



NTSB National Transportation Safety Board

Office of Aviation Safety

Cockpit Indications of Descent Flight Control System Training



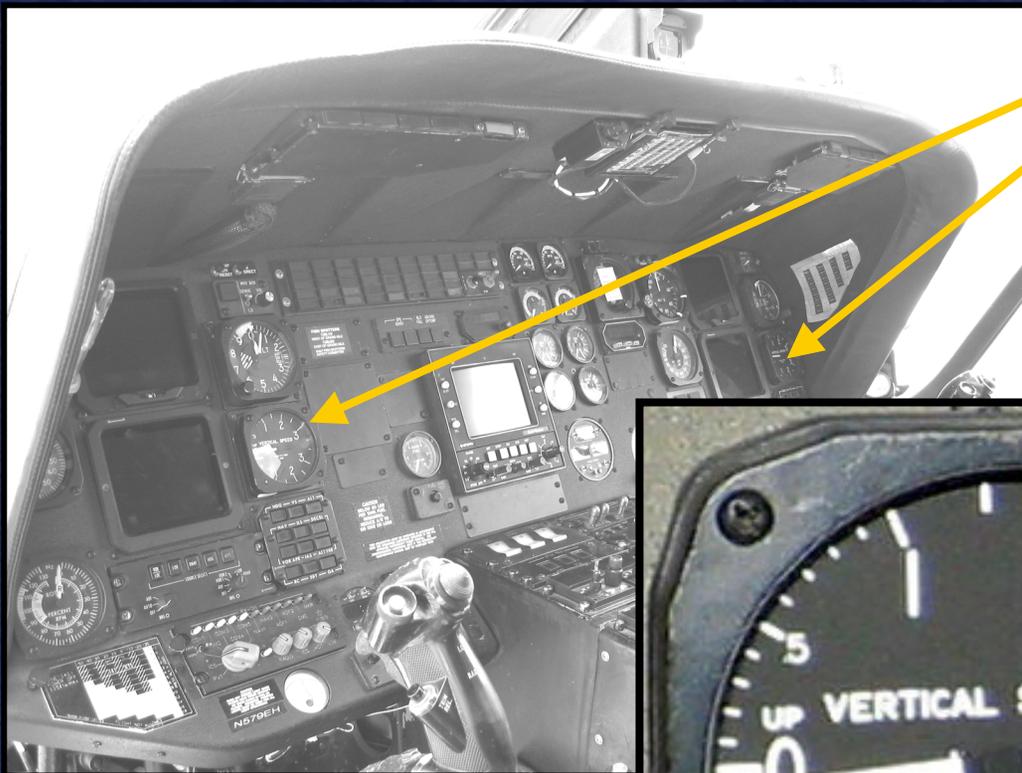
Captain and Copilot

- Certificated, qualified, trained
- Received CFIT training
- Experienced
- Adequate opportunity for rest
- No medical or behavioral conditions
- First pairing of flight crew

Indications of Descent



Indications of Descent



- Vertical speed indicators
- Barometric altimeters
- Radar altimeters
- Rising runway symbols



