DOCKET No.: SA-521
EXHIBIT No. 2S

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

Boeing DC-8 Elevator Presentation

DC-8 Elevator Position Indicator (EPI) and Elevator Flight Control Checks

Capt. Nicholas A. Gentile

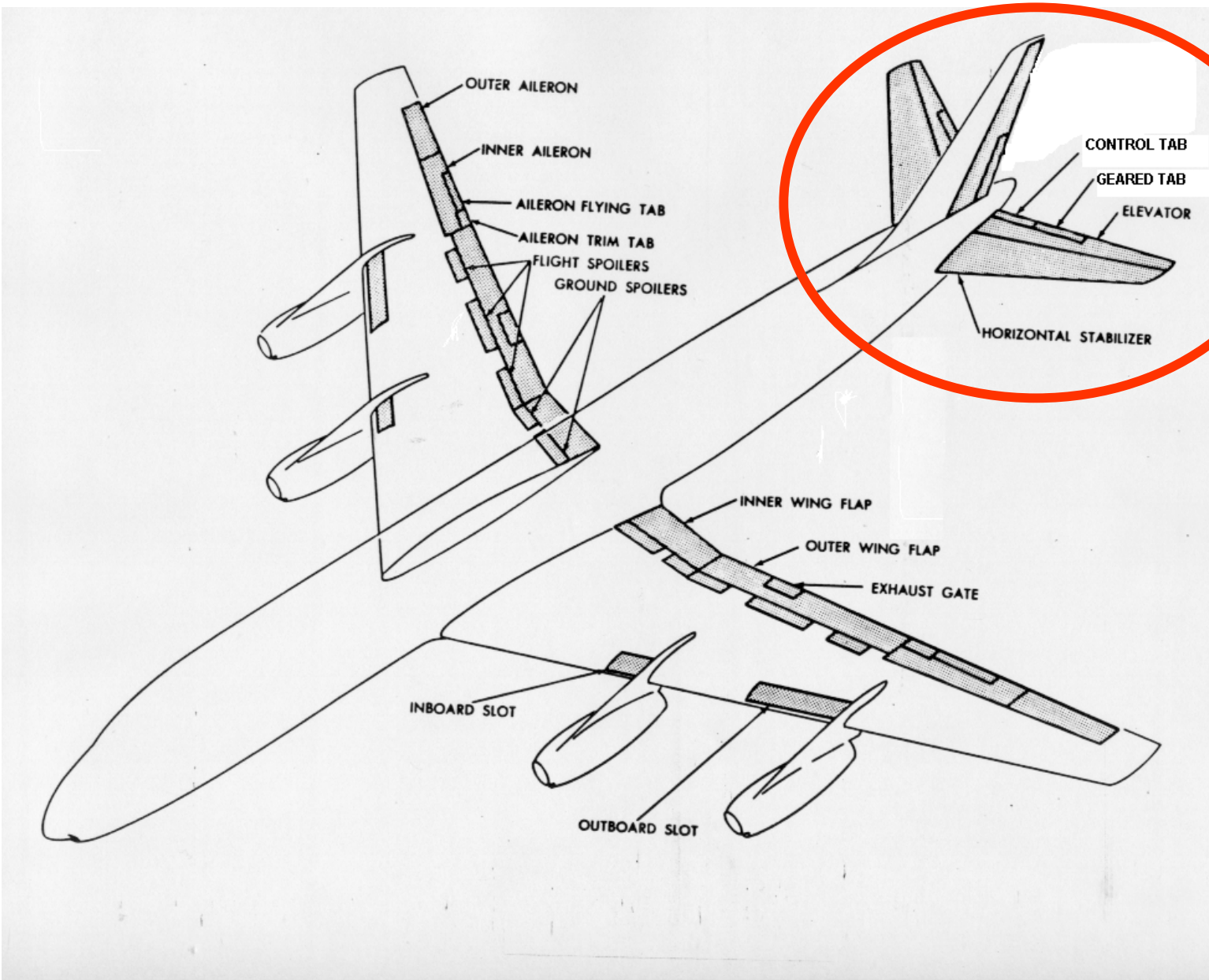
Chief Pilot Flight Crew Training

Boeing Long Beach Division

Agenda

- Elevator Control System Overview
- Elevator Position Indicator History
- Elevator Control Check Evolution
- Elevator Control Check Current Procedures
- “80 knot” Check During Takeoff
- Summary

