Should I Wear a Helmet?
And Other Risk Assessments

EAA Chapter 1
18 April 2023

Kevin “Skids” Strange

- Engineering and Production Test Pilot ICON Aircraft
- Over 20 Military and Civilian Flight Test Programs
- Flew in Support of Operation Iraqi Freedom and Operation Enduring Freedom
- National Test Pilot School in Mojave California
- Born at March Air Force Base – Raised at KRAL
- Flew with Dad in N2225V (C140) out of Flabob

Flight Test Safety and Risk Management

You don't want to react to situations, you want to respond to situations

Flight Test

- Flight Test Plan
  - A written plan of action to collect data
  - An overall risk is assessed
- Flight Test Event
  - Test card/cards that support data collection
  - Each event, card, and Flight Test Technique (FTT) can have its own unique risks

All flight test plans have flight test events, not all flight test events need a test plan.

Risk Assessment

RISK of the HAZARD = PROBABILITY x SEVERITY

- Identify the Hazards for the Test Plan and Test Events
  - Further identify hazards for test cards and FTT
- Test Safety Plan
  - Overall assessment of the Test Plan/Event
  - Standardized approach to all safety
  - Establish a Safety Culture
- See Advice

Write Down All Identified Hazards!

Risk Assessment Strategy

- Flight Test Plan
  - Risk Level Assessment (RLA)
    - For each safety hazard identified in the test plan
    - “Big Picture” hazards for each event
- Flight Test Event
  - Operational Risk Assessment (ORA)
    - Day of hazards
    - Specific to Pilot, Plane, and Location

Write Down All Identified Hazards!

RLA

RISK LEVEL ASSESSMENT				
MISHAP SEVERITY				
MISHAP PROBABILITY	I-Catastrophic	II-Critical	III-Marginal	IV-Negligible
A – Frequent	1	3	7	13
B – Probable	2	5	9	16
C – Occasional	4	6	11	18
D – Remote	8	10	14	19
E – Improbable	12	15	17	20

Assessment	Descriptive
High	Tests or activities that present a significant risk to personnel, equipment, and/or property even after all precautionary measures have been taken. Matrix levels 1 thru 5.
Medium	Tests or activities which present a greater risk to personnel, equipment, or property than normal operations even after the appropriate controls have been applied. Matrix levels 6 thru 9.
Low	Tests or activities which present minimally/no greater risk than normal operations after appropriate controls have been applied. Matrix levels 10 thru 20.

Mishap Severity	Level	Descriptive	Quantitative	Mishap Class
Catastrophic	1	Loss of life (or permanent total disability), DoD aircraft, facility, or expensive system	> $2.5M	A
Critical	2	Severe injury (permanent partial disability), hospitalization of three or more personnel, or permanent damage. Severe aircraft, equipment or property damage	$600K - $2.5M	B
Marginal	3	Minor injury, medical treatment requiring lost work days, but no permanent injury. Minor damage	$60K - $600K	C
Negligible	4	Superficial but recordable injury, works partial days, has restricted duties. Incidental, less than minor damage	< $60K	D/E

Figure A4.4. (Added-AFMC) Mishap Probability Definitions.

Mishap Probability	Level	Descriptive	Probability of a Mishap during the Period of Test Risk Acceptance
Frequent	A	A real likelihood to occur during the period of test risk acceptance. (e.g. test exceeds design limits or mishap occurred during similar testing, etc.)	$> 10^{-1}$ (greater than 10%)
Probable	B	Unlikely to occur during the period of test risk acceptance but not unexpected if it occurs. (e.g. test at design limits or mishap almost occurred during similar testing)	$< 10^{-1}$ but $> 10^{-2}$ (less than 10% but greater than 1%)
Occasional	C	Unlikely to occur during the period of test risk acceptance and is deemed unexpected if it occurs.	$< 10^{-2}$ but $> 10^{-3}$ (less than 1% but greater than 0.1%)
Remote	D	Highly unlikely to occur during the period of test risk acceptance. (e.g. test activity approaching design limits and done before w/no problems encountered)	$< 10^{-3}$ but $> 10^{-6}$ (less than 0.1% but greater than 1-in-a-million)
Improbable	E	So unlikely to occur that it may be assumed it will not happen during the period of test risk acceptance. (e.g. test activity within design limits and covered under normal operational procedures)	$< 10^{-6}$ (less than one-in-a-million)

ORA

OPERATIONAL RISK ASSESSMENT (ORA)

Physiological Factors

	None	Minor	Major	
PIC	0	3	5	0
SIC/FTE	0	3	5	

Duty Day (PIC)

0 to 6 Hours	0	3
6 to 10 Hours	3	
10 to 12 Hours	5	
More than 12 Hours	7	

Flying Hours (PIC per 30 Days)

> 20	20 to 10	10 to 5	< 5		
0	3	4	5	*PIC	0

* Over 60 days since last flight MUST fly with an IP for proficiency check.