Indications of Descent



Vertical speed indicators

Barometric altimeters

Radar altimeters

Rising runway symbols



Indications of Descent

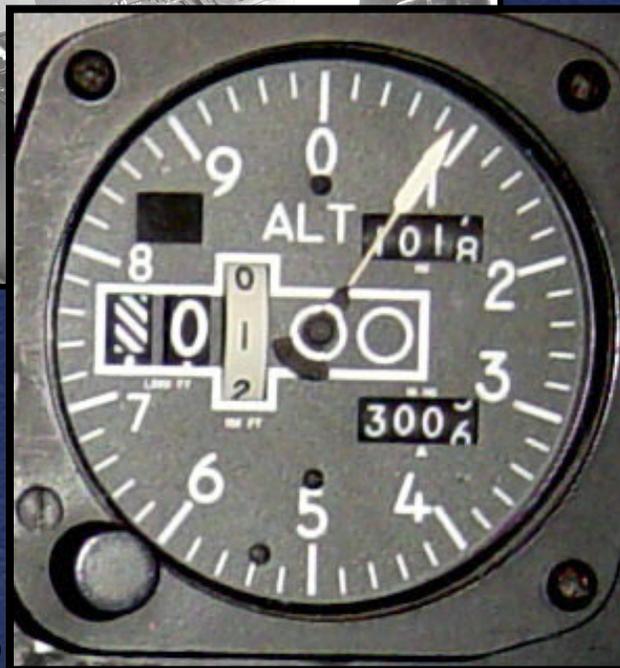


Vertical speed indicators

Barometric altimeters

Radar altimeters

Rising runway symbols



Indications of Descent



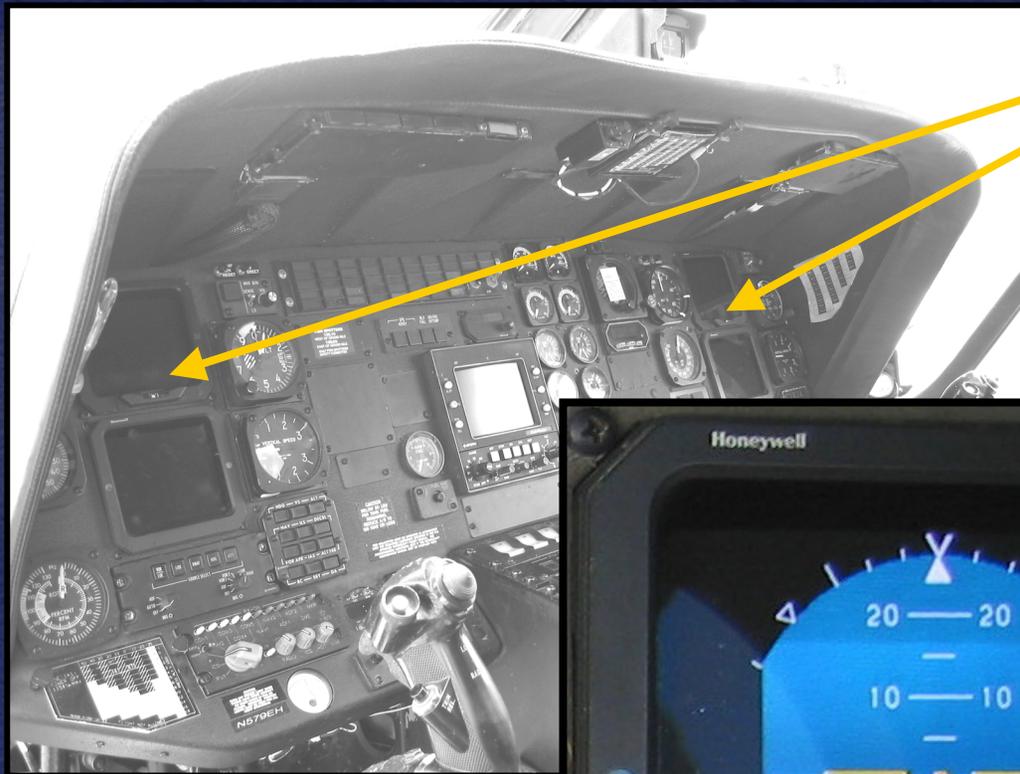
- Vertical speed indicators
- Barometric altimeters
- Radar altimeters
- Rising runway symbols



Additional Indications of Descent



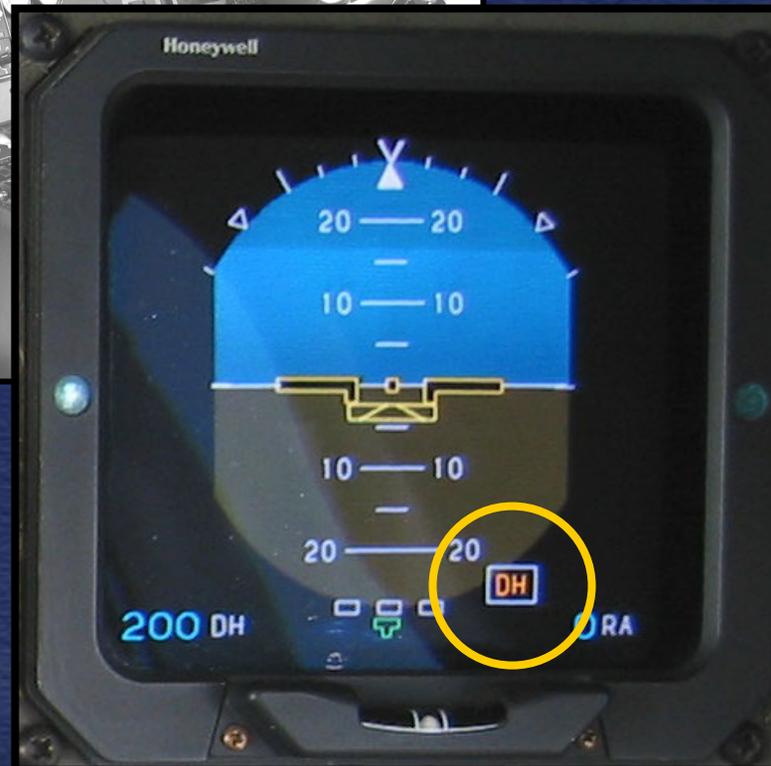
Additional Indications of Descent



Decision height

Altitude preselect

Pitch command cues



Additional Indications of Descent



Decision height

Altitude preselect

Pitch command cues



Additional Indications of Descent



Decision height

Altitude preselect

Pitch command cues



Additional Indications of Descent



Decision height

Altitude preselect

Pitch command cues



Indications of Descent

- Multiple indications of descent would have been available
- Flight crew capable of properly interpreting these indications
- Complexity of flight control system examined

SPZ-7000 DDAFCS

- ATT mode of autopilot system
 - Maintains pitch and roll attitudes
- Flight director system
 - Provides pitch and roll command cues
- Autopilot can be coupled to flight director

Human Factors: Automation

- Pilot overreliance
- Pilot mode awareness

Human Factors: SPZ-7000

- Flight director status (1 versus 2)
 - No visual annunciation on ADI
- Coupling status and alert
 - No visual annunciation on ADI
 - No decouple alert (visual or aural)
 - Decoupling requires manual flight
- Single-axis selection

Single-Axis Selection



Pitch command cue

Roll command cue

Single-Axis Selection



Pitch command cue

Roll command cue

Single-Axis Selection

Pitch command cue or Roll command cue



SPZ-7600 DDAFCS Differences

- Annunciations promote pilot mode awareness
 - Decouple visual alert
 - Decouple aural alert
- Design issues remain
 - Single-axis selection

Flight Control System

Additional training needed

- Flight director status
- Coupling status
- Single-axis command cues
- SPZ-7000/7600 differences



NTSB

7000/7600 Command Cue Formats

Aircraft symbol only

Dual-cue format

Single-cue format



SPZ-7000 Single-Axis Presentations

Dual-cue format

Single-cue format



SPZ-7600 Single-Axis Presentations

Dual-cue format

Single-cue format



SPZ-7600 Decouple Annunciations

- Visual decouple annunciation
 - On front instrument panel
 - Above each pilot's barometric altimeter
- Aural alert upon decoupling



ADI for Sikorsky S-92



- Visual annunciation
 - Flight director status
 - Couple status
 - Color coded
- Aural alert upon decoupling
 - With master caution