Elevator Control System Overview

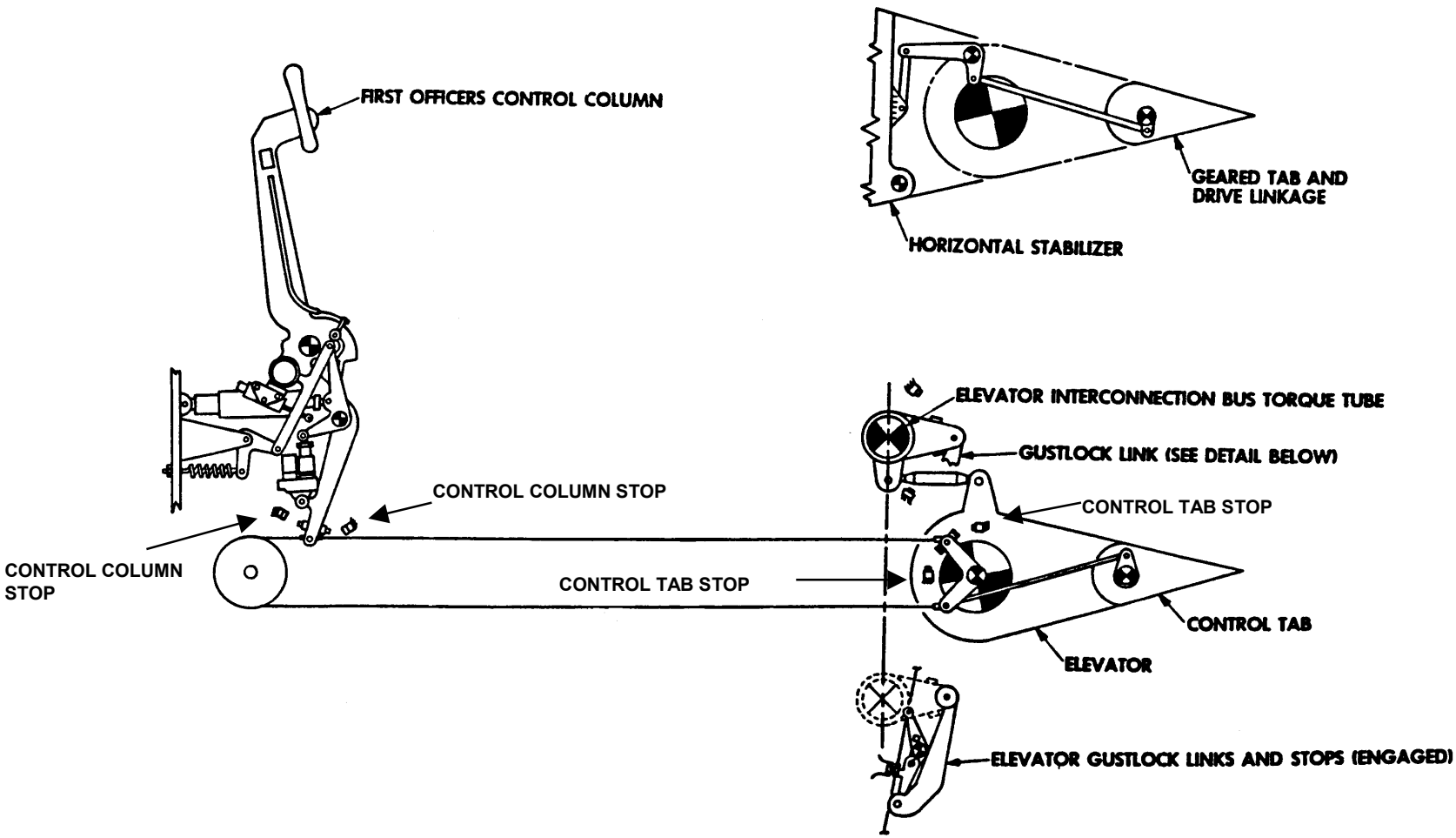

OUTER AILERON
INNER AILERON
AILERON FLYING TAB
AILERON TRIM TAB
FLIGHT SPOILERS
GROUND SPOILERS
CONTROL TAB
GEARED TAB
ELEVATOR
HORIZONTAL STABILIZER
INNER WING FLAP
OUTER WING FLAP
EXHAUST GATE
INBOARD SLOT
OUTBOARD SLOT

