NTSB National Transportation Safety Board

Office of Aviation Safety

Aviation Engineering Investigator Roles

What does an NTSB aviation engineering investigator do during an investigation?

Before we talk about what an investigator does, let's start at the beginning of an investigation…the Launch

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Launches

The NTSB is Responsible for Investigating:

- All U.S. aviation accidents (except those of military and intelligence agencies).

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Launches

- The NTSB also launches to foreign accidents involving a U.S. operator or aircraft/engine

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Major Investigations

Go-Team

- An NTSB “go-team” is dispatched from Washington headquarters to major transportation accidents.
- A “go-team” is the highly visible group of Safety Board professionals with a wide-range of investigative skills.

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Major Investigations

Go-Team

- A “go-team” typically includes the following:
  - A Board Member
  - An Investigator-In-Charge (IIC)
  - Investigative Specialists
  - Public Affairs Officers
  - Family Affairs Specialists

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Investigative Team

- Investigator in Charge (IIC)
- Group Chairs
  - Operations
  - Human Factors
  - Air Traffic Control
  - Weather
  - Structures
  - Systems
  - Powerplants
  - Maintenance
  - Flight Recorders
  - Survival Factors
  - Airports
  - Aircraft Performance
  - Materials laboratory

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Each part of the investigation is led by a Group Chairman – What do they do, exactly?

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Role of Systems Group Chairman

- On-scene responsibilities
  - Recorders
  - Cockpit documentation
  - Aircraft system documentation
- Teardown or testing of selected components
- Metalurgical Analysis
- Reporting
  - Factual
  - Analytical

Powerplant Group Chairman

- Locate all Powerplant components
- Was engine making required power?
- Is damage pre or post impact?
- Determine need for follow on work

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Uncontained Engine Failures

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Uncontained Engine Failures

- Identify and find liberated part(s)
- Map trajectory of liberated part(s)
- Teardown and metallurgy required
- Get history of engine and parts involved

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Powerplants - Fires

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Engine Fires

- Identify origin of fire
- Teardown of engine usually not required
- Did fire suppression systems work?
- Get maintenance history of engine

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Foreign Object Ingestion

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Foreign Object Ingestion

- Two types: hard and soft body
- Hard body is caused by rocks and metal
- Soft body is caused by birds and tire rubber
- If birds, collect bird remains

Structures Group Chairman

- Aircraft Recovery
- Documenting Structures Damage
- Two & Three Dimensional Mockups
- Reporting

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Aircraft Recovery

- Underwater
- In a Crater
- On Ground

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Underwater Recovery

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On-Ground Recovery

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ATLANTA
AIR
SALVAGE


Hertz Equipment Rental
bobcat

Documenting Structures Damage

- Walk Around Inspection
- Examination & Documentation
- Wreckage Distribution Diagram
- Analyze individual breaks
- Detailed laboratory analysis?