Flight Test Complexity

Previously briefed/No Adjustments	0	5
T-1 Adjustments	3	
Day of Adjustments	5	

Airspace Restrictions

No Mission Impact	0	3
Elevated Workload	3	
High Workload	5	

Mitigations

Flight Test Area Weather

	None	Isolate	Few	Scatter	Num.	
T-Storms	0	3	5	No-Go	No-Go	0
Vis Moisture	0	2	3	4	6	
Turbulence	0	3	No-Go	No-Go	No-Go	
Icing	0	3	No-Go	No-Go	No-Go	

Notes:

Local Weather

	> 3000	3000 - 2000	< 1000	
> 3 NM	0	3	5	0
0.5 - 3 miles	3	3	5	
< 0.5 NM	5	5	5	
Actual WX or Forecasted WX				

Airfield Status

Runway Conditions		
Dry	0	0
Wet	5	
Snow/Slush/Ice	No-Go	
Crosswind Take Off		
0 - 5 kts	0	3
6 - 10 kts	3	
> 10 kts	5	
Crosswind Landing		
0 - 5 kts	0	3
6 - 10 kts	3	
>10 kts	5	

Take Off Time

Sunrise to Sunset	0	0
All Other Times	3	
At Night	5	

Landing Time

Sunrise to Sunset	0	0
All Other Times	3	
At Night	5	

Airport/Area Familiarity

> 3 Flights	0	0
1 - 3 Flights	3	
No Previous Flights	5	

Bird/Wildlife Aircraft Strike Hazard

Low	0	5
Moderate	3	
Severe	5	

Mission Risk Summary

Add all blue sections.	22

Risk Category	Range	Approval Authority
LOW	<22	Pilot in Command
MODERATE	22 - 44	Dir of Eng.
HIGH	>45	COO

Signature	
LOW	
MODERATE	
HIGH	

Risk Management

- Apply Mitigation to the Identified Hazards
  - Develop steps to take
    - Before, during, and after the flight event
  - “If – Then” statements
- Eliminate or Reduce the Risk of the Hazard Occurring
- Seek Advice

Write Down the Risk Mitigation Steps!

Risk Management Strategy

- Checklists
  - Answers to the “If – Then” statements
- Mid-Air Collision Avoidance (MACA)
  - Radios
- Bird/Wildlife Aircraft Strike Hazard (BASH)
- General Minimizing Procedures (GMP)
  - Related to Test Safety Plan
- Test Hazard Analysis (THA)
  - Flight Test Safety Database
- EMS – On and Off Airfield

GMP

5. 4 Exceeding an Aircraft Limitation

Minimizing procedures:

- All appropriate airspeeds will be briefed/reviewed by crewmembers and adhered to
- No test points will be conducted below 1.1 Vs
- High and low speed data points will be reviewed and correlated to the appropriate high or low speed aircraft limits as required
- Test maneuvers will be conducted in a build up fashion

Corrective Actions:

- If limit exceeded, call “Knock it Off”, correct the condition, and return to level 1-g flight
- As required, perform a controllability check and/or the appropriate emergency procedures

HAZARD:		*THA#:*	
TEST CARD:		*AIRCRAFT:*	
FTT:			

Approved By:

Date Approved:

RISK LEVEL ASSESSMENT

HAZARD SEVERITY

HAZARD PROBABILITY	1-Catastrophic	2-Critical	3-Marginal	4-Negligible
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B - Probable	2 ☐	5 ☐	9 ☐	16 ☐
C - Occasional	4 ☐	6 ☐	11 ☐	18 ☐
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CAUSE(S)

EFFECT(S)