DC-8 Elevator and Elevator Tabs

Gust Lock On

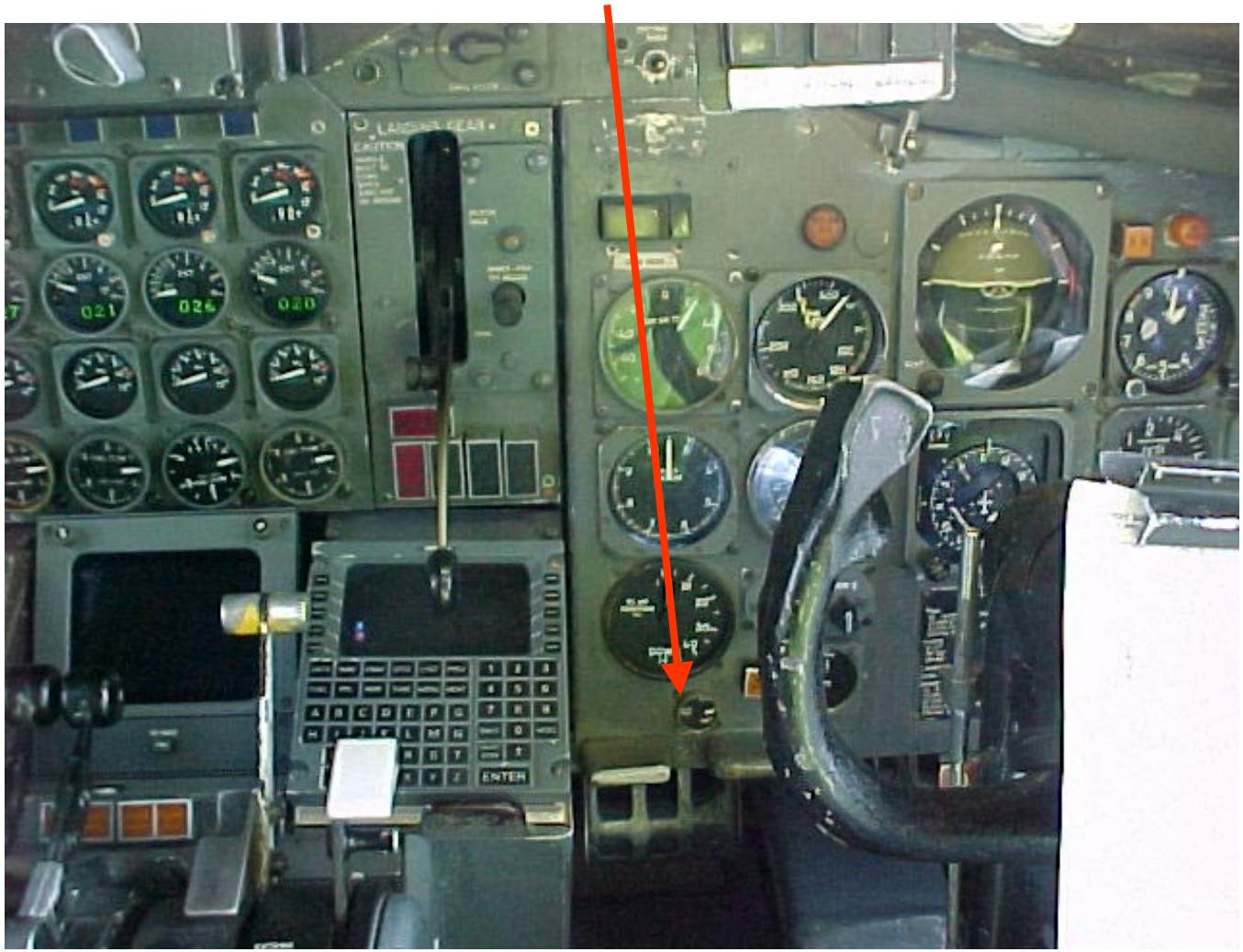
Gust Lock Off

Simplified DC-8 Elevator Control System

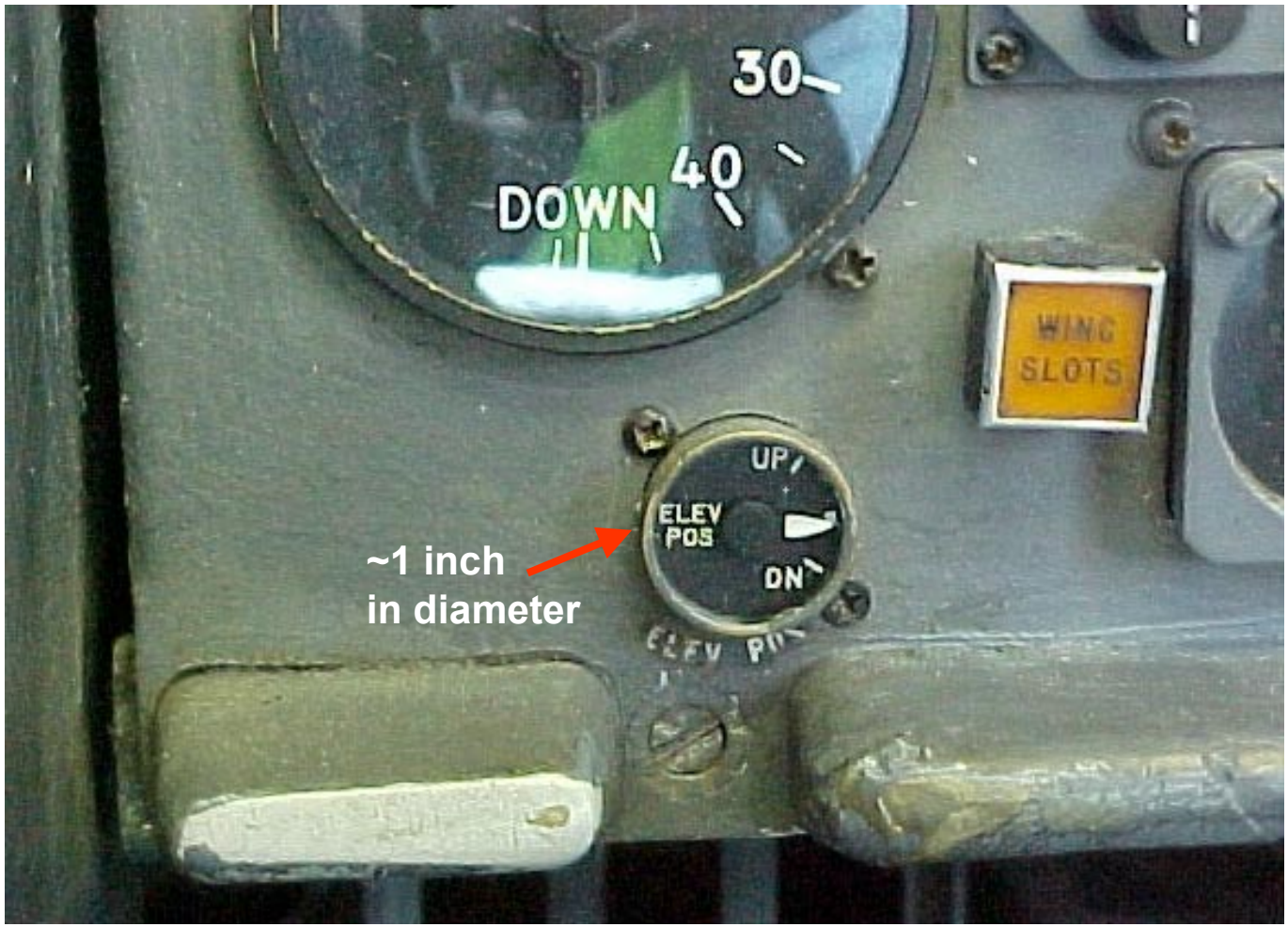


Elevator Position Indicator History

DC-8 Elevator Position Indicator (EPI)



DC-8 Elevator Position Indicator (EPI)



Elevator Position Indicator History

Occurrences of FOD jammed in elevator hingeline

1970: TIA takeoff accident

1972: F/E walkaround discovered hingeline FOD

1972-1974: Reports of cracked/fractured control columns

1974: Operator/ALPA reports of snow/ice FOD

EPI development

1970: NTSB recommended consideration of EPI

1971: DAC/FAA conclusion EPI not necessary

1973: DAC engineering renews EPI study

1974: ALPA requests EPI system

1974: In-service evaluation of EPI begins

1975: DAC EPI Service Bulletin released

Elevator Position Indicator History

1977: PAL RTO Accident

- Geared tab crank arm failed
- Elevator jammed trailing edge up

1978: EPI mandated by AD 78-01-15

- Installation of EPI
- Elevator check procedures (when EPI is not available)