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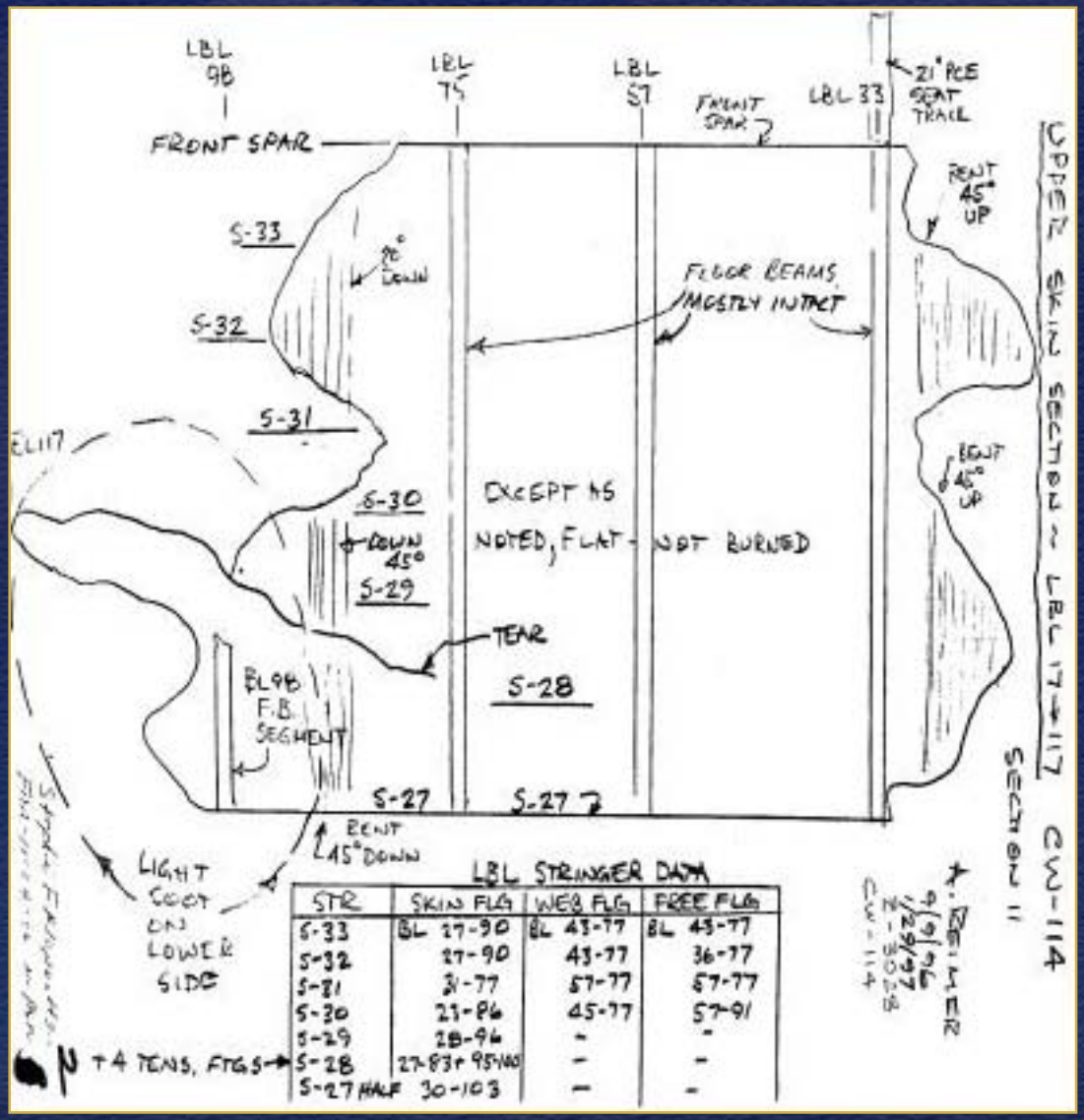
Examination & Documentation



STR	SKIN FLG	WEB FLG	FREE FLG
S-33	BL 27-90	BL 43-77	BL 43-77
S-32	27-90	43-77	36-77
S-31	31-77	57-77	57-77
S-30	23-96	45-77	57-91
S-29	28-96	-	-
S-28	27-83, 95-140	-	-
S-27 HALF	30-103	-	-

Wreckage Distribution Diagram

- GPS, Survey, Tape Measures
- Plotting Methods: Grid, Centerline, Map
- Aerial Photographs & Aerial Video
- Develop Numbering & Tagging Methods

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Wreckage Distribution Diagrams

