet RA until the PNF calls 10 degrees of pitch attitude. The PF should then allow a sink rate to develop. At touchdown the instructor will move the spoiler handle to the GROUND SPOILER position. The pitch up tendency will be pronounced and difficult to counteract.

  Reposition the simulator to the 6 NM point.

  The second part of this demonstration is set up identical to the first except this time the PF should make a normal descent with only a slight flare prior to touchdown. The landing attitude should be less than 5 degrees resulting in little or no pitch up tendency after touchdown.

  Repeat this demonstration with the other pilot flying.

HIGH SINK RATE AND BOUNCE RECOVERY DEMONSTRATION

- **Instructor note.**

  The primary objective of this scenario is to demonstrate proper sink rate and bounce recovery technique. Ideally, this demonstration will increase the pilot's awareness of the correlation between an increasing pitch attitude rate at touchdown and an increased pitch up tendency after touchdown. Additionally, Captains will be trained to recognize and recover from a high sink rate or bounce when the First Officer is flying.

  To ensure a consistent and standardized presentation, the instructor will sit in a flying seat and set up the high sink rate and bounce.

  The setup for this demonstration is as follows:

Position	6 NM final
Init runway	36L
Visual	Day
Ceiling	Clear
Visibility	48NM
Wind	Calm
AP and ATS	Engaged

  The instructor will first fly the sim from the left seat. The Captain will observe from the instructor station. The AP and ATS should be engaged and the FGS programed to fly the ILS. At 1000 feet AGL the instructor will disconnect the AP and set up the high sink rate and bounce as follows:

  At 100 feet RA go high on glideslope
  Pull the throttles back to idle
  Push over to establish a high sink rate
  Ideally, a GPWS warning will activate
  Just prior to touchdown establish an increasing pitch attitude rate
  Ideally, the aircraft will touch down and bounce less than 20 feet
  Transfer control after the bounce by saying, *"You have the airplane."*

  The First Officer should establish a 7 1/2 degree pitch attitude and arrest the sink rate with thrust. Re-accomplish this demonstration until proficiency has been achieved.

  The instructor will now fly the sim from the right seat. The First Officer will observe from the instructor station.

  Repeat the demonstration until proficiency has been achieved.

- **Instructor note.**

  The final phase of tail strike awareness training is designed to improve the Captain's ability to recognize and recover from a high sink rate or bounce when the First Officer is flying. Analyses of some tail strikes that have occurred while the First Officer was flying has shown that the Captain did not take control of the aircraft or did not make a positive transfer of control resulting in both pilots manipulating the flight controls.

  Ideally, the Captain should now be able to recognize the pilot controlled factors that will cause an increased pitch up tendency after touchdown, specifically:

  High sink rate
  High aircraft attitude
  Increasing attitude rate

  In the final phase of the high sink rate and bounce recovery demonstration, the instructor will set up the high sink rate, and the Captain should make a positive transfer of control by saying, *"I have the airplane,"* as soon as he recognizes the situation developing. The Captain should establish a 7 1/2 degree pitch attitude and arrest the sink rate with thrust. If a high bounce occurs, a go-around should be initiated. Low level go-arounds, i.e. less than 20 feet RA, are dramatically different than higher altitude go-arounds. High altitude go-arounds are initiated with pitch, while low level go-arounds must be initiated with thrust. During low level go-arounds main wheel touchdown may be unavoidable. The PF must not exceed 10 degrees of pitch or retract the landing gear until passing 20 feet RA with a positive rate of climb.

Attachment # 5

Interview summaries

5A.	Field notes EWR
5B.	Field Notes MEM August, 1997
5c.	Field notesMEM November, 1997