Elevator Control Check Evolution

DC-8 Elevator Control Check

Baseline “rollout” check:

Full aft column followed by full forward column, checking for full and free movement, no binding

Elevator Control Check Evolution

1970: DAC baseline check reiterated after the TIA accident (Know Your DC-8 Letter No. 43)

1973: Recommendation to accomplish rollout check into the wind (Know Your DC-8 Letter No. 43A)

1973: Inspect the area between the stabilizer and elevator for FOD after engine ground runs (AOL 8-645)

1974: To prevent control column fatigue, both pilots must simultaneously apply full aft then full forward pressure during the rollout checks (AOL 8-686)

Elevator Control Check Evolution

1975: DAC-recommended rollout check procedures with EPI installation:

- Check that EPI needle moves down into or transitions through the white band with full AND elevator
- Accomplish elevator rollout check into the wind if tailwind prevents a valid rollout check
- Accomplish a positive visual check to verify proper elevator operation if a valid rollout check is not achieved

(Know Your DC-8 Letter No. 53)

1975: Installation of the EPI as an aid for the flight crews during elevator checks (Service Bulletin 27-254)

1975: Flight crew apply forward column pressure slowly during the rollout checks (AOL 8-715)

Elevator Control Check Evolution

1977: For airplanes not equipped with an EPI:

- Recommend prompt incorporation of SB 27-254
- Accomplish elevator rollout check into the wind
- Introduce optional “80-knot” check during initial takeoff roll

(Service Bulletin A27-264)

1977: Reiterated information in:

- Know Your DC-8 Letter No. 53
- SB A27-264

(Know Your DC-8 Letter No. 53A)

Elevator Control Check Evolution

1978: EPI mandated (AD 78-01-15)

- **Install EPI per SB 27-254**
- **For airplanes not yet equipped with an EPI:**
  - Utilize elevator control check procedure of SB A27-264
- **For airplanes with an inoperative EPI:**
  - Utilize elevator control check procedure of SB A27-264
  - Verify proper elevator operation by a ground observer

Elevator Control Check Evolution

2001: Amplification of elevator control check procedures (Flight Operations Bulletin DC-8-01-02)

- **Reiteration of previous recommendations plus recommends:**
  - Check for position of elevator and tabs during walkaround
  - Check that EPI needle moves to a point below the white band with full AND elevator during the rollout check
  - If the rollout check is unsatisfactory a positive check must be made with a trained observer prior to takeoff
- **Advises operators that the "80-knot" control check is not an adequate substitute for the control rollout check**

Elevator Control Check
Current Procedures

Elevator Control Check
Current Procedures

- The elevator system is checked during:
  - Flight engineer's "walkaround" inspection (prior to starting engines; once or twice depending on the operator)
  - Cockpit check (after engine start)
    - Rollout check

DC-8 Flight Engineer's "Walkaround"

- **Visually checks elevator and tab position and condition:**
  - **With the gust lock on**
    - **Elevator and tabs are "faired" with stabilizer**
  - **With the gust lock off (and no control column input)**
    - **Elevator goes trailing edge up (mass balanced)**
    - **Control tabs go symmetrically trailing edge up**
    - **Geared tabs go symmetrically trailing edge down**

“Walkaround” Video

DC-8 Cockpit Check After Engine Start

- **Rollout check (elevator, ailerons, rudder)**
  - **Performed after engines start because the ailerons and rudder are hydraulically actuated**
  - **Elevator check calls for both pilots to simultaneously apply full aft control column followed by full forward control column**
  - **Checking for freedom of control column movement and appropriate elevator motion on the elevator position indicator (EPI)**

Rollout Check Video

“80 knot” Check During Takeoff

- Optional “80-knot” control check during initial takeoff roll
- Small up and down elevator motions to check weight distribution
  - Crew observes airplane pitch response
  - Use of EPI not recommended by DAC/Boeing
- Not a substitute for elevator control rollout check

Summary

- The DC-8 elevator control checks have evolved with service experience
- The EPI was designed to aid the flight crew during pre-takeoff control checks
- The “80-knot” control check is not a substitute for the elevator control rollout check