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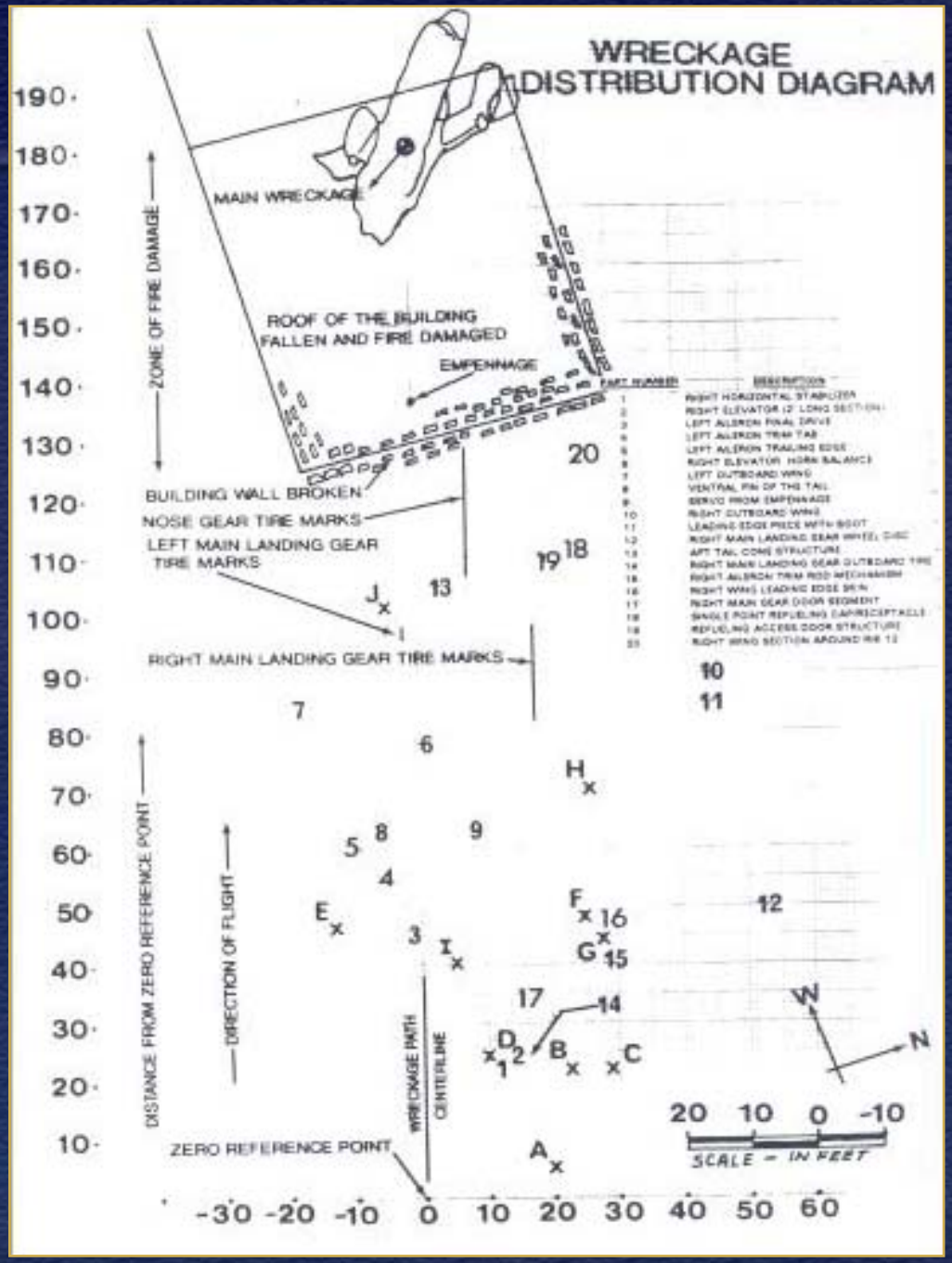
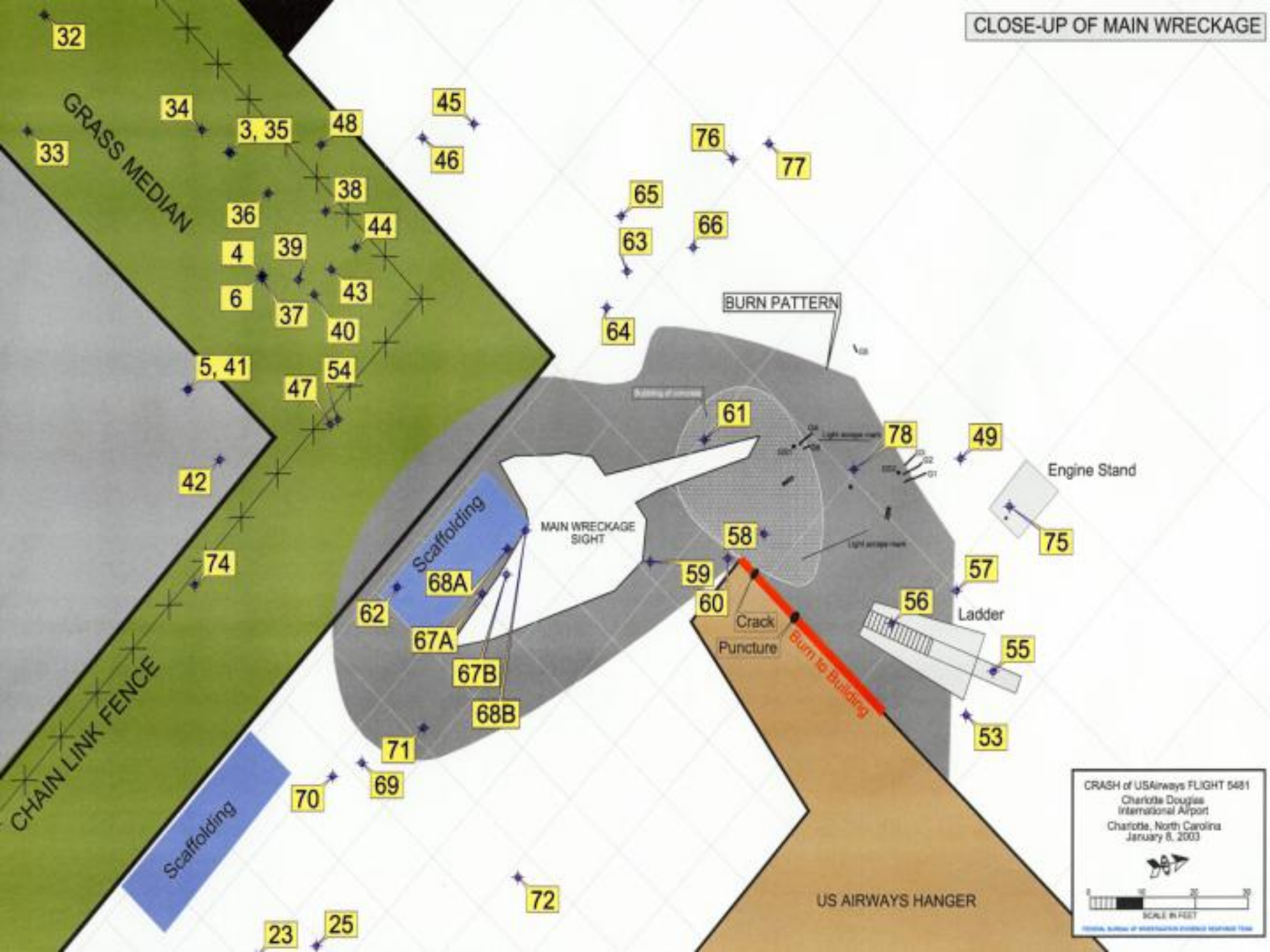