MINIMIZING PROCEDURES

EMERGENCY PROCEDURES

REMARKS

WEATHER MINIMUMS

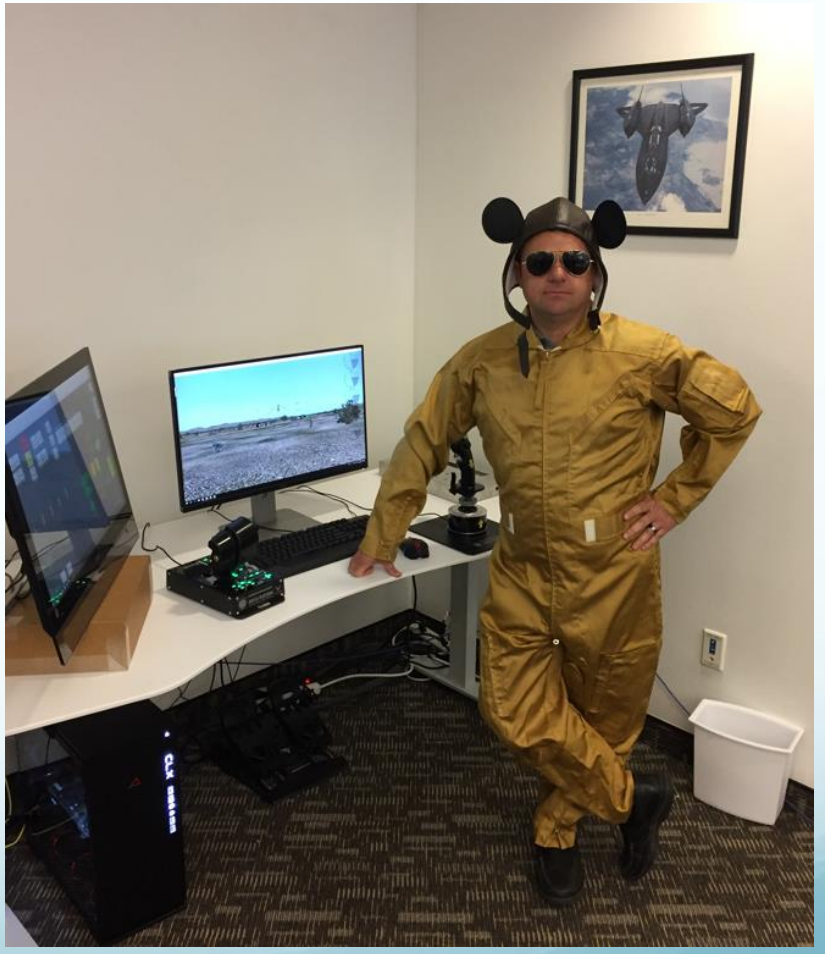
RISK LEVEL

LOW	MEDIUM	HIGH	AVOID

THA

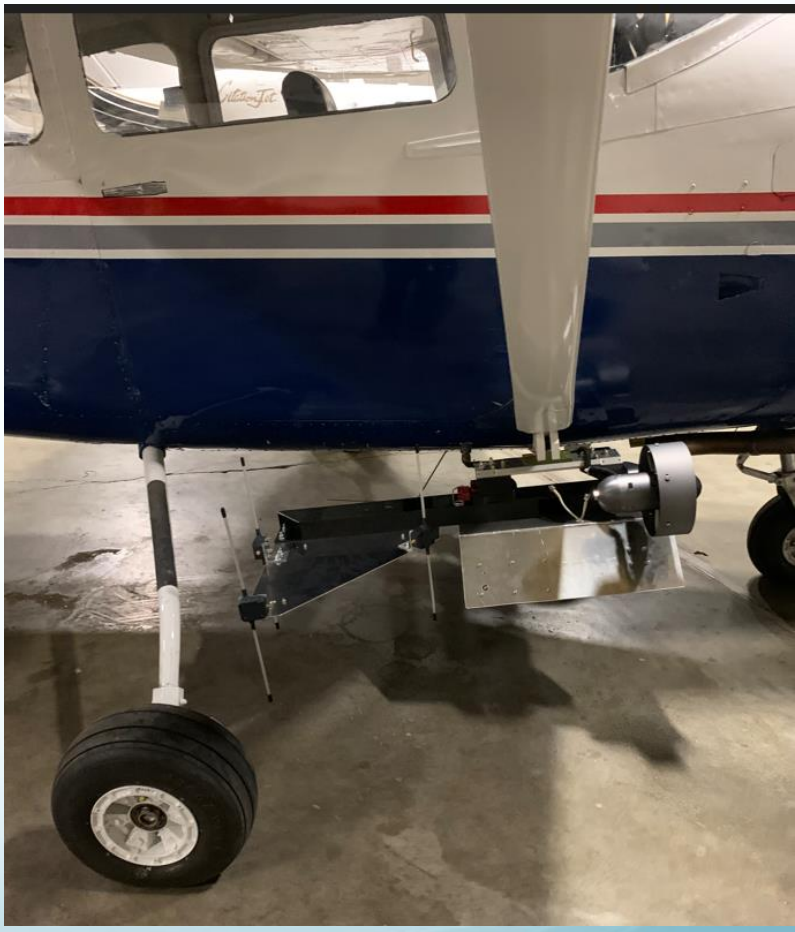
Pilot Hazards

- Adheres to Safety Culture
- Appropriate Experience
- Safety Equipment
- Understands the Flight Test Events
- Rehearsal?



