

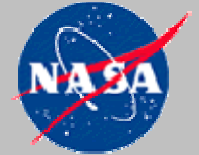
A Gift

(Lessons and Analogies from STS-3 Close Call)

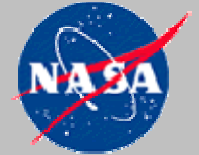
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STS-3 Autoland Test Flight: The Plan

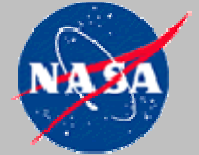


- CDR take over manually when subsonic
 - Fly Heading Alignment Circle manually
 - Roll out of final turn aprox. 12,000 ft., 19 degree glide slope
 - “Center the needles” (fly MLS pitch and roll commands)
- Engage autoland on final approach
- Monitor autoland approach through preflare
- Take over manually on short final (approaching runway threshold)
- Target landing: 195 kts. EAS, 2500 ft
- After touchdown, start nose down consistent with nose wheel groundspeed limits



Unusual Factors

- Northrup Strip N.M. backup landing site: at ~4000 ft elevation, relatively high density altitude (thus high groundspeed on rollout)
- First extended Shuttle mission (8 days): life science community still learning physiology of fluid shift and “sit up” landings
- Unusually short heading alignment circle: ~90 degrees (not much “stick time” before handoff to “Auto”)



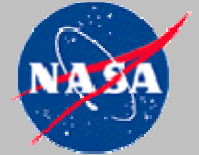
The Landing

- Touchdown was 25 kts. fast (220 kts vs. 195 kts EAS)
- CDR started nose down prematurely (habit), then realizing error, immediately applied aft stick to stop nose down pitch
- CDR needed excessive aft stick to stop nose, then was surprised by pitch rate reversal (pitch gain glitch)
- Second pitch reversal resulted in higher than desired nose gear slap down
- **Close call**: nothing broken, nobody injured, but STS-3 came close to being 2 flights!



Lessons from STS-3

- **Flight Test**: post flight data analysis showed a previously unknown pitch gain problem (in spite of thousands of manned simulator landings)...***Lesson: you always learn new things in flight test***
- **Certification**: taking over manual flight control close to landing is problematic...***Lesson: we could not certify autoland throughout landing approach (flight crew cannot be counted a leg of redundancy)***
 - High landing weather minima throughout program life
 - Autoland eventually certified as “emergency system”
- **Risk Management**: in retrospect, flight crew leadership admitted to lack of critical oversight of “can do” test plan...***Lesson: highly motivated risk takers may sometimes accept unacceptably high risk...operations manager should be prepared to step in and say no***



Gratuitous Final Thoughts

- **Smart Buyers**: Lack of recent “stick time” made for an exiting landing on STS-3...***Analogy: NASA needs to have enough ongoing in-house hands-on work to be able to “take over manually” if the contracted effort runs into technical problems on “short final”!***
- **Governance**: Our high risk ground and flight activities are executed by volunteers, some of whom belong to organizations not directly in the governance model.
Caution: If the Program Manager, the Engineer and SMA are all go, we are not done yet...Center Directors make sure the risk taker’s leadership is go too!