WRECKAGE DISTRIBUTION DIAGRAM
MAIN WRECKAGE
ROOF OF THE BUILDING FALLEN AND FIRE DAMAGED
EMPENNAGE
ZONE OF FIRE DAMAGE
BUILDING WALL BROKEN
NOSE GEAR TIRE MARKS
LEFT MAIN LANDING GEAR TIRE MARKS
RIGHT MAIN LANDING GEAR TIRE MARKS
DISTANCE FROM ZERO REFERENCE POINT
DIRECTION OF FLIGHT
WRECKAGE PATH CENTERLINE
ZERO REFERENCE POINT
SCALE - IN FEET
20 10 0 -10
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
-30 -20 -10 0 10 20 30 40 50 60
W
N


CLOSE-UP OF MAIN WRECKAGE
GRASS MEDIAN
CHAIN LINK FENCE
Scaffolding
Scaffolding
BURN PATTERN
MAIN WRECKAGE SIGHT
Engine Stand
Ladder
Crack
Puncture
Burn to Building
US AIRWAYS HANGER
32
33
34
3, 35
48
45
46
76
77
65
66
63
64
36
38
44
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37
43
40
5, 41
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78
49
75
58
59
60
57
56
55
53
62
68A
67A
67B
68B
71
70
69
72
23
25
CRASH of USAirways FLIGHT 5481
Charlotte Douglas International Airport
Charlotte, North Carolina
January 8, 2003
SCALE IN FEET

Mockups

- Need For a Mockup
- Two Dimensional & Three Dimensional
- Partial or Complete

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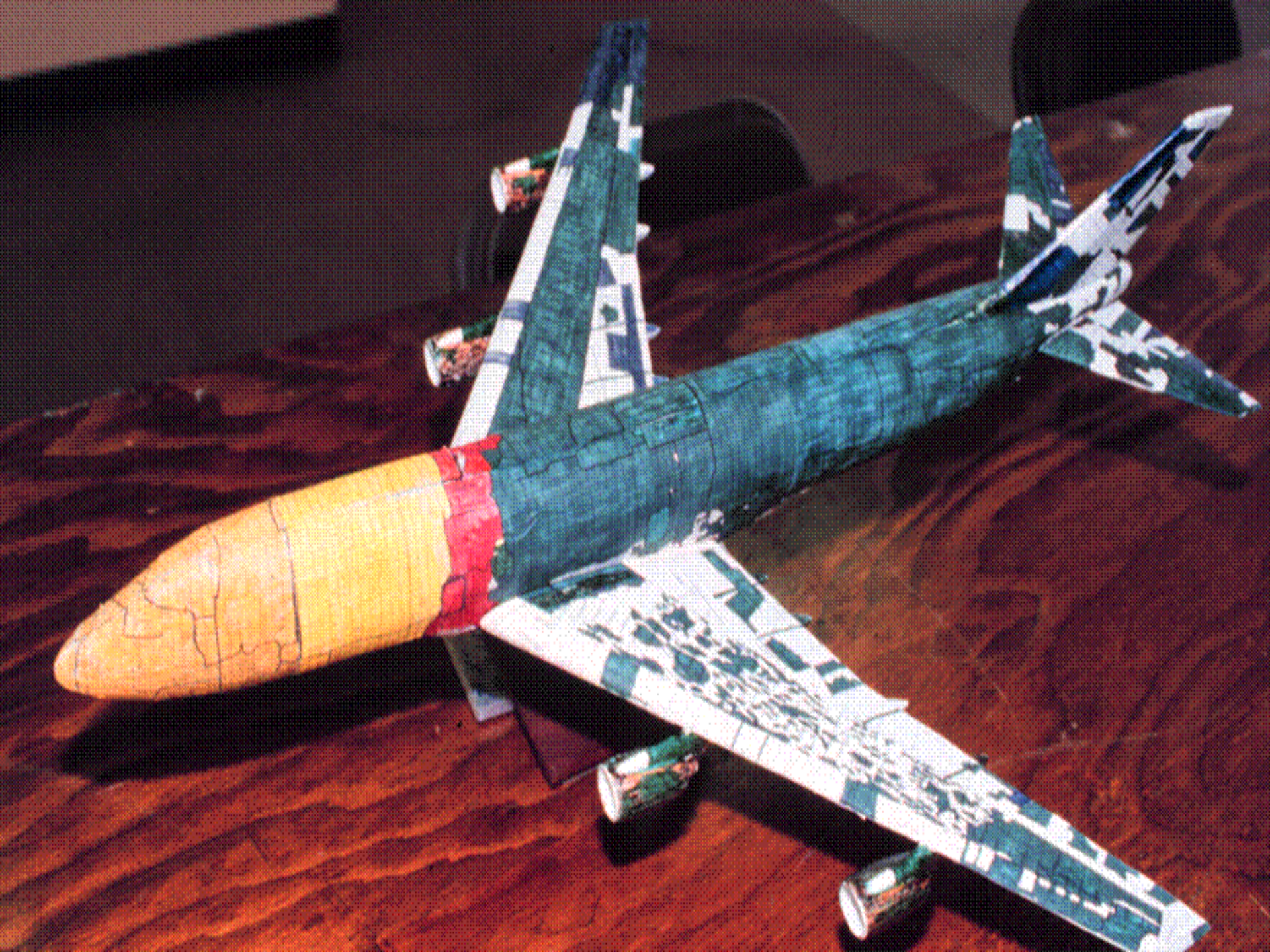
2-D Mockup