Airplane Hazards

- Unique Flight Characteristics
- Build Up Approach
  - AC 90-89
- Safety Equipment
- Configuration Changes
  - No “Day Of” Changes



Considerations

- Flight Test Plan/Flight Test Event
  - Write down the intended plan of action
    - Test Cards
  - Can deviate real time
- Write Down Risk Assessment and Management
  - Within sections of the test plan
  - Within sections of the test card/event
- Formal Discussion
  - Technical Review Board (TRB)
  - Safety Review Board (SRB)
  - Test Readiness Review (TRR)
  - Flight Readiness Review (FRR)

Examples

- Communications Plan

ALPINE FLIGHT TEST PHASE 1

FLIGHT TEST PHRASEOLOGY	
Abort	Stop launch, takeoff or mission
Knock it Off	Stop maneuver or test point
Release	Release the tow line from the aircraft
Emergency Release	Release the tow line from the tow vehicle
RTB	Return to base
Divert	Proceed to an alternate test point or mission
Joker Fuel	Fuel above Bingo. Finish test point (if already begun), and transition to next phase of flight – descent, before landing, RTB, etc.
Bingo Fuel	Stop all test points and RTB
Minimum Fuel	Land with little or no delay
Emergency Fuel	Declare an emergency with MAAF and land immediately
Show Time	Mission briefing begins
Step Time	Aircraft dispatch begins

Examples

Test Readiness Review

PROJECT TITLE:		Date:	

All items should be completed prior to the Test Readiness Review. After review, forward checklist to Chief of Test for filing in the Test File.

RISK LEVEL	Approval Authority	Approval Date
LOW	OL-Det 3/CC or CT or Det 3/CC	
MEDIUM	ASC/WII via formal TRR	
HIGH	ASC/WI via formal TRR	

Test Documentation	Completion Date	Remarks
Test Plan		
Test Plan Approved/Signed		
Test Plan Amendments Approved/Signed		
Technical Review Board		
Minutes in TPSR/Action Items completed		
Safety Review Board		
Minutes in TPSR/Action Items completed		
GA Aircraft Flight Approval (AFA) approved/signed		
TPSR Approved/Signed		
TPSR Amendments Approved/signed		
Test Cards		
Reviewed by Test Team and approved by Approval Authority		
Configuration Documentation	**Completion Date**	**Remarks**
T-2 Modification Packages (identify in Remarks)		
Aircraft		
GCS		
External		
Technical Orders		
Baselines Flight Manual/Checklists identified/available		
Draft/Red-lined Flight Manual/Checklists available		
Airworthiness		
Airworthiness Approved by ASC/EN and in CT files		
Mission Readiness	**Completion Date**	**Remarks**
Range Safety Coordination completed (weapon footprints, laser firings, FRR, etc.)		
Frequency Clearances secured/scheduled (telemetry, radios, pod emissions, etc)		
Instrumentation Installed/Checked (TM Van, HF TM, etc)		
Security Considerations addressed (COMSEC, OPSEC, Key Loaders, GPS Keys, etc)		
Ground Test Results/WITS/Known Anomalies/Aircrew Impact/Go-No Go Items briefed at TRR		
Aircrew Training/Simulations completed		
Airspace/Range scheduled (targets, Pred Box, comms, etc)		
Aircraft/GCS configuration sheet competed		

ACTION ITEMS TO PROCEED:

TRR

Final Thoughts

- Work to Assess and Mitigate Risks
  - Adapt each assessment and mitigation to the specific flight events
- Codify the Risks and Hazards
  - Risk = Probability x Severity
- Develop a Safety Plan and Safety Culture

References

- **AC 90-89** – FAA Flight Test Safety
- **FAA-H-8083-2** – FAA Risk Management Handbook
- **AC 23-8** – Flight Test Guide for Part 23 Airplanes
- **FAA Order 4040.26** – FAA Flight Test Risk Management (AIR)
- **AFI 11-2ftv3** – Flight Test Ops Procedures
- **AFI 91-202 Sup 1** – USAF Mishap Prevention Program
- **OI 99-103** – USAF Test and Evaluation Process

Questions?