3-D Mockup



So, how is an investigation conducted?

Let's take an example…

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The Accident:
Colgan Air Flight 3407
DHC-8-400
February 12, 2009

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History of Flight

- February 12, 2009
- 2217 eastern standard time
- Colgan Air, Inc.
- Bombardier DHC-8-400
- Continental Connection flight 3407
- Buffalo, New York
- 2 pilots, 2 flight attendants,
  45 passengers, and 1 resident killed

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History of Flight

- Snow and light-to-moderate icing expected en route
- Captain set reference speeds switch to increase (icing conditions)
  - Lowered angle-of-attack reference for stick shaker activation
  - Raised low-speed cue on airspeed displays by 15 knots
  - Improved performance margins

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History of Flight

- First officer obtained landing speeds for non-icing conditions
  - Mismatch with position of ref speeds switch resulted in landing speed that was 13 knots lower than stick shaker activation speed

History of Flight

- Stick shaker activated; autopilot disengaged
- Airplane had minimum ice accretion
- Captain pulled back on control column and added power short of rating detent
  - Increased angle-of-attack, pitch, and load factor
  - Airplane entered accelerated stall

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History of Flight

- Stick pusher activated three times
- After each activation, captain continued to pull back on control column
  - Exacerbated airplane's stalled condition
  - Prevented potential recovery

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Investigation

- On scene for 8 days
- 3-day public hearing covered
  - Effect of icing on airplane performance
  - Cold weather operations
  - Sterile cockpit rules
  - Flight crew experience
  - Fatigue management
  - Stall recovery training

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Investigation

- Flight crew and airplane properly certificated
- No evidence of any preimpact structural, engine, or systems failures
- ATC not factor in accident
- Accident not survivable

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Investigation

- Weather was typical for time of year
- Ice accretion did not affect crew's ability to fly and control airplane
- Need to provide complete and accurate weather documents
- Change in icing definitions needed

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Safety Issues

- Crew response and monitoring failures
- Airspeed selection procedures
- Stall training
- Pilot training records and remedial training programs

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Safety Issues

- Pilot professionalism
  - Sterile cockpit
  - Leadership training
  - Use of personal portable electronic devices
- Fatigue and commuting
- FOQA programs, FAA oversight, and SAFO process

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Here are the details for how it went for a Group Chairman:

It all starts with a phone call…

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The Phone Call

Feb 12

- FAA notifies NTSB comm center
- NTSB comm center gathers decision makers
- Launch/No launch
- Who's launching
  - Specialties
  - People
  - Timing
- How are they launching

The Launch

Feb 13

- Launch on FAA jet – two trips
- 1st trip – Board Member, IIC, structures, TDA
- 2nd trip – other group chairmen
- Direct from DCA to Buffalo
- Police/FBI escort upon arrival
- Recorders returned to DC when FAA jet returned

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On-Scene Work – Initial Walk Around

Feb 13

- Initial assessment of wreckage
- Fire still burning – gas leak
- Large variations in wreckage condition
- Aircraft wreckage mixed with ground wreckage
- Photo documentation begins

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On-Scene Work – Initial Walk Around

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On-Scene Work – Initial Walk Around

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On-Scene Work – Organizational Mtg

Feb 13

- First night on-scene
- Led by the IIC
- Create groups based on party availability
  - Parties : FAA, ALPA, Colgan, United Steelworkers Union (F/A's), NATCA
  - Accredited reps: TSB, AAIB
    - Advisors: Bombardier, P&W Canada, TC, Dowty propellers

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On-Scene Work – Organizational Mtg

Feb 13

- 12 groups formed for Colgan accident
  - Systems, structures, powerplants, ops/human performance, survival factors/rescue, weather, pipeline, ATC, performance, FDR, CVR, mx records
- Not every party placed on every group

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On-Scene Work – Documentation

Feb 13-21

- Majority of work on-scene
- Led by the group chairman
- Document the condition of the aircraft
- Must be done as quickly as possible
  - Things change with time
    - Gauge readings degrade
    - Switches get moved
    - Corrosion
- Priorities vary w/ each accident

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On-Scene Work – Documentation

Feb 13-21

- For Colgan accident (Systems):
  - Flap tracks and jackscrews
  - DDV's (de-icing system components)
  - Cockpit switches
  - Actuators
  - Avionics boxes (NVM)
  - Deicing bleed lines

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On-Scene Work – Documentation

Feb 13-21

- Photos:
  - Absolutely essential
  - Use a good camera
  - Get training
  - Spot metering and macro modes
  - Take pictures of labels/data plates
  - Can never have enough photos
- Field notes

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On-Scene Work – Documentation

Feb 13-21

- Interviews:
  - ATC (conducted by ATC Group)
  - Dispatch/wx briefers (by Wx Group)
  - Crew (if possible) (by Operations Group)
- Progress meetings each night
  - Each group reports
- Press briefing
  - Board Member is lead spokesperson

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On-Scene Support

Feb 13-21

- Essential for successful investigation
- Many groups provide support
  - Law enforcement
  - Fire fighters
  - Medical examiner
  - Red Cross
  - Community organizations

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On-Scene Support

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On-Scene Support

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On-Scene Support

- FBI Trailer

On-Scene Support

- Decontamination Tents

On-Scene Support

- Fire Fighters

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Post On-Scene Work

Feb 22- Nov 9

- Transition from “what happened” to “why did it happen”
- Simulations and performance analysis
- More interviews
  - Training
    - Procedures
    - Review of training records
- Teardowns

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Post On-Scene Work

Public Hearing

May 12-14

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Post On-Scene Work

May 12-14

- Public hearing - 3 days of testimony
  - Icing certification
  - Stall recovery and cold wx ops
  - Training programs
  - Pilot selection
  - Fatigue management
- 20 witnesses questioned
- Tech panel, parties, & Board of Inquiry
- Get statements on public record

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Post On-Scene Work

Nov 9

- Technical Review
  - Formal meeting to finalize all factual reports
  - Starts the countdown on party submissions (60 days)
  - Final opportunity for parties to request additional factual work

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Report Writing

- Factual Report (including addenda) – Group Chairman (May 6, Aug 3, Nov 25)
- Analysis Report – Group Chairman (Aug 15)
- Final Report – Dedicated writer
  - Several drafts
    - Staff Draft (Nov 17)
    - Pre - Director's Draft (Dec 7)
    - Director's Draft (Dec 10)
    - Notation Draft (Jan 5, 2010)

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Board Meeting

Feb 2, 2010

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Board Meeting

Feb 2, 2010

- The end of the investigation
- All board members discuss the final report
- Presentations by key group chairmen
- Findings, conclusions, probable cause, and recommendations adopted

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